How Effective is Public Spending?
Public Investment Composition and Rural Welfare in Ethiopia

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1. Public Spending and Rural Welfare in Ethiopia

In developing countries, public expenditure is one of the sharpest instruments that the govenment can use to achieve its development objectives. Perhaps a reflection of the attention given to public investment by international development organisations, donors provide an ever growing part of their resources to support the public budget of developing countries[1] or through financial support of public investment in sectors they deem growth-enhancing or poverty reducing.

Development research analysing government policies has been extensive in the various areas of nonexpenditure policy, such as regulatory policy influencing the rules of trade, property rights, and the general operating environment of the private sector, or macroeconomic policy affecting growth prospects through its influence on inflation, exchange rate, etc. In contrast, research on the effects of public expenditure on development outcomes is less common, especially research that is useful for guiding policy.

This paper explores and compares the impact of different types of public spending on rural household welfare in Ethiopia. The remainder of this section will first discuss the empirical literature on public investment and development goals in developing countries, followed by a discussion of the existing evidence on Ethiopia. To place the later empirical strategy and estimation of public expenditure effects into context, Section 2 begins by giving a brief overview of the key currents of Ethiopia's development strategy and of development outcomes in the last decade and half. This will be juxtaposed in Section 3 against broad trends in public expenditure. Going into further detail in selected sectors, development strategies, expenditure trends, and performance of these sectors are also discussed. Section 4 presents the conceptual context for this paper and explores some of the challenges inherent in such public expenditure analysis. Section 5 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 in Section 6. Section 7 concludes.

Among studies which examine the link between public expenditure and development outcomes, most fall into one of two categories. The first set of papers explores how the size of *overall* public expenditure or public investment affects growth or poverty. In this category, for example, Agenor et al. (2004) (described in more detail below) looks at the impact of shifting resources from recurrent to capital expenditure in Ethiopia. Aschauer (2000) compares the contributions of overall stocks of public and private capital to national income, and in so doing accounts for both the size, financing, and efficiency of public capital.

The second set of papers seeks to trace spending in one economic sector to outcomes in that sector, or to 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 which are primarily motivated by the question of aid effectiveness, and which in this context assess to what extent aid contributes to growth and poverty reduction by enabling an increase in certain types of public investment. An example is Gomanee et al. (2003) on social sector investment.

[1] Examining OECD data on aid, budget support loans as a share of total ODA loans increased from less than 2% in the 1970s to up to 14% in 2002.

The body of work exploring either the contribution of public investment in general, or public investment in a particular sector, can be a useful input into policy. Striking, however, is the dearth of research aiming at a particularly policy-relevant question, namely how the *composition* of public spending affects key development outcomes. Usually, the public investment decision facing policymakers, and deliberated on from year to year or in a medium-term strategy in the budget decisionmaking process of a given country, 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. While budget allocation is inherently also a political process (in developing and industrialised countries alike) and while decisions on this will usually also reflect a range of considerations other than overall economic growth or poverty reduction, there is nevertheless considerable need for evidence on which types of public investments contribute most to development goals, as an input to that aspect of the budget process that is concerned with using expenditure policy as a tool to achieve such outcomes.

Paternostro et al. (2005) give account on how the absence or shortage of research-based evidence that compares the effectiveness of different types of public expenditure in contributing to poverty reduction has led to developing country governments, and even more international donors, to equate pro-poor spending with spending in the social sectors, and orient or support expenditure policy accordingly. However, several studies (discussed below) suggest that in many developing countries, the greatest contributions in poverty reduction do not necessarily derive from social sector spending. It is furthermore also likely that, in the absence of empirical evidence on the development-returns to public spending, considerations other than economic development may "fill the vacuum" created by the knowledge gap. Hence research on the relative returns to different types of public investment may contribute to better policy in more ways than one.

The studies analysing the relative contributions toward development outcomes of public spending in different sectors are methodologically varied. Marginal benefit incidence analysis has been among the more commonly used tools to assess the relative poverty orientation of various forms of investment. Ajwad and Wodon (2001) compare the benefit incidence for municipalities with different income levels in Bolivia of education, water, sewerage, electricity, and telephone services. However, this study, as several other studies employing marginal benefit incidence analysis, does not incorporate in the empirical analysis actual expenditure outlays for these public services. General equilibrium models, usually projecting public investment effects into the future, include Lofgren and Robinson (2004) using African country data, Dabla-Norris and Matovu (2002) on Ghana, and Jung and Thorbecke (2003) on Tanzania and Zambia. At the centre of several of these studies are the effects of education, although other types of investment are analysed as well. Devarajan et al (1996) employ regression analysis (OLS and fixed effects models) to compare the growth effects of public expenditure, both across functional as well as economic classifications.

A series of studies have used panel data simultaneous equations 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 on India and Fan et al. 2002 on China). These studies use aggregate state-level data on public expenditure in several sectors, on public capital and sectoral performance indicators in these sectors, on labour and wage variables, and on agricultural productivity and poverty. The models incorporate the various pathways by which spending may affect poverty:

Public spending on agriculture, health, education, and other sectors builds up public capital and improves public services at the sector level. Better public services and sector-level development increases incomes of rural residents in two ways: it fosters agricultural productivity, which improves agricultural incomes, but also enables more nonfarm income earning opportunities, which increases both wages and (off-farm) employment. Agricultural productivity has also a price effect, as it reduces agricultural relative to other prices. Both the price and the (farm and off-farm) income effects contribute positively to poverty reduction.

The empirical evidence across studies on the relative contributions of public investment in different sectors is mixed, perhaps reflecting the range of methodologies employed, the variation in the types of economies studied, and the relative sectoral emphases of the different studies. Education spending has the largest poverty reducing effects in several of the studies (e.g. Fan et al. 2002 and Fan, Zhang and Rao 2004), but especially in those that are centred on the education sector (e.g. Jung and Thorbecke 2003, and Dabla-Norris and Matovu 2002), while transportation spending has either limited or even negative impact on poverty (e.g. Ajwad and Wodon 2001, and Lofgren and Robinson 2004). Devarajan et al. (1996) find some weak evidence that expenditure in certain types of education (subsidiary services such as school feeding and transportation to schools) and health (public health research) have a positive effect on growth, whereas capital-intensive spending categories such as infrastructure have a negative effect on growth. On the other hand, road infrastructure investment is shown to be the first or second most effective in reducing poverty in several cases (Fan et al. 2000 and Fan, Zhang and Rao 2004).

This relatively large variation in findings suggests an evaluation of methodologies that have been used to analyse the relative returns to public spending. A thorough methodological review goes beyond the scope of this paper but, briefly put: the quality of analysis is likely to be enhanced when the effects of different types of spending are assessed in a common empirical framework, when the estimation takes into account the multiple pathways by which spending may affect growth or poverty, and when the common simultaneity problem of a policy variable like public expenditure is appropriately addressed (see also Paternostro et al. 2005 for further discussion of methodological approaches).

If there is little research that provides guidance to public resource allocation across sectors, and that does so by econometrically analysing differential returns to public expenditure in terms of poverty, there are even fewer such studies at the country level, especially on African countries. This constitutes an important knowledge gap for the continent, especially given the centrality of public exenditure policy in many African economies. Certainly, part of the reason for this shortage of research could stem from the challenge of rather limited data, for example data on regionally and sectorally disaggregated expenditure, sector-specific outcome variables, and regionally specific poverty, income and growth indicators. Given the potentially high policy relevance of research into public investment priorities, such data constraints call for adapting existing empirical methods to the data landscape in Africa.

As with the literature on public investment in the context of other developing countries, the few papers on Ethiopia are based either on general equilibrium models that simulate the effects of changes in overall public spending, or else are concentrated on how public spending in one particular sector affects performance in that sector. One exception includes Seifu (2002), which

conducts a benefit incidence analysis of public spending in education and health. We are not aware of any other study comparing poverty effects of different types of public expenditure in Ethiopia.

Agenor et al. (2004) and Collier et al. (2002) are among the more carefully done research papers on the topic in the Ethiopian context, and hence will be discussed in some detail next. These two recent studies, while otherwise entirely different from each other on the scope of public spending examined, type of effect explored, and methodology employed, focus both on the relative returns from reallocating resources from recurrent to capital expenditure. Agenor et al. applies an aggregate one-representative-household, one-good macroeconomic model to Ethiopia that explores the links between foreign aid, the composition of public investment, growth, and poverty. It conducts policy experiments to assess the poverty and growth effects of changes in the composition of public spending. Herein, however, the main distinction made is between 'government consumption', or recurrent expenditure, and public investment, or capital expenditure, in three broad sectors: health, education, and infrastructure. Hence, rather than a policy simulation of changing the sectoral allocation, this study simulates the effects of a shift from recurrent to capital expenditure.

The second paper, Collier et al. (2002), hones in on the health sector to explore how different types of health sector public spending determine the extent to which health services are used by rural residents in various areas of the country. They find that reallocation of public resources for health away from spending that seeks to increase the 'quantity' of healthcare toward spending enhancing the 'quality' of healthcare would increase usage rates. In this sense, as in Agenor et al., the key tradeoff in public expenditure at the centre of the analysis is that between recurrent and capital expenditure.

Aside from academic literature on public investment, a range of policy and review papers produced by development finance organisations, most notably the World Bank through its Public Expenditure Reviews and similar reports, 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, 2004a).

2. Development Strategy and Development Outcomes

2.1. Development Strategy

In 2002, the Ethiopian government spelled out a four-pronged development strategy, its pillars being: the continuation of the Agricultural Development Led Industrialisation (ADLI) strategy; fiscal and administrative decentralisation; reform of the the civil service and justice system; and capacity building. The latter is a cross-cutting element, pertaining to enhancing skills and institutions in the agricultural sector, in the civil service system, and at the lower tiers of governnment. Thus, the development strategy involves both economic policies as well as the transformation of noneconomic institutions.

Both the ADLI strategy and the trend toward increased fiscal decentralisation have informed the government's public expenditure priorities. ADLI, conceived at the onset of the current government in 1993, is formulated as a long-term strategy to bring about economic growth and poverty reduction through a focus on agriculture as the engine of growth. Within this focus on the agricultural sector, ADLI emphasises the development and use of labour-intensive and land-augmenting technologies, the commercialisation of agriculture, and expanding markets for agricultural products through greater export-orientation.

The second pillar of Ethiopia's long-term development strategy, decentralisation, has affected public investment by restructuring the budget process. 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, wide executive and legislative power to the regions is expressly provided for in the constitution, and even their right to secession. Fiscally, revenue generation powers still lie predominantly with the federal government, and financial transfers from the central administration to the regions take place formally in the form of untied block grants. Table 1 shows that federal grants received as a share of regions' total budgets is substantial, ranging from 60% to 87% (except for Addis Abeba, which has special revenue raising capacity as well as responsibility). From 1996 until recently, the region was the level of government with the greatest responsibility for making public expenditure decisions.

Table 1: Regional budgets and federal block grants to regions, 1997

Region	Per capita regional budget (birr)	Per capita transfers received (birr)	Transfers received as % of budget
Addis Abeba	292	12	4.2%
Afar	216	159	73.3%
Amhara	65	46	71.9%
Benishangul-Gumuz	354	308	87.0%
Dire Dawa	183	126	68.9%
Gambella	670	406	60.5%
Harari	572	433	75.7%
Oromia	60	43	71.1%
SNNP	32	19	60.1%
Somale	225	163	72.3%
Tigray	103	79	76.9%
Average	252	163	65.6%

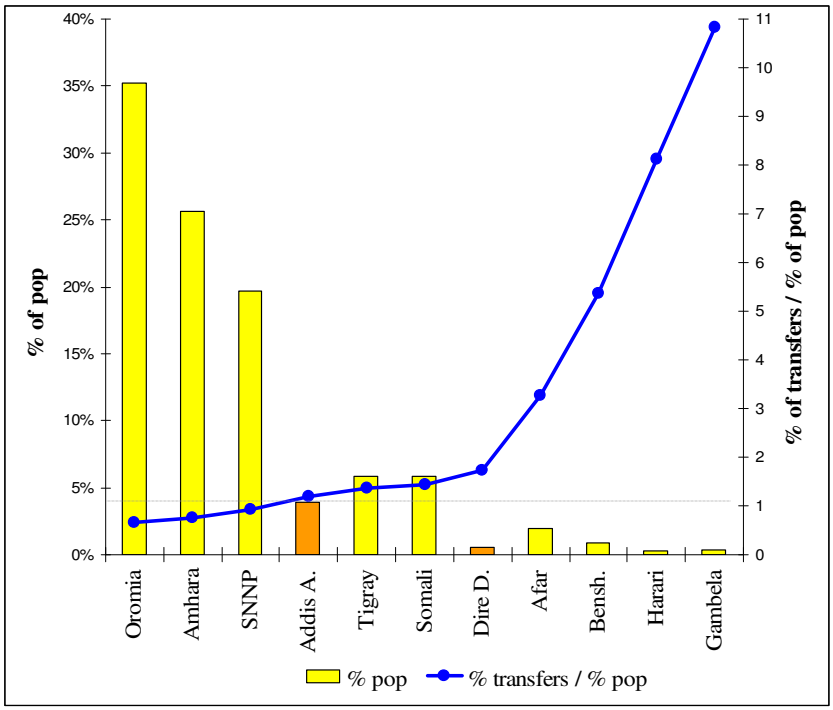
Source: Own calculations using data from MOFED.

As is also apparent from Table 1, there is considerable regional variation in the size of the transfers, normalised by population size. Addis Abeba aside (for reasons mentioned above) Oromia region receives by far the smallest block grants, amounting to 19 birr per person. Transfers to Harari and Gambella are over 20 times that much, over 400 birr per person. Interestingly, federal transfers are not allocated in a way so as to reduce the inequality of public budgets: the order of magnitude of difference between the largest and the smallest per capita

transfers is the same as the analogous value for total regional budgets, and the same as the spread in the own-source component of the budget.

However, a pattern does emerge that sheds light at how the allocation of transfers play out across regions, when comparing the size of the region (in terms of population) with the transfer/population ratio. Figure 1 ranks the regions from left to right according to the ratio between the percent of total federal grants the region receives, and the share of population in the region. A 'transfer share to population share' ratio of 1 for a region suggests that that region is receiving transfers in line with its population size, i.e. the share of transfers received equals the share of total population in that region. A ratio less (greater) than 1 implies disproportionately lower (higher) federal grants.

Figure 1: Regions' population shares and budget transfer shares



Source: CSA; MOFED

This ratio is measured along the right-hand axis and is represented for each region by the curve. For example, Oromia, the region with the lowest ratio, receives 23% of total federal transfers to all regions but its population makes up 35% of Ethiopia. Hence, its ratio is 0.67. The left hand axis measures simply each region's share of the total population (e.g. 35% in Oromia). Tracing these two variables, there is a near-perfect inverse relationship between population size and transfer/population ratio. The larger the region, the smaller the transfer-to-population share ratio. This inverse relationship is only violated by the two city-states (darker-coloured bars) Addis Abeba and Dire Dawa, which have special revenue raising responsibilities and capacity.

Recently, in 2002, a further shift of responsibility and spending autonomy to the wereda (district) level[2] was initiated in the four largest regions of Ethiopia[3], which taken together comprise over 85% of the population. Mirroring the 1996 devolution to the regions, the weredas receive a large share of their revenue as block grants from the regions. Nearly half of regional budgets are transferred to the weredas in this fashion in the four largest regions.

The government's substantial and far-reaching decentralisation policy has necessitated a shift in priorities of public expenditure, both through the need for capacity building at lower tiers of government brought about by greater administration and policy implementation demands on them, as well as potentially due to differences in policy priorities at the local as opposed to the higher levels of administration (however, to date, we are not aware of any research undertaken to examine the extent to which weredas' actual discretion in expenditure decision-making matches their formal fiscal autonomy. For a detailed study which, among other things, explores the extent to which actual and formal political autonomy at the wereda level diverge, see Pausewang (2002)).

2.2. Growth, Welfare and Poverty in Ethiopia

Macroeconomic performance has been positive in Ethiopia over the 1990s. This period saw macroeconomic policies that sought to control the size of government deficit, keep inflation low and generally restore macroeconomic stability. Aside from the the transition period of the early 1990s during which the inflation rate spiked to above 30%, inflation has since remained within single digits. The budget deficit, while not very low, has been between approximately 2% and 10% of GDP and therefore within moderate bounds, with the exception of the period of the border war with Eritrea, where the deficit increased to some 12-13% (IMF 2002, World Bank 2005b).

Growth performance since the 1990s was moderate, and characterised by high volatitility. The beginning of the '90s decade was marked by instability after the overthrow of the marxist dictatorship, and during this transition period per capita GDP growth reached the low of -11% (WDI 2005). With the end of the civil war, the establishment of a provisional government, and the restoration of political stability, GDP increased from 1992 to 1993 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 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 is only 8% greater than income 20 years before, which reflects the overall very weak performance of the economy during the 80s, a decade of stagnation and even decline (from 1982 to 1992, average annual growth was in fact negative). In this sense, part of the initial

[2] Weredas are administrative units below zones, which in turn lie below regions. Weredas, of which there are approximately 550 in Ethiopia have on average a population size of 100,000.
[3] These regions are Amhara, Oromiya, and SNNP (Southern Nations, Nationalities and Peoples) and Tigray.

growth with the emergence of the current government reflects recovery from long-term civil war and from the effects of preceding damaging economic policies.

The moderate economic growth of the last decade didn't translate fully into strongly noticeable poverty reduction. While poverty rates decreased slightly from the mid-90s to 2000, with the poverty head count ratio falling from 45.5% to 44.2% over the 5-year period, interestingly this was not driven by declines in urban poverty. Quite on the contrary, urban poverty increased markedly from 33% to 37%, while in rural areas the poverty incidence fell by two percentage points (MOFED 2002). This rural-urban differential in incidence change is even more pronounced when poverty rates are measured using spatially and temporally specific poverty lines (World Bank 2005d). This differential may reflect the emphasis on the agricultural sector as the engine for development in the context of the ADLI strategy, as well as other factors such as outmigration of the 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 derives nearly exclusively from poverty reduction in the Amhara region, where the poverty rate fell by 10 percentage points.[4] For most other regions, poverty either increased or declined marginally.

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

	Lower poverty line			Upper poverty line		
Region	**1995**	**1999**	Diff. (%age points)	**1995**	**1999**	Diff. (%age points)
Addis Abeba	34%	41%	7	50%	57%	7
Afar	20%	43%	23	26%	63%	37
Amhara	45%	36%	-9	65%	55%	-10
Benishangul-Gumuz	49%	54%	5	72%	71%	-1
Dire Dawa	47%	49%	2	65%	68%	3
Gambela	35%	66%	31	48%	79%	31
Harari	25%	29%	4	43%	47%	4
Oromiya	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 is most prevalent in the two small western regions Benshangul-Gumuz and (especially in the latter year, 1999) Gambella. SNNP's poverty rate was among the highest in 1995. As was seen in Section 2.1 and will also be apparent in later sections, while poverty and income measures show the two western regions to be among the worst off, both investments as well as public capital variables that may reflect investments, are among the highest, especially for Gambella. Interestingly, Somale region enjoys by far the lowest poverty incidence, in both time periods and using either poverty line. Afar (in the earlier period) and Harari (in 1999) follow as

[4] The distinction between upper and lower poverty lines derives from two different ways of calculating the poverty line, whereby the former uses a 'poorer' reference group for the calculation of the poverty line than does the latter. For more details, see World Bank (2000d), p. 16.

the the regions with the next lowest rates of poverty. It is also noteworthy that the two city-states Addis Abeba and Dire Dawa are at or below the medium among regions.

In assessing average welfare, we will concentrate on rural welfare given that that is the central variable of interest in the analysis of public investment impact to follow. While on average the percentage of people in poverty has moderately declined in the rural areas, average rural welfare has actually fallen, as seen in Figures 2a and 2b (which reflect Table A1 in the Appendix). Overall, rural household welfare declined by a slight 2%, driven by welfare declines in eight out of the eleven regions. The two figures rank regions by their initial (1995) average per capita household welfare. In so doing, Figure 2a shows an inverse relationship between initial welfare and subsequent welfare growth.

Figure 2a: Per capita household expenditure by region

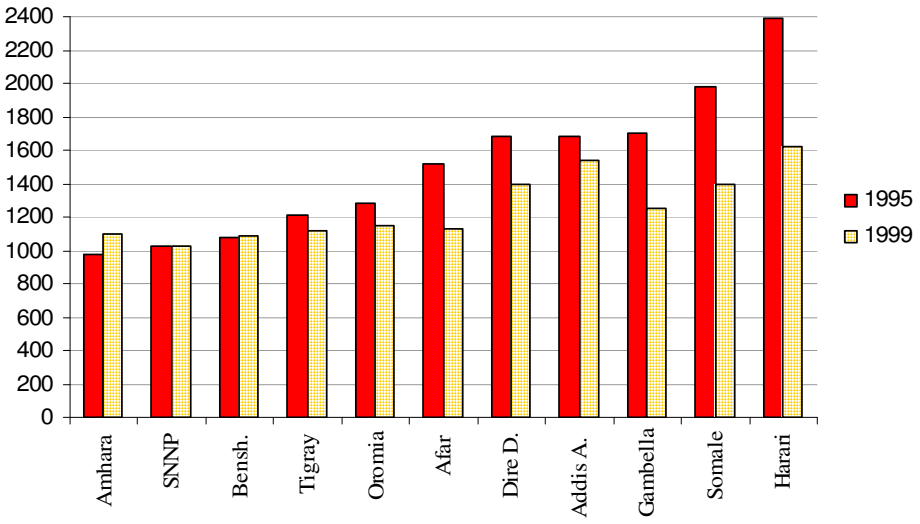
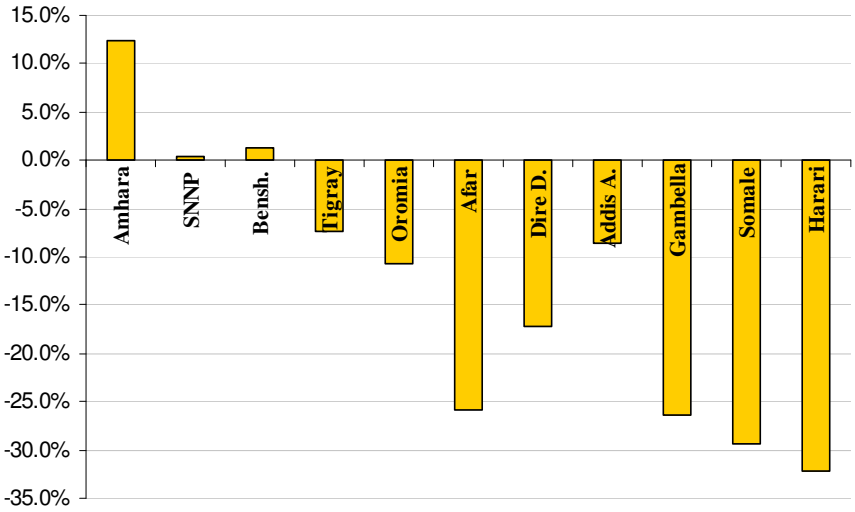


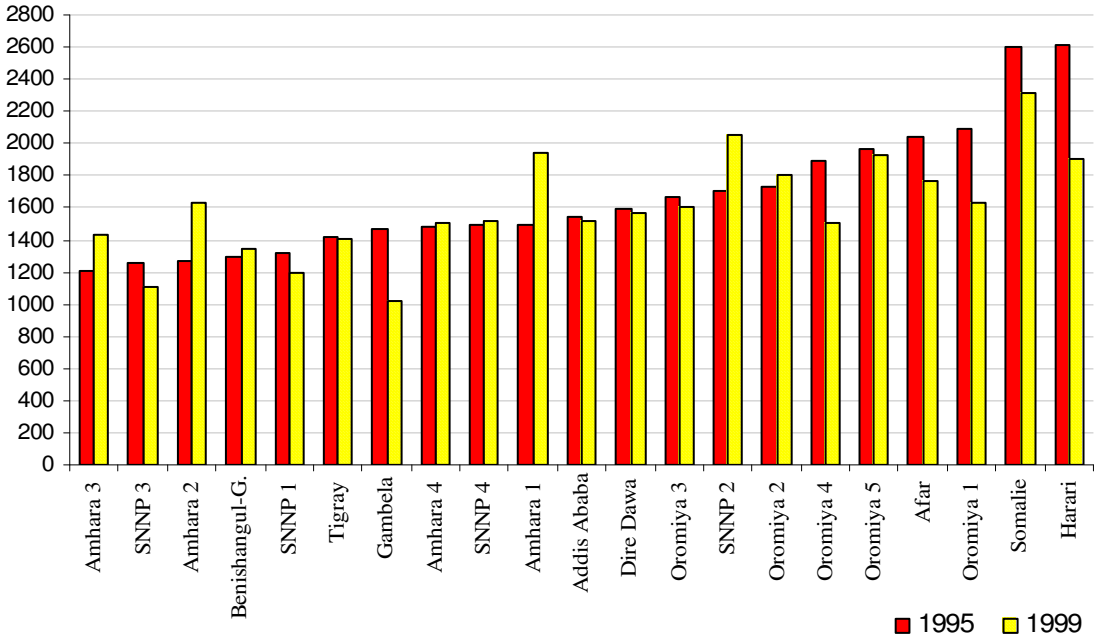
Figure 2b: Change in per capita household expenditure 1995/96 – 1999/00



Based on the Household Income, Consumption and Expenditure (HICE) surveys. Source: CSA (2001).

Figure 3 represents, like Figure 2, a disaggregated picture of household welfare, but is based on different nationwide survey and provides a further breakdown of large regions' mean household expenditure by groups of zones (see Table A2 in the Appendix for further detail on Figure 3). The two representations of the geographic distribution of welfare are broadly consistent with each other.

Figure 3: Real Per adult-equivalent household expenditure



Based on the Welfare Monitoring (WM) surveys. Source: World Bank (2005d).

The general picture that emerges with regard to the geographic distribution of wellbeing, drawing on both poverty and mean income estimates above, is: Residents of the two western regions Gambella and Beneshangul-Gumuz, and the Southern region, are the least well off; Highest incomes and lowest poverty rates are found in the pastoralist region Somale and the small dominantly urban eastern region Harari; and the only notable improvement in poverty incidence as well as average household incomes was achieved in Amhara region.

3. Strategies, Public Spending, and Performance in Key Sectors

Public expenditure trends since the conception of ADLI in 1993 only partially reflect the agricultural development orientation of the government's strategy. While those sectors seen as important to poverty reduction (agriculture, natural resource development, health, education, road infrastructure, etc.) have been absorbing an increasingly larger share of non-defence spending, amongst these sectors, the proportion of expenditure on agriculture first declined until 1996 and then moderately increased (see Table 3).

Table 3 : Public expenditures on selected sectors (as % of total for these sectors)

Year	Energy & Mining	Agriculture & Nat.resources	Education	Health	Transport & Communication	Road[1]	Total
1984	16.9	39.4	24.1	7.9	6.4	5.3	100
1989	14.3	38.9	28.5	10.0	5.1	3.2	100
1994	7.3	28.1	29.1	11.1	5.0	19.3	100
1995	9.4	26.8	31.9	11.1	5.2	15.6	100
1996	14.9	24.9	26.9	10.8	7.4	15.0	100
1997	8.1	24.8	30.9	13.1	4.2	19.0	100
1998	7.7	28.2	29.2	10.9	6.4	17.6	100
1999	5.8	26.8	30.4	10.7	6.2	20.0	100

Source: World Bank 2004a.
[1]Only capital expenditure; however, road capital expenditure trends to make up nearly all of roads expenditure that goes through the public budget; see also Table 6)

But ADLI does not only imply increasing expenditure on agriculture, but also greater investment in public goods that predominantly benefit households relying directly on agriculture, and that are instrumental in bringing about the transformation of the agricultural sector from a subsistence sector to one that contributes to commercial activity and to the country's export revenue. Expenditure policy in these sectors is discussed in more detail in the subsections below.

As Table 4 shows, decentralisation of public investment responsibility has gone further in the social sectors than in infrastructure (energy, road infrastructure, transport and communication). The share of federal level expenditure to countrywide expenditure in the energy sector is as high as 97%, whereas in education and health federal expenditures make up only 25% and 16%, respectively, of total government spending in these areas.

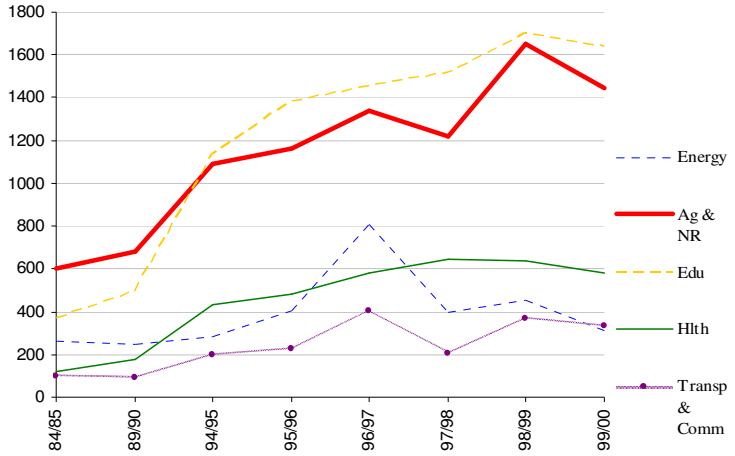
Table 4: Composition of total expenditure by level of government (in million Birr and as % of national total), 1998

	Federal government	Regions governments	National Total
Roads	598.73	461.06	1059.79
	56.5%	*43.5%*	*100%*
Education	429.92	1272.82	1702.74
	25.2%	*74.8%*	*100%*
Health	104.54	533.82	638.36
	16.4%	*83.6%*	*100%*
Agriculture	569.58	589.66	1159.23
	49.1%	*50.9%*	*100%*
Natural resource devt.	122.15	366.86	489.01
	25.0%	*75.0%*	*100%*
Energy & Mining	437.79	12.84	450.63
	97.2%	*2.8%*	*100%*
Transp. & Communication	354.35	17.27	371.62
	95.4%	*4.6%*	*100%*

Source: Own calculations using data from MOFED.

As Figure 4 shows, the dominance of education in public budgets is nothing new, and reflects the very large recurrent expenditure requirements of teachers' salaries.

Figure 4: Total government expenditure for selected sectors (in million birr)



Source: World Bank (2004a)

While education absorbs the largest absolute amount of resources nearly in each region, there is greater diversity in regions' relative sectoral emphasis. In Tigray, for example, energy related spending constitutes 26% of all energy spending by the regions. In no other sector is Tigray region's share in all regions' spending as large as in the energy sector. In this sense, while in absolute terms spending in Tigray on energy is much smaller than in other sectors (and its per capita energy spending is less than in some other regions), one can say that it has a "relative (to other regions) sectoral spending emphasis" in the energy sector. Energy is similarly the "relative sectoral emphasis" in Amhara and the small region Harari. On the other hand, in Somali and the Southern region, agricultural spending is largest in relative terms. Oromiya and the city-state Dire Dawa have seen the largest relative expenditures in the transport and communication sector. In Afar, natural resource expenditures are not only largest in absolute amount, but also relative to all regions' expenditures.

3.1. Energy

The lack of infrastructural development in general, and of energy supply in particular, constitutes a tremendous constraint for agricultural development and for the development of rural towns. Agricultural productivity is severely inhibited due to reliance on rain-fed production in volatile climates, where irrigation facilities are nonexistent in part due to lack of power supply. In rural towns without electricity, not only residents but shops and small-scale industry must rely on inefficient and insufficient traditional energy technologies, which keeps commercial activity and production at low levels and holds back rural growth.

As is the case in several other Sub-Saharan African countries, the main source for energy supply in rural Ethiopia are biomass resources, e.g. fuelwood and dung. The use of electricity in Ethiopia is minuscule. For example only 0.7% of rural households use electricity for lighting (Wolde-Ghiorgis 2002). Access to electric power is not only extremely low, but also compares unfavourably with other poor countries. Electricity consumption per capita in 2001 was 22 kWh in Ethiopia, whereas for Sub-Saharan Africa as a whole, South Asia, and Least-Developed Countries[5] the figure is 456; 331; and 89 kWh, respectively (World Bank 2005b). Other sources such as solar power and other renewables, petroleum, and natural gas represent a negligible share of total rural energy consumption.

Access to electric power in general, and rural electrification in particular, remains low despite the fact that electricity related expenditures have comprised around 90-95% of the energy sector capital budget in the course of the past decade (with the rest allocated to petroleum and tradition/alternative energy) (Wolde-Ghiorgis 2002), and even though public expenditure on energy, while not very high, still measures up against expenditure in other important sectors such as public health (see Figure 4).

While public investment in infrastructure is important as 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 to receive escalated financing are agriculture (and within that an emphasis is placed on the provision of extension services and food security), the water sector (with a focus on rural water supply), the road sector (construction and upgrading of trunk roads), education (primary education), and health (maternal and child health, malaria, and TB).

3.2. Road Infrastructure

Table 5 gives the road density (km per 1000 km^2) for the 15 countries with the lowest road density values. It is apparent that, while Ethiopia ranks tenth, those countries with lower road densities also have vast areas of uninhabited land, for example the desertous countries of the Sahel zone. Measuring road density instead as km of road per million people, the second column of Table 5 compares Ethiopia with eastern and southern African economies, and shows that road infrastructure in Ethiopia falls very far behind that of other poor countries in the region. With 75 km per million people in Ethiopia, road infrastructure is substantially worse than 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 led to an increase of the total roads network in Ethiopia from about 23,500 km in 1995 to 32,000 km in 2001. This only constitutes a 35% increase, which is a much more rapid increase than the growth in road infrastructure over the years before this period.

Table 5: International comparison on road infrastructure

Table 5a: Countries with lowest physical road density

Table 5b: Road density in Southern and Eastern Africa

[5] United Nations classification.

Road density in km / 1000 km^2	
Sudan	5.01
Mauritania	7.47
Niger	7.97
Mali	12.38
United	12.95
Botswana	18.02
Chad	26.53
Kazakhstan	30.61
Mongolia	31.43
Ethiopia	31.66
Russian	31.81
Afghanistan	32.21
Gabon	32.81
Somalia	35.25
Congo, DR	37.43

Source: WDI 2005

Road density in km / million persons (1993)	
Ethiopia[a]	75
Uganda	120
Tanzania	129
Malawi	277
Mozambique	277
Lesotho	315
Kenya	334
Madagascar	366
Zambia	744
Swaziland	765
Angola	816
Zimbabwe	1,360
South	1,433
Botswana	2,022
Namibia	2,722

Source: FIAS. [a]1991 data

At present, about half of Ethiopia's roads network is made up of trunk and link roads. The remaining are so-called rural roads. The latter are administered by the regional agencies, or Rural Roads Authorities, whereas the responsibility for trunk and link roads lies with the federal roads agency, the Ethiopian Roads Authority.

As in the case of the education and health sector, public investment and other policy regarding roads is laid down in the Road Sector Development Programme (RSDP) developed by the Ethiopian Roads Authority in 1997. The RSDP oulines the long-term strategy (over a 10 year period) for developing road infrastructure. For the first phase from 1997 to 2002, road building projects were to give piority to providing improved access to ports, to existing and new resource areas, to food deficit areas, and to maintaining a certain degree of equity of transport infrastructure between the regions, in that order. Given these priorities, a relatively large share of capital expenditures were allocated for asphalt and gravel roads. Nevertheless, 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 roads sector development programme defining policies and expenditures for the 2003 to 2007 period addresses the low level of road connectedness between the regions. The main roads radiate from Addis Abeba to the regions, but travel between regional towns is substantially more difficult. In the second phase of the RSDP, also greater emphasis was placed on developing those type of roads more likely to immediately benefit poor populations, namely village rural roads. The strategy document on transport development at the village level stresses participation of local communities, not only in formulating investment priorities for rural road construction and maintenance, but also in helping to cover these expenses. For this purpose, village level associations are assigned the task of proposing and implementing roads projects.

But institutions across all tiers of administration – villages, weredas, regions, and the federal level – are involved in various stages of the development of rural roads.

Public investment in roads as a share of spending in the agriculture, social and infrastructure sectors really picked up with the change of government. 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 '90s. Indeed, the relative increase in road construction spending is unrivalled by any of the other social, agricultural and infrastructure sectors.

Table 6 below shows the geographic distribution of road spending. Comparing the share of each region's (capital) expenditure in total capital spending of all regions with the population shares shows that the capital city-state Addis Abeba and the more marginal areas, Benshangul-Gumuz and Gambella and to some extent Afar, allocate 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	Amhara	Bensh-Gumuz	Dire Dawa	Gam-bella	Harari	Oromia	SNNP	Somale	Tigray	Regions total
Capital	117.90	17.68	78.31	23.49	-	13.81	0.01	98.50	48.39	24.04	20.63	442.80
w%	26.6%	4.0%	17.7%	5.3%	-	3.1%	0.0%	22.2%	10.9%	5.4%	4.7%	100.0%
Recurrent	8.41	0.00	3.86	0.22	-	0.00	0.00	4.74	0.00	0.00	1.06	18.29
%	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.

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 is broadly aligned with the expenditure distribution. We see that road density, measured as km of roads per 1000 people, is consistently highest in Gambella, with the second-highest road density being in either Benshangul-Gumuz or Affar, depending on the year. However, while population-based road density is highest in the marginal regions, it is lowest – or to be precise, zero – for asphalted roads in regions such as Benshangul, Gambella, and Somale (interestingly and surprisingly, though, Table 8 shows that it is highest for the pastoralist region Affar). When road density is measured in terms of area (km of roads per 1000 km^2) Addis Ababa followed by the city-state Harari have the highest density.

Table 7: Density of all-weather roads

	km/1000 persons					km/1000 km^2				
Region	1995	1996	1997	2003	2004	1995	1996	1997	2003	2004
Addis Abeba	n.a.	n.a.	n.a.	0.71	0.72	n.a.	n.a.	n.a.	3659.4	3849.7
Afar	0.72	1.01	1.00	1.49	1.62	8.7	12.6	12.7	21.3	23.7

Amhara	0.22	0.32	0.32	0.39	0.40	20.8	32.1	32.9	46.0	48.5
Benishangul-Gumuz	0.84	0.86	0.83	2.54	3.09	8.0	8.4	8.4	29.1	36.4
Dire Dawa	n.a.	n.a.	n.a.	0.40	0.52	n.a.	n.a.	n.a.	93.6	126.8
Gambella	1.70	4.79	4.66	5.86	6.64	12.6	36.3	36.3	52.1	60.5
Harari	n.a.	n.a.	n.a.	0.42	0.67	n.a.	n.a.	n.a.	188.8	315.7
Oromia	0.35	0.52	0.51	0.38	0.38	22.5	34.4	34.4	29.8	31.0
SNNP	0.21	0.26	0.26	0.37	0.39	19.5	25.2	26.5	43.8	46.8
Somale	0.37	0.38	0.38	0.82	0.83	3.8	4.0	4.2	10.1	10.6
Tigray	0.21	0.48	0.49	0.62	0.70	12.0	29.1	30.0	44.1	51.0
Ethiopia	0.28	0.41	0.41	0.49	0.51	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

	km/1000 persons				km/1000 km^2			
Region	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
Benishangul-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: CSA Transportation and Communications Bulletin.

3.3. Agriculture

As discussed above, agriculture is at the heart of ADLI and is expected to fuel economic growth and poverty reduction. Given such a focus on the agricultural sector one would expect to see a heavy emphasis on agriculture in terms of resource allocation since 1993 (year of the conception of ADLI). Indeed, despite fluctuations, real agricultural expenditure has been on an increasing trend (Table 9). The decentralization and intensification of extension services being one of the key features of ADLI, expenditure on agricultural extension approximately doubled over the 1990's, although it continues to constitute a rather small share of agricultural spending. Table 9 also suggests that, over time, allocations have shifted somewhat away from natural resource and environment-related spending in favour 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
Fertiliser	-	-	-	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, i.e. the share of expenditure executed by subnational administrative units versus the federal government, the last row shows that in the 1990s regions handled the majority of expenditures in the agricultural and natural resources sector although the this share has been in the decline in the recent years. This is somewhat surprising, given that it can be expected that the decentralisation process to the regions would have become more consolidated over time.

A regional breakdown of real per capita expenditure on agriculture is presented in Table 10. For most of the regions, agricultural spending is less than 30 birr per capita. Among the highest expenditures however take place in Addis Abeba and Harari, although these regions are characterised by higher urban concentration than other regions. Gambella region spends by far the largest amounts per capita in agriculture. This is likely a reflection of the overall dramatically higher per capita public budget and federal transfers going to Gambella. While the national figure for agricultural spending as a whole has moderately increased, the high variation at the regional level makes no particular regional spending pattern discernable.

Table 10: Real per capita 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
Benish.-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.

Agricultural performance has not fully corresponded to agricultural spending patterns. The regional distribution of land productivity as an indicator of agricultural performance is illustrated in Table 11. Given its favorable agro-ecological conditions Gambela has by far the highest yield levels, while on the contrary the arid region Somali together with Afar, Dire Dawa and Harari have the lowest yield levels.

Table 11: Yield of annual crops (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
Benish.-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 CSA's Agricultural Sample Surveys 1995-2000.

Although there would naturally be a lag period between the time expenditures are made on agriculture and results can be observed in terms of agricultural performance, having received focused government attention and with increasing investments being channeled to agriculture (see Figure 4), it appears that agricultural productivity has not fully responded to investments. An extension of this descriptive analysis to examine other indicators of agricultural performance, further dissect public services provision within the agricultural subsectors, and the use of a longer time series on agricultural sector performance indicators may be warranted to explore further the link between investment and outcomes in this sector.

3.4. Education

The rural literacy rate in Ethiopia (for the population 10 years old and above), while starting from a very low base, has shown some improvement in recent years, both in levels as well as in the degree of urban-rural and gender disparity. In 1999 the rural and urban literacy rates were at 22% and 70.4% respectively (MOFED 2002). This constitutes a recent improvent, from 16% and 70% two years before. The gender gap in rural literacy has improved somewhat recently, with the ratio of female to male literacy rate rising from 0.28 to 0.33. However, Ethiopia lags far behind in educational outcomes relative to other poor countries (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.

However, taking the longer view and in terms of intermediate outcomes in the education sector, Ethiopia has made some important progress. Over the last 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 enrollment ratio in secondary education increased from 8% to 12%, and in tertiary education from 0.5% to 1.7% (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	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
Benishangul-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
Oromiya	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
Somali	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.

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 this decade (Table 14). The quality decline has been even more precipitous in rural areas. For example, the rural PTR, which at 32 in 1994 used to be better than the urban PTR of 34, more than doubled to 73 in 2001, in contrast to the urban ratio of 48 in the

same year. This has dramatically accelerated the burden on teachers in rural areas, which has made it more difficult to encourage graduates from cities and towns to take teaching positions in the rural areas.

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
Benishangul-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
Oromiya	21	32	53	60	66	68	72
SNNPR	28	51	61	63	66	67	67
Somali	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 adopted the New Education and Training Policy. This reform changed the structure of the education system, as the existing system, which was modelled after western education systems, was perceived by the government as inappropriate for the realities of Ethiopia. The new system, in which primary education is defined as grades 1 through 8, has generated pressure on schools' capacities in the higher secondary grades (as now standardised testing doesn't take place before grade 8) and has led the government to recently drastically raise enrollment barriers into the 11th grade. The 1994 reform also placed a new emphasis on the expansion of technical and vocational education and training (TVET) and, in the spirit of the overall decentralisation policy, required the use of local languages instead of Amharic as the language of instruction at the primary level.

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 from 1993 to 2001 by 78%, TVET expenditure increased more than 12-fold, or by 1120% (World Bank 2005a). Recurrent expenditures on higher education also increased disproportionately to the overall rise in spending, as it more than tripled. While primary level spending constitutes the largest share in education expenditure, it grew more slowly from 1993 to 2001 than overall expenditure, only by 40%. Possibly to rectify this imbalance, more recently in its 2002 poverty reduction strategy the government pronounced the improvement of access to primary education as the top priority within the education sector.

3.5. Health

On a range of health indicators, Ethiopia has improved modestly and gradually, but is still at a very low base. Child mortality has gone from 269 per 1000 live births in 1960, to 204 in 1990, to 170 in 2002. However, meeting the Millenium Development Goals for health would require

further halfing this figure in the next decade. Immunisation rates, which have been more subject to large swings over the decades, the downswings often coinciding with periods of unrest and war, has been brought up to slightly above 50%, among the lowest rates even among very poor countries (see Table 15). Maternal mortality, at about 500-700 per 1000 births (World Bank 2004a), is also among the worst in the world. Only about a quarter of the rural population have access to any modern health services at all (Russel and Abdella 2002).

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

		Immunisation (% 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.

Upon taking power in 1991, the transitional government set as the health priority the reconstruction, repair and rehabilitation of hospitals and clinics which have been destroyed or looted in the course of the civil war. Wartime destruction had also led to the outbreak of epidemics and to the lowest level of health services coverage in 30 years (Kloos 1998). Beyond post-war priorities, the health sector formulated directions that departed markedly from the previous regime, most notably private participation and more authority to local governments. Specifically, the 1993 Ethiopian Health Policy laid out as the key elements of sectoral reform the strengthening of primary health care, a new focus on cost recovery mechanisms, decentralisation of delivery, and the encouragement of 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, as when the Ministry of Health closed private clinics in Addis Abeba in 1996; see Kloos (1998).

Table 16: Potential health service coverage (%)

	Includes health centres and health stations					Includes health centres, health stations, health posts, and private clinics		
Region	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
Benish.-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 has access to health facilities 10km away or less (World Bank 2005c). May exceed 100%.

Access to health services measured by the potential health coverage (see Table 16), has not markedly improved when considering only access to health stations/centres. In fact, there appears to be a significant decline from 2002 to 2003 in access to such health facilities. This, however, may be a feature of the fact that there has been an effort to downgrade health stations to health posts which offer predominantly only preventative services. The second half of Table 16 shows that access to health services from a broader array of health facilities have shown more of an increase. While a regional distribution of potential health service coverage is not available for years earlier than 1999, MoH (1999) reports nationwide PHSC by health stations/centres to have been 38% in 1992, 48.5% in 1996, and 51% in 1997. This suggests, then, that coverage by health stations/centres had increased rapidly in the first half of the 1990s, after which it stagnated and even slightly declined. Some of this decline has been compensated for by the increase in coverage by private clinics. One thing that is striking about the distribution in health coverage is the relatively high coverage in regions often deemed marginal by various indexes of development. For example, Beneshangul-Gumuz and Gambella show the highest coverage rates. This may be a reflection of the strong policy focus on equalising public services between regions.

More recently, Ethiopian health sector policy has been guided by the Health Sector Development Programme (HSDP).[6] This programme, intended to steer health sector policy for the short and medium term, reaffirms 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, per GDP government expenditure on health exceeds the average in South Asia and low income countries, but lies below the Sub-Saharan African average. However, public and private expenditure on health is a smaller share of GDP than any of the other developing country groups (Table 17), which points to the relatively large role that public financing plays in Ethiopia's health sector financing. In absolute terms, spending on health per person falls very short of expenditures in Africa, South Asia, and the group of low-income countries. Health expenditures per head at $3 are between one-seventh and one-tenth of other low-income economies.

Table 17: Health expenditure in Ethiopia and other low-income country groups, 2001

	Expenditure as % of GDP		Public as % of	Expenditure
	Total	Public	total expenditure	per capita ($)

[6] Generally, the Sector Development Programmes, which have so far been launched for the road, health, and education, and some other sectors, have been motivated by a need to harmonise donors' activities in these sectors and thus use aid money more effectively. Along with a trend in aid agencies, especially the World Bank to place less emphasis than in the past on project financing and move toward programmatic lending, Ethiopia's SDPs have been designed in collaboration and with the support of several donors.

Ethiopia	3.6	1.4	40.5	3
South Asia	4.8	1.0	21.6	22
Low income	4.4	1.1	26.3	23
Sub-Saharan Africa	6.0	2.5	41.3	29

Source: WDI 2005.

In the implementation of Ethiopia's decentralisation policy, the social sectors were those sectors for which the devolution of resource allocation responsibility to the lower tiers of government was most extensive. Accordingly, the regions accounted for over 87% of government recurrent expenditure and nearly all (99%) of capital expenditure in 2001. With the recent deepening of decentralisation since 2002, part of regional health budgets are being passed on to weredas. As in the decentralisation of spending responsibility in other sectors, here too there have been some problems associated with the devolution, as weredas are not fully capable of maintaining facilities, do not have adequate staffing (despite the continued deployment of health personnel from the regions), and face the challenge of coordination with other weredas for services and drugs distribution activities that span a wider geographic space.

In the following sections, we will build on this descriptive overview to expand the inquiry to ask how public expenditure in key sectors may have differentially affected welfare of rural households. The next section will set the stage by providing the conceptual context of how public spending may contribute to rural households' incomes, by the way that public services affect the productivity of household private assets. We also discuss here the possibility of expenditure policy itself being influenced by sector-specific levels of development, and what this implies for identification in the analysis.

4. Public Spending, Public Services, and Private Assets

Access to public services can have direct as well as indirect effects on household welfare. The direct effects include improvements in wellbeing that are usually not captured by monetary measures of welfare (Ferroni and Kanbur 1992 incorporate such measures in designing a framework for poverty-oriented public expenditure allocation). For example, improved sanitation arising from public subsidies in the construction of household latrines will make individuals directly better off, given the inherent desireability of improved hygene. The direct effects of certain forms of public expenditure may also primarily be manifested through the monetary form of welfare, such as public provision of unconditional safety nets transfers, which boosts the household's income directly.

Most public services, however, operate indirectly to make a household better off: by affecting the returns to, or the productivity of, the household's private assets. Public investment in the construction of rural roads in a community does not have an inherent value for the community's residents, but enhances their wellbeing by making their means of transport more productive by reducing travel time. Access to irrigation infrastructure will affect the welfare of agricultural households by increasing the contribution of their agricultural assets to income, such as cultivable land.

Naturally, the provision of public services may have a mix of both direct and indirect impact on wellbeing, such as in the example of access to better sanitation given before, where in addition to the inherent (nonmonetary) benefits of improved latrines, health improvements arising from these public investments may make household members more productive. In this sense, sanitation investments will also affect welfare through increasing the returns to the household's labour assets. Similar mixed effects will obtain with regard to better access to education.

The previous section discussed briefly how access to different types of public services may affect households' wellbeing. But for them to be able to benefit from services and infrastructure, resources first need to be committed to provide public services and build infrastructure. When assessing how public expenditure results in public capital, several issues that affect the transformation of financial resources into services and infrastructure must be considered.

Firstly, an improvement or increase in services/infrastructure can be expected to materialise from public investment with a lag. This lag length may differ depending on the type of sector-specific service indicator. For example, substantial resources invested in road construction in some region may be expected to affect a measure of road capital – road density – within one or two years of the investments made. On the other hand, an improvement in the measure of human capital for some region – the literacy rate – will arise from education spending only after a longer time period has passed (given that children educated today will enter in 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: Enrollment ratio or school density can be expected to be affected by spending sooner than the literacy rate.

Secondly, 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: Firstly, at the expenditure policy or budget process level, the decision to spend more in some sector will imply a reduction in resources for another sector. Secondly, resources allocated to one sector may also immediately benefit outcomes in another sector. For example, public investment in energy that increases town electrification may reduce the use of environmentally harmful in-house dungfuel burning practices, thus increasing health outcomes directly, especially for female household members. However, such cross-effects are more appropriately analysed by assessing the effects of, say, connectedness to electricity on health, rather than expenditure on electricity on health, if the within-sector effects of spending are already accounted for.

5. Empirical Strategy

5.1. Public Services and Private Assets

This paper explores the relative magnitudes of the returns of different types of public investment to rural welfare in Ethiopia. Using the conceptual frame above, we proceed with the analysis in three stages. In the first stage, a household consumption equation specifies the role of household private assets A for consumption welfare, as well as the effects of access to a range of public

services (*PS*), which are allowed to operate directly (superscripted *d*), as well as indirectly (superscripted *A*) by potentially enhancing the productivity of private assets. *X* constitutes the vector of control variables, which include a range of household and household head characteristics.

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

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

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

where D_j is a dummy equal to 1 if household *i* is in location *j*. Note that the public service and the private asset terms are still vectors, given that the impact of multiple types of public services is being assessed. The parameters of interest are obtained straightforwardly as:

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

in the case of direct effects and:

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

for the indirect effects, where $\overline{A}_j$ is the mean of the measure of private assets.

5.2. 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 the previous section. In addition, public expenditure is a flow measure. As such, an appropriate approach to identify from such a measure the effect on sectoral performance at some particular point in time would need to take into account the effect of public investments over time, especially in cases where results may be expected only with a time lag.

Before proceeding, it is worth clarifying here that for the purposes of the type of analysis and inquiry of this paper, we use the terms ‘public investment’ and ‘public expenditure’ interchangeably. Given that ultimately we are not solely interested in the outcomes of public investment strictly in terms of physical capital items, this distinction, while critical in other contexts, is not useful here. For example, if only interested in the number of school buildings, one may want to examine the role of only capital expenditure (which is what is usually referred

to as 'public investment' in other contexts) in education for the number of schools in some region, disregarding recurrent expenditure in teachers' salary, 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 refer to the total (i.e. recurrent and capital) amount of public expenditure interchangeably as 'public expenditure' or 'public investment'.

In the following we discuss alternative approaches used in the literature for determining public expenditure impact, with the aim of providing a context for the empirical strategy used in this paper. In so doing, we draw selectively on a few studies for illustration. Also, given the concrete interest in discussing the merits of certain methodological questions which may inform the econometric specification — e.g. how the the flow nature of public spending is handled, and how to account for the way that results may be achieved with a time lag — we will focus here only on studies that explicitly draw on public spending data in their analysis (as opposed to studies that infer public investment effects from public capital returns).

We first consider the aforementioned literature on Ethiopia. Collier et al. (2002) use public expenditure data at the national level to compute unit costs of increasing the quantity and quality of health care, and conduct simulations using these unit costs. The unit cost approach, while illustrative, does not permit accounting for nonexpenditure factors to affect health capital variables. Also, as employed here, it does not account for the potential span between intervention and outcome. At the same time, expenditure data limitations may necessitate this approach. Fan, Zhang and Rao (2004) and Fan et al. (2005) similarly used the unit cost approach.

Agenor (2004) (as other CGE studies) embeds 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 that the multiple pathways from spending to growth and poverty in an aggregate-macroeconomic framework are assessed. It is however 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) use quantile regressions on cross-country panel data, in which the effect of social sector expenditure on the human development index is introduced contemporaneously. I.e. Countries' HDI index of period t is regressed on expenditure in period t, along with other control variables. While in contrast to the unit cost approach, regression estimation permits controlling for non-expenditure influences on the outcome of interest, in this particular study, as in the previous ones, the possibility of lagged effects is not explored.

The potential time interval from public resources spent to economic performance realised is given greater attention in the less recent study by Devarajan et al. (1996). In this analysis which uses 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 hypothesised to have an influence. This relationship is assessed using various reduced-form estimation methods. This structure is intended both to account for investment lags, as well as to mitigate potential

simultaneity arising from public policy usually being driven by economic performance indicators such as growth.

An alternative approach to take into explicit account the flow nature of public expenditure and the potential effects of past spending on current outcomes is akin to a distributed lag model:

$$PS_{jt}^{s} = \alpha + \sum_{q=0}^{t} \beta_q I_{j,t-q}^{s} + \gamma Z_j + u_j \qquad (1)$$

where $I_{j,t-q}^{s}$ refers to public investment in sector *s* and region *j* undertaken at time *t-q*. In this case, investments made in each of the *t* time periods are included, and the effects of spending in each year preceding the time period at which the sector-specific outcome variable is measured can be differentiated.

One challenge to this approach is the potentially high correlation between the investments in a given sector and region, across time. Especially sectors which have a high component of recurrent expenditure, e.g. health and education, tend to be relatively stable over time, implying that, for example, $I_{j,t}^{edu}$ and $I_{j,s}^{edu}$ would be highly correlated, which would tend to wash out the significance of the investment effects. Secondly, there may be multiple ways how to extract from model (1) the parameter of interest. The question of interest here is: How much would a marginal increase in public investment in sector *s* affect performance in this sector? The policy change implied here is not a one time-period increase, but rather one that is sustained through time.

In a simultaneous equations model, Fan et al. (2000) and Fan et al. (2002) use a specification in the expenditure equations that allows for such lagged effects. On the issue of accounting for lags, these two studies differ methodologically from Devarajan et al. in two important ways. Firstly, implicitly Devarajan et al. seek to capture lagged effects by assessing the impact of current expenditure on subsequent (average annual) growth over five years. This does not permit for a parameterisation of the individual effects of spending at different time intervals (e.g. for 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 expenditure 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 modelled 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'. This approach, then, assesses the effect of accumulated public investment in sector s and location j on sectoral outcomes in s and j:

$$PS_{jt}^{s} = \alpha^{s} + \beta^{s} K_{jt}^{s} + \gamma^{s} I_{j} + u_{j} \qquad (2)$$

The marginal impact of interest is β^s. Unlike the prior approaches in Fan et al. (2000) and (2002), estimating the impact of accumulated public investment on public services does not generate separate estimates for expenditure effects in different years. But one can derive time-differentiated effects from the estimated coefficients and the 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 analysed) are appropriately estimated in a systems framework. Firstly, it is likely that shocks that affect the general local economy in location j and that affect the random variation in performance or services in sector s may also likely affect anaccounted for variation in the services in another sector s'. Secondly, we want to allow for cross-sectoral synergies, i.e. the possibility that outcomes in one sector affect those of another sector.

Whichever the approach to modelling the impact of expenditure, it is, as with most policy interventions, the case that the decision to invest public resources in some activity will be influenced by state of affairs in the sector to be invested in. If, for example, the health sector is better developed in some region compared to other regions, this may have an effect on spending in two ways: A strong equity focus in expenditure policy would imply the tendency to spend less per capita on health than in other other regions, holding other factors constant. On the other hand, to the extent that a higher density of health facilities and medical staff in this region generates greater needs for complementary health resources, such as medical supplies, than in locations with fewer facilities per capita, 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 to capital expenditure on health centres themselves).

Furthermore, a sectoral expenditure policy primarily concerned with efficiency may lead to greater investments in a given sector where performance indicators are already high. For example, areas with higher agricultural potential (be this due to agroecological conditions, existing high capital base, institutional structures, etc.) may also be those areas in which public

investment in the promotion or provision of 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 well aligned with sectoral strategies, would allocate relatively greater public resources in the agricultural sector to better performing areas.

In addition to the question of whether a given region has an equity- or an efficiency-oriented policy, other, more indirect, ways in which sectoral development may determine sectoral public investment suggest that the direction of this influence is ambiguous. Naturally, the size of public expenditure in a sector depends not only on sectoral policy, but also on the overall size of the public budget the region has to its disposal. This budget envelope is determined mainly by two things. First, regions receive a substantial share of their budget from federal transfers, or block grants, as seen in Table 1. Given the features of the broader strategy that led to the particular federal structure in Ethiopia, the size of block grants from the federal government to the regions is determined to some extent by the emphasis placed by the government on reducing the relatively high degree of inequality between regions. Hence, as shown in Table 1, the size of per capita transfers from the federal government to Benshangul-Gumuz, a rather underdeveloped region, is 87%, whereas the transfers to Addis Abeba only comprise 4% of the Addis Abeba budget. However, based on Table 1, the simple correlation between the per capita regional funds' own sources (regionally collected taxes, etc.) other than federal grants on the one hand, and the size of per capita grants on the other hand, is -0.70. This suggests 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 regions' budgets is their own revenue raising capacity. Better developed regions are generally better equipped to generate their own revenue through taxes, user fees, etc. This source of regional budgets therefore tends to be higher where sectoral performance indicators are also higher. Through this link between level of regional development and own-revenue raising capacity, then, higher sectoral development tends to contribute, holding other factors – including federal transfers – constant, to more public resources, and that in turn to higher levels of public expenditure in any given sector.

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 possibly ensuing bias cannot be conclusively determined. However, given the large size of transfers in regions' budgets, given that transfers tend to be higher when own revenue raising capacity is lower (see above), and given that the overall size of the budget seems to be a significant factor in the size of sectoral investment, 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 (regions') sectoral investment decisions are not made centrally but regionally, and the impact of the variation in regions' total public budgets may wash out the possible trend of higher development of some sector in a region resulting in lower resource commitment.

Nevertheless, we cannot be certain that the various possible divergent effects of sectoral development on spending will cancel each other out. Hence, noting the role of the overall

regional budget envelope for the size of sectoral spending, we will instrument the accumulated public investment variable with the size of expenditure on public administration for each region. This expenditure item is not associated with 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, etc., and yet will be highly correlated with the amount of spending in the sectors of interest.

Given the high likelihood that the sector-specific performance indicators may be all affected by shocks to the economy not captured in the equations, thus creating correlation of the error terms across equations, 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. We employ the above instruments in a System-2SLS framework.

5.3. Linking Public Spending with Household Welfare

In the third stage of analysis, we use the results of both the estimation of sector-specific performance variables on household welfare, and public spending on the sectoral performance indicators, to compare the effects of an increase in per capita public expenditure in various sectors on household wellbeing measured by household consumption. For most sectors, these effects are differentiated by region. Using the results from the first two stages gives:

$$\eta_j^s \equiv \partial \ln(c_{ij}) / \partial K_{jt}^s = \phi_j^{s*} \cdot \beta^s \tag{3}$$

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): 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 both 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:

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

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

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

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

In the case of our model, the function $h(\hat{\gamma})$ takes on the simple nonlinear form of equation (3), i.e. $h_m(\hat{\gamma}) = \hat{\phi}_m \cdot \hat{\beta}_m$, and here $M = K/2$, 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:

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

6. Data and Estimation

For both the descriptive and econometric analysis, this paper uses multiple sources of data. 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) collected by the Central Statistical Authority (CSA) in 1999/2000. Given that we focus in this paper on rural welfare, only the observations on rural households of the HICE are used. Part of the data on households' access to public services is obtained from CSA's Welfare Monitoring Survey for the same year as the HICE mentioned above.

The analysis also includes data on sectoral performance from a World Bank database of a range of economic, agricultural, and demographic variables at the zone level. Public expenditure data is made available by the Ministry of Finance and Economic Development (MOFED). Expenditure data exists yearly from the 1993/94 fiscal year to 2000/01 and includes expenditures of the federal government and of the regions (and for the later years partially of the districts and other administrative units) and is disaggregated by functional and economic classification. Further sector-specific data, usually disaggregated by region and available for multiple years, obtained from the respective line ministries is drawn on primarily in the descriptive presentation. The latter also makes use of agricultural variables, including yield, labour productivity in agriculture, etc. which are obtained from multiple years of CSA's Agricultural Sample Survey (AgSS).

Table 18 provides descriptive statistics on the variables included in the first-stage regression (further descriptives on regression variables are presented in the tables of section 3), and Table 19 gives the estimation results from the first stage. Indicators of performance, and thus of access to services, are included for four sectors seen as important for welfare enhancement in rural areas: road infrastructure, health, agriculture, and education. Underlying the specification is the hypothesis that higher average performance in agriculture, and better access to roads, will affect the contribution of rural households' agricultural assets to their welfare. Access to education, proxied for by the primary school enrollment rate, is interacted with the household's labour assets, given that better access to educational services is expected to make labour more productive. Access to health services, represented by the potential health coverage is introduced in the regression directly, to capture in a simple form the multiple channels through which it may be welfare enhancing. The sector-specific variables are measured as zonal averages.

Table 18: Descriptive statistics on hypothesised determinants of household expenditure

Variable	Mean	Standard deviation

Log of per adult-equivalent household expenditure	7.23	0.48
Households with male head (%)	0.77	0.42
Age of head	43.66	14.97
Household size in adult-equivalents	3.43	1.35
Distance in km to fuel source for cooking	2.07	3.86
% in town using public transportation	0.58	0.28
% in town using public telephone	0.12	0.13
Years household lived in this house	9.00	10.10
Number of agricultural assets held by the household	3.79	1.79
Number of working-age household members (labour assets)	2.57	1.40

As the results in Table 19 show, there is strong variation across regions in the effects of access to roads on the contribution of agricultural assets to rural household consumption. Interestingly, this effect is strong and significant in two neighbouring but agroecologically quite different regions, Affar and Amhara regions, the former being a predominantly pastoralist region and the latter consisting of mostly sedentary and partly agropastoralist households. As the discussion on Tables 8 and 7 suggested, Gambella and Affar have relatively high road density, although they are often referred to as backward regions. Amhara's road density is medium to high compared to other regions.

Table 19: Public services and private Assets: Determinants of household welfare

Dependent variable: *ln*(household consumption per adult-equivalent) Ordinary least squares estimation with robust standard errors, errors corrected for EA cluster-effects	
Gender of head (male dummy)	0.0219
	(0.015)
Age of head	-0.0052 **
	(0.002)
Age of head squared	0.0000
	(0.000)
Household size in adult-equivalents	-0.1015 ***
	(0.010)
Distance in km to fuel source for cooking	-0.0018
	(0.002)
% in town using public transportation	0.1209 ***
	(0.046)
% in town using public telephone	0.1198
	(0.104)
No. of years household lived in this house	0.0006
	(0.001)
Ag. (productive) assets	-0.0036
	(0.019)
Labour assets	-0.0329 *
	(0.018)
Ag. (productive) assets * road density:	

Affar	0.0794***
	(0.014)
Amhara	0.0761***
	(0.021)
Beneshangul-Gumuz	0.0202
	(0.038)
Gambella	0.0140
	(0.010)
Oromiya	-0.0007
	(0.025)
SNNP	-0.0230***
	(0.006)
Somale	0.0859
	(0.071)
Tigray	0.0071
	(0.022)
Ag. (productive) assets * land productivity:	
Affar	-0.0018
	(0.002)
Amhara	-0.0001
	(0.002)
Benesh.G.	0.0008
	(0.009)
Dire Dawa	0.0100***
	(0.002)
Gambella	-0.0072
	(0.006)
Harari	0.0096***
	(0.003)
Oromiya	0.0056***
	(0.002)
SNNP	0.0042***
	(0.001)
Somale	0.0047
	(0.009)
Tigray	0.0074***
	(0.002)
Labour assets * primary enrollment rate:	
Affar	-0.0430
	(0.096)
Amhara	0.1234***
	(0.034)
Benesh.G.	0.0283
	(0.023)
Dire Dawa	0.0839**
	(0.033)
Gambella	0.0067
	(0.021)

Harari	0.1082***
	(0.023)
Oromiya	0.0580**
	(0.028)
SNNP	0.0587**
	(0.027)
Somale	0.3240**
	(0.135)
Tigray	0.0093
	(0.028)
Potential health coverage	0.0863**
	(0.040)
Constant	7.3290***
	(0.068)
No. of observations	7890
R^2	0.20

Road density: km roads per 1000 persons. Primary enrollment rate: Gross primary school (grades 1-8) enrollment ratio. Yield: Average physical yield of all annual crops.
Standard errors in parenthesis and italicised. Coefficents significant at: * 10% level; ** 5% level; *** 1% level.

The direction and significance of the effect in the case of the Southern region is, however, surprising, even though the magnitude of the effect is small. We find an interesting analogue between the results for this region and those regions referred to above, found to have high welfare returns to access to roads. Referring again to Table 7, the SNNP is seen to have the poorest access to roads in all the years for which data is available. Taken together, one tentative conclusion that may be drawn is that there appear to be increasing returns to access to all-weather roads, in terms of the gains in private household assets' productivity that such access affords.

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

Access to education, repesented by the primary enrollment rate, interestingly shows the highest returns to labour assets in the Somale region (which, along with Afar, has the lowest enrollement ratios along with Afar, see Table 13), followed by Amhara and Harari regions (the latter of which has among highest enrollment achievement, along with Gambella). The lowest among the significant effects are for Oromia and SNNP regions. In contrast to infrastructure, it appears here that access to education leverages households' labour assets most in those regions where the levels of access are lowest, and vice versa.

Table 20 estimates the impact of different types of public spending on the sectoral performance variables discussed above in the context of the first stage results, as specified in (2) (Table A4 in the Appendix shows descriptive statistics for these variables to the extent not already presented in the tables of Section 3). 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 way for all years considered.

Note that 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 included 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.

We select a priori the first specification as the primary one, since the effect of the provision of the inputs included (improved seed, fertiliser, irrigation, and pesticides) are heavily dependent on public expenditure in Ethiopia, and thus their effects should be accounted for through the public investment variable. Secondly, a priori we also hypothesise that there exist cross-sectoral synergies, especially for agriculture. A better road infrastructure may reduce transactions costs both for agricultural input as well as for the marketing of agricultural outputs, both potentially leading to improved productivity. Similarly, in areas with greater exposure to health risks, agricultural labour productivity may be lower, which, ceteris paribus, may reduce yields. Care is taken not to assess cross-sectoral effects by determining the impact of expenditure in one sector on outcomes in another sector, but rather by assessing the influence of realised outcomes (or in the case of health, the existent risks) in one sector on those in another.

We also focus the 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 a more intermediate variable. For example, were the dependent variable in the health equation a measure of how exposed to ill health a population was, 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 how 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, health service coverage, can be better understood as an intermediate health outcome variable, such cross-sector effects on the health variable are not hypothesised.

Table 20: Effect of public expenditures in four sectors (System-2SLS estimation)

	(1)	(2)	(3)	(4)
Road infrastructure				
K^{ROD}	0.0200***	0.0198***	0.0198***	0.0199***
	(0.0016)	*(0.0016)*	*(0.0016)*	*(0.0017)*
sh.urban	0.8020	0.8449	0.8498	0.8210
	(0.9171)	*(0.9149)*	*(0.9136)*	*(0.9183)*

pop.dens.	-0.0009	-0.0009	-0.0009	-0.0009
	(0.001)	*(0.001)*	*(0.001)*	*(0.001)*
const.	-0.0636	-0.0545	-0.0535	-0.0596
	(0.2085)	*(0.208)*	*(0.2077)*	*(0.2087)*
PI effect (% incr. in *y*)	1.741%	1.724%	1.724%	1.732%
Agriculture and natural resources				
K^{AGR}	0.0053	0.0043	0.0048	0.0052
	(0.0047)	*(0.0045)*	*(0.0045)*	*(0.0050)*
rain	0.0010	0.0016	0.0017	0.0007
	(0.001)	*(0.0011)*	*(0.0011)*	*(0.0011)*
land/hh	-1.8399 *	-2.4291 **	-2.3066 **	-1.9083
	(1.1043)	*(1.1038)*	*(1.0496)*	*(1.2102)*
althi	0.4119	-0.2071	0.0250	0.3896
	(0.801)	*(0.8165)*	*(0.8012)*	*(0.8557)*
sh.seed		6.1748	3.7125	
		(12.471)	*(12.5625)*	
sh.irrig.		6.5832 ***	6.2182 ***	
		(2.4808)	*(2.3737)*	
sh.pest.		8.5298	5.9558	
		(5.8802)	*(5.7887)*	
sh.fert.		1.9239	1.2438	
		(2.5736)	*(2.4643)*	
dist.road	-0.2615 ***		-0.1719 *	
	(0.0958)		*(0.0966)*	
malaria.vuln.	-1.5380		-1.4675	
	(1.3649)		*(1.353)*	
const.	13.3064 ***	9.5935 ***	11.5570 ***	11.1098 ***
	(1.9437)	*(1.5861)*	*(1.8616)*	*(1.7317)*
PI effect (% incr. in *y*)	0.047%	0.038%	0.043%	0.046%
Education				
K^{EDU}	0.0014 ***	0.0014 ***	0.0014 ***	0.0014 ***
	(0.0002)	*(0.0002)*	*(0.0002)*	*(0.0002)*
sh.urban	-0.3934 *	-0.4350 **	-0.4351 **	-0.3961 *
	(0.212)	*(0.2075)*	*(0.2074)*	*(0.2125)*
dist95	-0.0320 ***	-0.0319 ***	-0.0319 ***	-0.0320 ***
	(0.0096)	*(0.0096)*	*(0.0096)*	*(0.0096)*
const.	0.5122 ***	0.5044 ***	0.5043 ***	0.5117 ***
	(0.0546)	*(0.054)*	*(0.054)*	*(0.0547)*
PI effect (% incr. in *y*)	0.235%	0.235%	0.235%	0.235%
Health				
K^{HLT}	0.0026 ***	0.0026 ***	0.0026 ***	0.0026 ***

	(0.0005)	*(0.0005)*	*(0.0005)*	*(0.0005)*
sh.urban	-0.0580	-0.0528	-0.0506	-0.0689
	(0.3361)	*(0.3318)*	*(0.3317)*	*(0.3369)*
malaria.vuln.	0.1413	0.1417	0.1418	0.1406
	(0.1184)	*(0.1183)*	*(0.1182)*	*(0.1184)*
const.	0.4374 ***	0.4375 ***	0.4375 ***	0.4373 ***
	(0.0806)	*(0.0806)*	*(0.0805)*	*(0.0806)*
PI effect (% incr. in *y*)	0.316%	0.316%	0.316%	0.316%
R^2				
Road infrastructure	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	56.4%	56.4%	56.4%	56.3%
χ^2 (p-value)				
Road infrastructure	218.2 ***	216.3 ***	216.7 ***	212.6 ***
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*
Agriculture	28.6 ***	21.1 ***	15.0 **	4.3
	(0.0015)	*(0.007)*	*(0.020)*	*(0.365)*
Education	64.3 ***	64.3 ***	57.1 ***	57.0 ***
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*
Health	64.2 ***	64.3 ***	62.7 ***	62.9 ***
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*

Variables: 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.seed = share of cultivable land using pesticides; sh.seed = share of cultivable land using fertiliser; dist.road = average distance in km to the nearest dry weather road.
Standard erros are in parenthesis and italicised. N = 53. Coefficents significant at: * 10% level; ** 5% level; *** 1% level.

Table 20 shows that the results of all the other three sectors are very stable vis-à-vis the changes in specification in the agriculture equation. The coefficients in the agriculture equation also do not change much. 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 are not affected. Interestingly, including the 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 variables are highly significant for all sectors. The magnitudes of the coefficients on public investment are not directly comparable with each other given the different units in which the dependent variables are measured. 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.

While this last interpretation of the expenditure coefficients makes comparison of expenditure returns across sectors somewhat more feasible given that the units of measurement are equal, 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 6 above, the third stage estimation draws on those of the first two stages of the analysis, using (3), to assess the effect of a marginal increase in per-capita public expenditure in various sectors on rural household consumption (Table 21). While the first stage regression already showed that two regions seem to stand out in terms of the strong effect that access to roads appeared to have on consumption, here the effect of road infrastructure expenditure on household consumption is quantified. For example, a one birr increase in per capita expenditure on roads in Affar and Amhara lead to an more than nine birr increase in per capita consumption of rural households of these two regions.[7]

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 can only be a part of the explanation, as that may address why returns are lower in the Southern region than elsewhere, but not why they are negative. Further reflection on this may call for exploring, and modelling explicitly, other mechanisms by which road infrastructure may have a bearing on household income, in addition to the returns to agricultural assets. More specifically, to the extent that better accessibility of all-weather roads encourages formerly agricultural households to begin nonfarm enterprises and facilitates access to the wage labour market by making travel to locations of employment easier and cheaper, improved road density may in fact reduce the returns to agricultural assets to the extent that agricultural production becomes less dominant as a livelihood for some households.

Table 21: Impact of per capita public expenditure on household welfare

	Roads	**Agriculture**	**Education**	**Health**
Afar	**9.571** ***	-0.056	-0.239	
	(1.877)	(0.075)	(0.533)	
Amhara	**9.177** ***	-0.004	**0.685** ***	
	(2.680)	(0.049)	(0.225)	
Benshangul-Gumuz	2.438	0.024	0.157	
	(4.561)	(0.288)	(0.130)	
Dire Dawa		**0.317**	**0.466** **	
		(0.293)	(0.200)	
Gambella	1.691	-0.228	0.037	
	(1.169)	(0.272)	(0.114)	

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

Harari		**0.302**	**0.601** ***	
		(0.286)	(0.165)	
Oromiya	-0.084	**0.178**	**0.322** **	
	(3.004)	(0.166)	(0.164)	
SNNP	**-2.772** ***	**0.133**	**0.326** **	
	(0.740)	(0.126)	(0.161)	
Somale	10.360	0.150	**1.799** **	
	(8.588)	(0.306)	(0.810)	
Tigray	0.852	**0.235**	0.052	
	(2.600)	(0.222)	(0.153)	
Average effect				**0.354** **
				(0.175)

Notes: Standard errors in parenthesis and italicised. Associated estimates significant in 1st-stage estimation in bold. Coefficents significant at: * 10% level; ** 5% level; *** 1% level

The effects of spending on agriculture may be interpreted with caution, given that the standard errors obtained via the delta method are not significant. Nevertheless, some tentative findings can be established. The strongest effects of spending appear to have been realised for rural households in the two "city-states" Harari and Dire Dawa. Here, a one-birr increase in spending results in a greater than 0.3 birr increase in per capita household consumption. Among those regions for which the coefficents are significant in the 1st stage estimation, the returns in terms of household welfare of a birr increase in agricultural spending varies from 0.13 to 0.31 birr. Comparing this to the results on road expenditure, the latter 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 substantially fall short of the road investment returns. As with the level of returns, also the interregional variation of the returns lies between those in agriculture and road infrastructure. Among the regions with coefficients significantly different from zero, a birr increase in education spending is associated with somewhat over a 0.3 birr increase in household expenditure at the lower end of the spectrum (Oromiya, SNNP), and in the largest case with a 1.8 birr increase in household expenditure (Somale). Health expenditure effects, here not differentiated by region, have a positive, moderate and statistically significant effect on average rural household welfare.

7. Concluding Remarks

Returns to road investments are both significantly higher than returns to other spending, as well as much more variable across regions. This regional variability in returns to road investment suggests careful consideration as to where household welfare impact of roads is highest. There is tentative evidence that there may be increasing returns to road spending, with higher returns in those areas which have a better developed road networks, and vice versa. In this context, it is worth mentioning again that, reflective of the government's policy to attend to regional

inequality in various development indicators, better road networks are found in what are usually referred to as marginal regions.

The household expenditure impact of per capita public expenditure in agriculture and in education are smaller but also less variable across regions than the effects of road spending. The largest effects of agricultural expenditures on rural households are observed in two small regions that are dominated each by a major town. While proximity to markets has not been explicitly estimated in this model, it appears that the the relatively high returns to agricultural spending for rural residents in Dire Dawa and Harari regions may be capturing just that. Returns to public expenditure on education lie in magnitude between returns to agriculture and infrastructure expenditures.

Some useful steps may be taken to strengthen any conclusions arising from this analysis, or alternatively shed light on further insights about the relative effectiveness of different types of public spending. Firstly, while this paper assessed how rural households' consumption is affected by public expenditure, it will be important and insightful to go beyond average welfare effects to using these results 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, the role of the various components of such investment, notably agricultural extension, agricultural research, and food security spending, would be parsed out. The lack of availability of regionally disaggregated time series data on spending in the subsectors of agriculture necessitated an analysis of agricultural expenditure as a whole. More effort in collection of such data, e.g. from the regional bureaus of agriculture, would alleviate this constraint.

An issue that goes beyond the scope of this paper, but the analysis of which would constitute highly complementary research especially as an input into policy, is the issue of 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, especially, in the Ethiopian context, with respect to agricultural investments, both because agriculture strongly dominates Ethiopia's economy, as well as because the government's development strategy has emphasised the agricultural sector. Especially given that a substantial body of research suggests that a strategic focus on agriculture may be appropriate given the stage of development of Ethiopia, an investigation into the drivers of efficiency in the country's agricultural public spending may be the important next 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	2465.66	2482.87	1540.35	1685.89	-8.6%
Afar	1537.71	2302.04	1127.01	1520.46	-25.9%
Amhara	1165.59	1754.39	1095.67	974.42	12.4%
Benshangul-Gumuz	1158.31	2014.27	1088.44	1074.99	1.3%
Dire Dawa	1766.95	1899.32	1394.43	1682.83	-17.1%
Gambella	1330.32	1898.10	1255.71	1706.66	-26.4%
Harari	1904.90	2106.19	1618.71	2388.73	-32.2%
Oromia	1208.40	1701.01	1144.48	1282.91	-10.8%
SNNP	1080.07	1768.86	1025.18	1021.34	0.4%
Somale	1626.71	2106.72	1395.12	1975.42	-29.4%
Tigray	1189.45	1536.65	1120.86	1209.60	-7.3%
Ethiopia	1222.45	1921.02	1109.92	1136.59	-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%
Benishangul-G.		1296.7	1347.0	3.9%
Dire Dawa		1595.9	1573.9	-1.4%
Gambela		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%
Somalie		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	Beni-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
Education	7.9	2.6	21.9	2.0	0.9	2.9	1.0	33.7	18.3	2.7	6.2	100
Health	8.4	4.5	21.7	3.8	1.2	2.3	1.9	23.6	15.4	5.1	12.1	100
Agriculture	1.0	4.1	23.4	2.9	0.6	1.0	0.3	31.0	25.2	5.5	4.9	100
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
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
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
Other	24.3	6.3	16.4	4.5	1.9	2.4	1.2	16.5	13.8	7.0	5.7	100
Total	15.8	5.1	19.4	3.4	1.1	2.2	1.0	24.8	15.8	4.9	6.6	100
Population	3.9	1.9	25.6	0.8	0.5	0.3	0.3	35.2	19.7	5.8	5.8	100

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

Table A4: Zonal averages for selected variables used in 2nd stage regression (see Table 20)

Zone	Dist. school	Dist. road	Malaria vuln.	% urban	Pop. dens.	High altit.	Rain-fall	Land/ hh	% land seed	% land irrig	% land pesticid	% land fertiliser
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%
Bensh.-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 Welega	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 Welega	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.