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Economic Benefits and Returns to Rural Feeder Roads

Summary of ESSP II Working Paper 40 "Economic Benefits and Returns to Rural Feeder Roads: Evidence from a Quasi-Experimental Setting in Ethiopia"

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We estimate households' willingness-to-pay for rural feeder roads in Ethiopia. Using a quasi-experimental setting, we find that the benefits of reducing transportation costs by 50 US dollars per metric ton of goods (agricultural surplus, purchased consumption goods, purchased agricultural inputs) would result in benefits worth roughly 35 percent of household consumption. A hypothetical gravel road of 21 km (a road built halfway through the survey site) that lasts 10 years will have an internal rate of return (a measure for the profitability of an investment) that ranges from 12 to 34 percent, using conservative assumptions. These results suggest that investments in rural feeder roads are cost-effective ways to help reduce widespread poverty even in unfavorable settings where small-scale farmers have low levels of marketed agricultural surplus, nonfarm earnings opportunities are negligible, and the provision of motorized transport services is not guaranteed.

While the benefits of lower rural transport costs are well-recognized, there is also however increasing skepticism on returns to road investments, especially so in Africa due to low productivity and limited commercial surplus production by smallholders, underuse of rural road infrastructure, and problematic transport service delivery. The analysis here assesses the benefits of rural feeder roads in Ethiopia. As part of an effort to revitalize the agricultural and rural sector since liberalization, the government of Ethiopia has emphasized the development of rural infrastructure. Given the high costs of transport, the large number of poor people living in remote areas, and the large investments required for road infrastructure improvements, there is a great need to better understand the returns to such road investments.

Results

The survey on which the analysis is based was conducted with 850 households in a remote area in the Amhara region. To better understand what remoteness means in the study area, dry season travel times reported by households in the survey are shown in the table below. The average travel time to the nearest market town in the sample is 4.5 hours, which varies by transport cost quintile from an average of 1.4 hours in the least remote quintile to an average of 6.7 hours in the most remote quintile. Transport costs range from 18 Birr/quintal in the least remote quintile to 69 Birr/quintal in the most remote quintile.

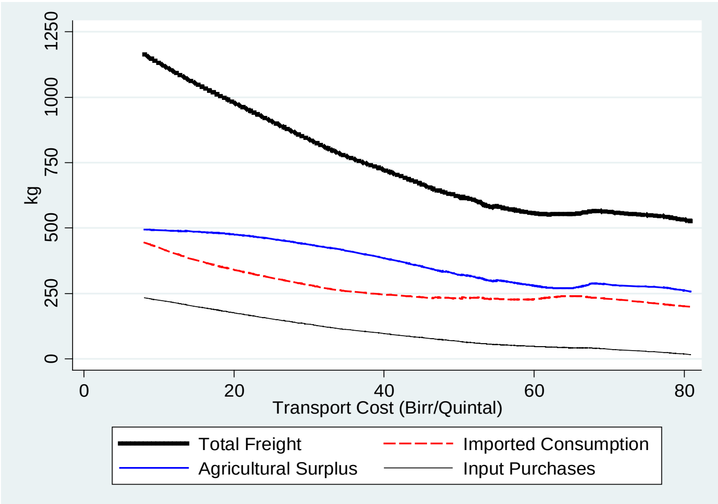
Table 1—Average travel times and transport costs to the market town

	Travel time (hours)	Transport cost (Birr/Quintal)
Transport cost quintile		
Least remote	1.4	18.4
Quintile 2	3.7	40.1
Quintile 3	4.9	54.4
Quintile 4	6.0	61.1
Most remote	6.7	69.1
Total	4.5	48.6

Source: Authors' calculations from Ethiopia Rural Transport Survey 2011

Figure 1 shows estimates of the demand for transport tonnage curve along with its components—marketed agricultural surplus, imported consumption goods, and purchased agricultural inputs. As expected, the transport cost gradients for each of the components is negative. Overall demand for freight drops by almost 50 percent from over 1,100 kg among the least remote households to just over 500 kg for those in the more remote areas. Each of the components contributes roughly equally to the total decline in total demand. Purchases of inputs drop to very low levels in the more remote areas, compared to the demand of nearly 250 kg on average in the least remote areas.

Figure 1—Transport tonnage per household and transport costs



Source: Authors' calculations from Ethiopia Rural Transport Survey 2011

Table 2 presents the results of the benefit and cost estimates for various lengths of roads, with ratios of initial construction costs to the one-year benefits shown in columns 2 and 3. These ratios range from a low of 1.5 for a 7 kilometer road that reduces transport costs to zero and when consumption is included in the benefit estimate, to a high of 6.4 for a 35 kilometer road that reduces transport costs by half for everyone and when imported consumption is excluded from the benefit estimate. For a 35 kilometer road, the ratio ranges from 2.3 to 6.4. A ratio of 2.3 can be interpreted as taking 2.3 years for the accrued benefits to outweigh the costs (ignoring discounting, annual maintenance costs, and population, income, or productivity growth that might take place over this time period). In all of the scenarios in the table, the initial cost–benefit ratios are roughly similar up to halfway through the study area. They then rise quickly for the longer 28 and 35 kilometer roads, indicating that the returns to constructing a road drop off over this interval.

Table 2—Estimated Internal Rates of Return for different road lengths

Length of gravel road (km)…	Initial cost/benefit*		Internal Rate of Return**	
	Total	Without consumption	Total	Without consumption
Road reduces travel cost to zero				
7	1.5	2.4	0.60	0.35
14	1.6	2.4	0.58	0.34
21	1.6	2.4	0.57	0.34
28	1.9	2.8	0.47	0.28
35	2.3	3.5	0.37	0.20
Road reduces travel cost by half				
7	2.9	4.6	0.27	0.15
14	3.1	4.8	0.25	0.14
21	3.2	5.0	0.23	0.12
28	3.4	5.3	0.20	0.11
35	4.1	6.4	0.14	0.07

Source: Authors' calculations from Ethiopia Rural Transport Survey 2011
Notes: * Assuming a cost of 1 million Birr per kilometer; ** Assuming a 10-year life span of the road and 5 percent annual maintenance costs.

To account for discounting and annual maintenance costs, we calculate the Internal Rate of Return (IRR, i.e. a measure to calculate the profitability of an investment) for each road length under different assumptions about transport cost reduction and demand for transport tonnage. We present IRR estimates of benefits that include and exclude demand for imported consumption, and estimates for both the elimination (upper bound) and a 50 percent reduction (lower bound) of transport costs. With regard to the former, we prefer to focus on the estimates that exclude imported consumption as this corrects for the observed pattern of back loading. For the latter, we interpret the 50 percent reduction in costs as a conservative estimate of the returns to a road on which only Intermediate Means of Transportation (IMT) such as donkey-drawn carts are made available, while the elimination of costs is more akin to the provision of motorized transportation. As such, we are cognizant that the true benefits are likely to be somewhere in between the two bounds.

In the last two columns of Table 2, we find that the IRRs vary from 60 percent for a 7 kilometer road with travel costs reduced to zero to 14 percent for a 35 kilometer road with travel costs reduced by half. If we take a conservative approach to tonnage demand (i.e. exclude consumption in the calculation), then the benefits range from 35 percent to 7 percent. We note that, as with the cost–benefit ratios, there is an evident drop in the IRR for the longer roads. For example, when we calculate benefits without consumption goods and assuming an elimination of transport costs (top section of last column), the IRRs consistently are 34–35 percent for roads whose lengths are between 7 and 21 kilometers. The IRR falls to 28 percent for a 28 kilometer road, and further to 20 percent for a 35 kilometer road. Although this does indicate that the returns fall for a road spanning the more distant part of the survey area, it is worth noting that a 35 kilometer road is likely to also benefit households beyond the study area. Because these households are not included in the sample, the benefits accruing to them are not included in the estimate of total benefits. As such, the benefits of the longer roads are likely underestimated, as are the IRRs for such roads.

Concluding remarks

Based on our estimate of benefits, a hypothetical feeder road project in this rural setting that reduces the transport costs for the most remote households by 50 US dollars per metric ton would result in benefits worth roughly 35 percent of household consumption for these households. These benefits range from 15 percent to 54 percent depending on our assumptions. A simple cost–benefit analysis reveals that a hypothetical 10-year road constructed halfway through our study area (a road of 21 km) has an IRR ranging from 12 percent to 34 percent. The lower range of estimates is consistent with transport service delivery that is limited to rudimentary Intermediate Means of Transportation (IMT) such as donkey-drawn carts. As such, even if trucks fail to ply the new road to collect agricultural products for sale in the market, the provision of IMTs is sufficient to generate a relatively high rate of return. These returns fare favorably to IRR calculated for trunk road projects, suggesting that the rural feeder roads are rightly placed as an integrated component of rural infrastructure development in Ethiopia. Our results suggest that investments in rural feeder roads may be cost-effective in helping reduce widespread poverty even in unfavorable settings where (a) small-scale farmers have low levels of marketed agricultural surplus, (b) nonfarm earnings opportunities are currently negligible, and (c) the provision of motorized transport services is not guaranteed.

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