Macroeconomic and Microeconomic Impacts of Improving Physical and Social Infrastructure: A Macro-Micro Policy Model for Ghana and Tanzania

Ajit Zacharias, Thomas Masterson,
Fernando Rios-Avilla, Michalis Nikiforos,
Kijong Kim, and Tamar Khitarishvili

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Understanding the interlocking of income and time deficits for men and women in Ghana and Tanzania: Revisiting poverty measurement, rethinking policy responses

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1 INTRODUCTION

Our previous research has revealed that employed women are more prone to encounter time deficits in meeting their responsibilities of unpaid household and care work (referred to as "household production" hereafter) than employed men in a variety of national contexts.[1] We have also shown that taking account of time deficits in the assessment of poverty alters the picture regarding consumption poverty. The official estimates of poverty considerably undercount the consumption-poor and notably underestimate the unmet consumption needs of the poor (i.e., the gap between the poor household's consumption and poverty line) drastically. Our two-dimensional measure of deprivation further indicates that women are more vulnerable than men to bearing the double bind of time and consumption deficits; they are also less likely to encounter neither time nor consumption deficits. The central determinant of the time deficits faced by women is the relatively high time requirements of household production. Both men and women tend to encounter substantial demands on their time from commuting to work, which in turn also contributes to their time deficits.

In light of these findings, the purpose of our study is to investigate the costs and benefits of policies that can lower time requirements for unpaid activities (household production and commuting) and thereby alleviate the impoverishing effects of time deficits. We focus on two policy interventions in Ghana and Tanzania that constitute, respectively, two critical components of physical and social infrastructure: road improvements and the expansion of early childhood education (ECE) services. We should emphasize at the outset that these interventions have favorable effects on overall economic development and human welfare via a variety of channels that are often described by economists as positive externalities. Our estimates of the benefits from these interventions are quite narrow in the sense that we do not take these external benefits into account.

An important strand of feminist economics literature has long emphasized the role of physical and social infrastructure as determinants of the time spent by women on household

[1] We have developed estimates for a set of countries (in a given year): Argentina (2005), Chile (2006), Ghana (2012–13), Korea (2009), Mexico (2008), Tanzania (2011–12), and Turkey (2006). Detailed analysis of the results and information regarding sources and methods can be found in the following list of references: Zacharias, Antonopoulos, and Masterson (2012) for Argentina, Chile, and Mexico; Zacharias, Masterson, and Memiş (2014) for Turkey; Zacharias, Masterson, and Kim (2014) for Korea; and Zacharias et al. (2018) for Ghana and Tanzania.

production. In her pioneering work on male bias in the development process, Diane Elson (1995, 177) discussed how reductions in public expenditures on health, education, water supply, sanitation, and rural transportation often translate into increasing care responsibilities for women: "If fewer of the services required for the sustenance of human resources are provided for by the public sector, then women have to make up some of this shortfall." More recently, Evelyn Wamboye and Stephanie Seguino (2015, 101) have argued based on their econometric analysis of female labor supply in Sub-Saharan Africa that improvements in physical infrastructure have a positive effect on women's labor supply by easing the household production responsibilities for women. Their proxies for the development of physical infrastructure—the percentage of the population with access to improved sanitation and telephone lines per 100 persons—generally prove to be positive and statistically significant.

The impact of physical infrastructure on gendered dimensions of well-being is also documented in studies outside of the realm of feminist economics. For example, in a study on Pakistan, the authors found that access to roads improved the use of prenatal care and childbirth under skilled attendants, leading to potentially lower maternal death rates. They also found that girls' school attendance improved with the access to all-season roads (Babinard 2011). Access to roads reduced women's time spent on household production and enabled women to participate in market work in Laos PDR (Thammanosouth, Douangphachanh, and Khounphakdy 2012), and women's labor supply was increased substantially in Bangladesh (Yunxian and Qun 2012).

It is reasonable to suppose that expanding access to ECE would reduce the time requirements of household production directly by reducing the time spent on childcare and indirectly by lowering the time spent on cooking, cleaning, etc. that often accompanies the task of looking after young children. Surprisingly, there is a lack of studies that directly investigate how improvements in access to care affect the time spent on household production. An initiative undertaken by Oxfam has recently made a significant contribution toward filling this lacuna. In a pilot study of women's time use in Uganda and Zimbabwe, Parvz Butt et al. (2018) find that the direct impact of better childcare services is ambiguous. In their linear model estimates, the effect on care time appears to be *negative*; in other words, it increases the time spent on unpaid care. However, time allocation on various household activities may be interdependent and, hence, can explain the counterintuitive result.

There is, however, more evidence to support the view that enhancing public expenditures on ECE leads to positive macroeconomic and distributional outcomes, including the reduction of gender inequity. Studies conducted at the Levy Institute on the United States (Antonopoulos et al. 2010), South Africa (Antonopoulos and Kim 2008), and Turkey (Illkkaracan, Kim, and Kaya 2015) demonstrate these outcomes via modeling the direct and indirect job creation associated with the expansion of ECE and its attendant effects on raising the employment rate of women, reducing gender pay disparity, lowering the incidence of income poverty, and diminishing the degree of income inequality. Using a methodology that is mostly similar to the Levy studies, the Women's Budget Group in the UK examined the impacts of expanding a variety of public care provisioning (including ECE) in a group of industrialized nations and emerging economies (De Henau et al. 2016; De Henau, Himmelweit, and Perrons 2017). The findings from these studies also echo the outcomes reported in the Levy studies, thus highlighting the importance of expanding ECE as an integral part of macroeconomic policies that seek to improve gender equity and achieve greater social justice.

We propose a framework to further the research described above as well as related studies (see, e.g., Fontana and Elson 2014). We integrate some of the themes in a unified analytical framework that is novel in that it enables the investigation of the gendered economic processes and outcomes at the microeconomic and macroeconomic levels, taking into account intersectoral linkages and external constraints such as balance of payments that are particularly important for many developing nations, including Ghana and Tanzania. The sections that follow describe the analytical framework, empirical methodology, and results from the estimation.

In the next section (section 2), we discuss the current state of the road network and ECE in Ghana and Tanzania. We also delineate the policy initiatives in place and goals enunciated by the governments. We then identify the goals in the two domains that we believe are appropriate to each country. Crucial to this identification is the relevance and informational constraints that are peculiar to each country. We also had to take into account the tractability of modeling the relevant effects of achieving the policy goals. The public expenditures required to achieve the goals are then derived. We used the time use surveys for each country (Ghana Time Use Survey 2009, and Integrated Labour Force Survey, Time Use Module 2006 for Tanzania) to econometrically assess the relationship between the policy interventions and time allocation, the

details of which are presented in appendix A. The results from that modeling exercise are discussed in a summary form in section 2.

We turn then to the specification and estimation of our macroeconomic model in section 3. All the earlier studies on the macroeconomic impacts of expanding ECE that we cited above use employment multipliers (the number of jobs created by an additional dollar, or some other monetary unit, of expenditure on ECE) derived from input-output data that provides comprehensive information regarding technological interdependencies in an economy. While this is a sound approach to obtaining reasonable estimates regarding the impact on employment, it does not shed much light on how other macroeconomic variables, such as the trade balance, may change as a result of the policy interventions. For example, road improvements may require imported machinery and raw materials in addition to domestically produced inputs and labor. Thus, pursuing this goal to reduce commuting time and time spent on household production may place demands on the foreign exchange reserves of the country and affect the exchange rate. Such demands may not be possible to meet for a country with problems of external indebtedness and limited policy autonomy due to agreements with international lenders. A full macroeconomic assessment should provide information about such impacts for several important reasons, most prominent among them being that the feasibility of the proposed intervention may depend on them. Accordingly, we develop our macroeconomic model based on a richer (than the input-output table) source of information: the social accounting matrix (2013 for Ghana, and 2015 for Tanzania; see descriptions below). Once the model is specified, we use it to assess the macroeconomic impacts of the additional public expenditures required for the policy interventions that we estimated in section 2.

In section 4, we discuss the measurement framework and empirical methodology that we deployed in analyzing the impact of the policy interventions on time and consumption poverty. The measurement framework is identical the one used in our earlier study on time and consumption poverty in the two countries (Zacharias et al. 2018). In section 4.1, we discuss the impacts of the policy interventions on the parameters and variables of that framework; we then describe our empirical methodology (section 4.2). Our information on individuals and households are derived, as in the previous study, from the statistically matched synthetic files (created for Ghana from the Ghana Living Standards Survey 2012–13 and Ghana Time Use Survey 2009; for Tanzania we used the Tanzania Household Budget Survey 2011/12 and the

Integrated Labour Force Survey, Time Use Module 2006). However, our empirical methodology underwent two significant modifications.

First, we revised our method of estimating the thresholds of household production. The earlier method differentiated the thresholds by the number of children and adults in the household. Our new method accounts separately for the number of younger and older children, and of younger and older adults. We also develop separate thresholds for households in the rural and urban areas. The full details of the new method are provided in appendix B.

The second modification pertains to our microsimulation model. In our earlier study on Ghana and Tanzania, we used this model to construct a counterfactual situation in which those "able and willing to work" from consumption-poor households ended up with jobs that they are most likely to get. For the current study, the total number and types of new jobs are determined by the macroeconomic model. We modified our model to allow for the possibility that the new jobs are available to individuals from consumption-nonpoor as well as consumption-poor households. The macroeconomic model also determines the rates at which aggregate household consumption expenditures change in the rural and urban areas as a result of the policy interventions. To have macro-micro consistency, we had to constrain the changes in household consumption expenditures generated by the additional earnings in the microdata. In contrast, in our earlier study, we assumed that the marginal propensity to consume was equal to one for all households with the newly employed. Given that all the newly employed were from consumption-poor households in that simulation, the assumption was reasonable. These modifications and the model are discussed in detail in appendix C.

In studying the impact of the policy interventions on time and consumption poverty, we found it useful to distinguish between their direct effects and total effects. Road improvements lead to lower commuting time. In our model, this has the direct effect of lowering the thresholds for commuting that apply to all employed individuals. Expanding the availability of ECE reduces the time spent on household production by individuals in households with young children ("beneficiary households"). The direct effect of this reduction is to lower the thresholds of household production for beneficiary households.

Additionally, the expansion of ECE lowers the time spent by females on household production to a greater extent than the time spent by males. The result is a change in the

intrahousehold division of household production responsibilities (i.e., the threshold hours of household production) in beneficiary households.

In sum, the direct effect of policy interventions is to change the time deficits of time-poor individuals. For some, these changes would facilitate a transition out of time poverty. Further, the decline in time deficits (via lowering the monetized value of time deficits) also reduces the consumption poverty line that includes the monetized value of time deficits ("adjusted poverty line"). For some, this decline would facilitate a transition out of consumption poverty. In section 4.3, we discuss the direct effects of the policy interventions on time and consumption poverty.

The policy interventions create jobs and, via the additional earnings, also increase household consumption expenditures. Individuals who get new jobs ("recipients") will naturally alter their time allocation between employment and household production. Furthermore, other individuals in their households ("recipient households") will also, potentially, alter the time that they spend on household production. The result is a new intrahousehold division of household production responsibilities (i.e., the threshold hours of household production) in recipient households.[2] We expect this change to generate changes in time deficits for individuals in recipient households. If the net result for the household is to create time deficits where there were none or add to existing time deficits, the result will be an increase in the adjusted poverty line.

On the other hand, additional employment provides extra income, which also enhances household consumption expenditures. We refer to the resulting changes in time and consumption poverty as "employment effects." When combined with the direct effects described in the previous paragraph, we obtain the total effects of the policy interventions on time and consumption poverty. We discuss the results in terms of total effects in section 4.4.

We summarize the principal findings of the study in the concluding section (section 5).

[2] For recipient households that have young children, the relevant thresholds are thresholds that reflect the direct effect of the expansion of ECE.

2 POLICY INTERVENTIONS

This section aims to provide a detailed discussion of the proposed interventions in social care and physical infrastructure. We place these interventions in the context of existing initiatives and discuss available data sources and their limitations in developing suitable estimates. We then present our methodology and results regarding the cost of the interventions. We conclude by discussing the estimates of the impact of the interventions on patterns of time use.

Tanzania is twice the size of Ghana in terms of its population and four times as large in terms of its territory; however its per capita GDP is only half of the per capita GDP of Ghana, which places Ghana and Tanzania as lower-middle and low-income economies, respectively (table 2-1). Despite being smaller, the length of the classified road network in Ghana is only slightly shorter than in Tanzania, with a larger share of trunk roads, which are equivalent to interstate highways in the United States. The district/urban/feeder roads are the types of (mostly unpaved) roads used most often for commuting and other daily activities, and they account for around 60 percent of all roads in both countries.

The two countries have different systems of pre-primary education. Crèche is officially a part of the preschool education system in Ghana and kindergarten is mandatory for children 4–5 years old (Anyinefa et al. 2014). In Tanzania, the mandatory kindergarten age is between 5–6 years old (PO-RALG 2016).

Table 2-1 Background Information for Ghana and Tanzania

	Ghana	Tanzania
Population	28.21 million (2016)	55.57 million (2016)
GDP	42.69 billion, US$ (2016)	47.43 billion, US$ (2016)
GDP per capita	1,513, US$ (2016)	879, US$ (2016)
Female employment rate	66% (1991), 61% (2007), and 71% (2017)	77.5% (2018)
Life expectancy	61.49 years (2015)	65.49 years (2015)
Pre-primary education	•crèche (0–3 years old) •kindergarten (4–5 years old) Kindergarten mandatory	•kindergarten (5–6 years old) One year mandatory (beginning in 2014)
Official entry age into primary education	6	7
Government expenditure on pre-primary education as a percentage of GDP (%)	0.41% (4–5 year olds)	0.21% (5–6 year olds)
Total land area	238,535km^2	945,087 km^2
Classified road network	71,063km	87,351 km
Trunk	14,873 km	12,786 km
Regional	14,000 km	21,105 km
District, urban, and feeder	42,190 km	53,460 km

2.1 Ghana

2.1.1 Physical Infrastructure: Public Road Network

The Ministry of Roads and Highways is the central agency responsible for the road infrastructure in Ghana. The daily management of the road sector is overseen by three road infrastructure agencies, the road fund management secretariat, and the training center. The Ghana Highway Authority (GHA) is responsible for the administration, planning, control, development, and maintenance of trunk roads and related facilities in the country. The Department of Urban Roads (DUR) is responsible for urban roads (the roads located within designated metropolitan areas), and the Department of Feeder Roads (DFR) is responsible for feeder roads (the roads outside of designated metropolitan areas). The Road Fund Secretariat was established in 1997 by Act 536 with the goal of financing activities such as routine and periodic maintenance of roads and related facilities, upgrading and rehabilitation of roads, road safety activities, and selected road safety projects. Finally, the Koforidua Training Institute is a center that trains professionals (engineers, contractors, consultants, administrative staff, etc.) employed in the road transport sector (Ministry of Finance and Economic Planning 2010; Ministry of Roads and Highways 2014).

The road network in Ghana is classified into three categories: trunk roads (21 percent of the classified network), urban roads (20 percent), and, the dominant category, feeder roads (59 percent). The road condition varies by the road type. As much as 32 percent of the feeder roads are in poor condition (table 2-2), compared to only 14 percent of trunk roads. As of 2009, only 19 percent of the roads were paved.

Table 2-2 Road Network and Conditions in Ghana

	Length (km), 2013	**Share in poor condition (percent), 2013**
Trunk roads (GHA)	14,873	14
Urban roads (DUR)	14,000	19
Feeder roads (DFR)	42,190	32
Total	71,063	
Addendum:		
Percent distribution of roads by type of surface, 2009		
Paved	19	
Unpaved (gravel, earth)	81	

According to the Ministry of Roads and Highways' pilot program–based budget (PBB) for 2013–15, over GH₵368 million are allotted for every year during the three-year period, of which only GH₵87 million were budgeted for maintenance and rehabilitation. Maintenance is usually given a low priority, leading to an increase in roads in poor condition (in that they are not passable in all seasons). Moreover, the poor road condition generally increases travel time that may be associated with time and consumption poverty, both directly and indirectly. Since we aim to assess the impact of road improvement on time deficits, we decided to model the complete repair of all roads in poor condition, while recognizing fully that an appropriate plan for the improvement of road infrastructure will have several other necessary elements.

To assess the cost of the proposed physical infrastructure interventions, we first review several sources of information (table 2-3). The first source is the Road Costs Knowledge System (ROCKS) database, which includes detailed information on the road works projects financed by the World Bank (such as unit costs and the type of technology used), and reveals a large variability in the cost of road construction and rehabilitation across countries. It includes 1993–2008 data for Tanzania and 1984–2008 data for Ghana. The analysis in Collier, Kirchberger, and

Söderbom (2015) that used the ROCKS database reveals a challenge of standardizing unit costs given their considerable variation across countries. The second source was developed as part of the Africa Infrastructure Country Diagnostic (AICD) and Africa Infrastructure Knowledge Program by the African Development Bank (AfDB) and is based on research undertaken during 2007 and 2008. Two publications derived from AICD's work that include standardized unit cost data are "Unit Costs of Infrastructure Projects in Sub-Saharan Africa" (AFRICON 2008) and "Study on Road Infrastructure Costs: Analysis of Unit Costs and Cost Overruns of Road Infrastructure Projects in Africa" (AfDB 2014) (table 2-3, panel A). These studies emphasize that the costs in the AfDB dataset tend to be higher than the costs in the ROCKS dataset (AFRICON 2008, 3). For the early 1990s, Heggie (1995) reports the replacement costs to be US$500,000 per km for a dual carriageway; US$250,000 per km for a main paved road, US$50,000 per km for a main, unpaved (gravel) road; US$250,000 per km for an urban road; and US$50,000 per km for a rural road. More recently, the World Bank (2016, fn 24) provides the following unit costs: US$1 million per km for primary roads (class A, B, and C) to be at least in good or fair condition; US$300,000 for secondary roads (class D and E) to be in good condition; and US$75,000 for tertiary roads to be in good condition. Finally, we supplement these numbers with the 2016 DUR standardized unit cost data for Ghana and the data on the input costs for urban, paved road construction for Tanzania that we obtained during our field investigations (table 2-3, panels B and C).

Table 2-3 Unit Costs of Road Construction and Improvement
Panel A: Cost Estimates from Various Sources, US$

	World Bank (2016, 48)	AfDB (2014, 25)	AFRICON (2008, 3)	Collier, Kirchberger, and Söderbom (2015)
	Cost per km			
Rehabilitation				
Primary road (class A, B, and C), good to fair condition	1,000,000			
Secondary road (class D and E) in good condition	300,000			
Tertiary road in good condition	75,000			
Rehabilitation of paved roads				
<100 lane km, median		180,300		
>100 lane km, median		84,400		
<50km, median			352,613	
>50km, median			299,551	
Regraveling/periodic maintenance of unpaved roads				
<100 lane km, median		9,600		
>100 lane km, median		11,300		
All			15,625	
Periodic maintenance of paved roads				
<100 lane km, median		N/A		
>100 lane km, median		64,600		
All			158,009	
Construction and upgrading of paved roads				
<100 lane km, median		227,800		
>100 lane km, median		147,100		
<50 km, median			401,646	
>50 km, median			290,639	
Asphalt overlays 40 to 69 mm				
Ghana, 1996				52,700
Ghana, 1998				42,900
Tanzania, 1996				111,700
Other categories				
Concrete pavement restoration				539,348
Reconstruction				220,287
Strengthening				139,371
Asphalt mix resurfacing				64,551
Surface treatment resurfacing				25,090
Gravel resurfacing				18,169
Bituminous pavement preventive treatment				7,355

	World Bank (2016, 48)	AfDB (2014, 25)	AFRICON (2008, 3)	Collier, Kirchberger, and Söderbom (2015)
	Cost per km			
Unsealed preventive treatment				4,347
Routine maintenance				2,144
Grading				515
Total				109,930

Panel B: DUR Cost Estimates, Ghana, 2016

Work activity	unit	unit cost (US$, 2016)
Unpaved Road		
Routine (2 frequencies with minor repairs)	km	2,377.30
Routine (1 frequency without minor repairs)	km	1,141.30
Grading only	km	413.86
Spot improvement	km	23,673.53
Regravelling	km	7,745.21
Rehabilitation of gravel road	km	54,973.21
Upgrading of gravel road to single bitumen surface Treatment	km	139,802.09
Upgrading of earth road to gravel road	km	43,019.05
Base and single bitumen surfacing works only	km	138,200.77
Paved Road		
Routine	km	2,595.37
Patching only (with bituminous material)	m^2	0.16
Resealing	km	43,713.38
	m^2	7.29
Resurfacing	km	98 253.22
	m^2	16.38
Town roads	km	282,965.45
Rehabilitation to single bitumen surface treatment	km	311,262.00
Rehabilitation to double bitumen surface treatment (Surface dressing)-slabbed drains and walkway	km	401,664.67
Rehabilitation to single bitumen surface treatment (Surface dressing)-slabbed drains and walkway	km	357,951.30
Upgrading of gravel road to double bitumen surface Treatment	km	183,515.46
Resurfacing plus asphaltic concrete overlay (70mm thick, 8m wide)	km	356,272.01
Reconstruction, asphalt (2x7m wide)	km	2,626,412.69
	m^2	187,600.91

Work activity	unit	unit cost (US$, 2016)
Asphaltic concrete overlay (70mm thick, 8m wide)	km	258,018.78
	m^2	32.25
Construction, asphalt (single carriage)	km	875,470.90
Construction, asphalt (dual carriage)	km	2,013,583.06

Panel C: Input Costs for Urban Paved Road Construction (Tanzanian Shillings [TZS] per km), Tanzania Roads Agency (TANROADS), Tanzania, 2016

	Unit	Unit price
Materials		
Gravel	m^3	29,737
Sand	m^3	35,000
Crushed stone base materials (CRS)	m^3	161,606.43
Chippings (16mm)	m^2	90,000
Chippings (10mm)	m^2	90,000
Prime coat on base coarse (MC30, MC70)	m^2	4,717.52
Resealing surfacing layer, first seal	m^2	9,607.99
Resealing surfacing layer, second seal	m^2	7,189.12
Labor	**(number of work days)**	**(daily wage rate)**
Machine operator (roller, grader, truck, etc.)	day	30,000
Manual laborer	day	10,000
Foreman	day	40,000
Engineer	day	50,000
Surveyor	day	40,000
Skilled laborer	day	16,000
Driver	day	15,000
Machines	**(number of days operated)**	**(daily rental rate)**
Roller	day	1,180,000.00
Graders	day	1,180,000.00
Tipper truck (7–10 tons)	day	354,000.00
Water bowser (9,000 ltrs)	day	472,000.00
Excavator	day	1,416,000.00
Survey equipment	day	47,200.00
Mechanical broom	day	70,800.00
Bitumen sprayer (10,000 ltrs)	day	590,000.00

	Unit	Unit price
Chipping spreader	day	472,000.00
Pickup Landcruiser	day	236,000.00
Overhead	**Unit**	**Unit price**
Provision for compliance	Lump sum (LS)	Varies depending on the size of the contract
Mobilization/demobilization of plant and equipment	LS	Varies depending on the number of equipment to be mobilized
Provision of insurance	LS	Varies depending on the size of the contract
Site establishment and removal	LS	Varies depending on the size of the project
Excavation and laboratory testing	Per set (PS)	Varies depending on the number of tests to be conducted
Provision of information panel	LS	2,000,000.00
Provision for royalties for material extraction	PS	1,000,000.00
HIV/AIDS awareness campaigns	PS	450,000.00

The unit costs vary widely across different sources. In particular, the unit cost of maintenance/rehabilitation of paved and unpaved roads—the item that is most relevant to our research—varies from US$84,400 to as much as US$352,613 per kilometer of rehabilitating paved roads. For unpaved roads, the unit cost ranges from US$7,745 for regraveling for urban roads in Ghana to US$18,169 (Collier, Kirchberger, and Söderbom 2015). Given the wide variety of standard costs for a similar type of road work, we are to choose one for ascertaining the total cost of our proposed intervention. For this study, the unit cost estimates by the AfDB (2014) are used for three reasons. First, the average unit costs of rehabilitation of unpaved roads from this source are similar to the cost of regraveling urban unpaved roads in Ghana. Second, because the information for Tanzania is limited to the construction costs of urban paved roads, the universal unit cost estimates for Sub-Sahara Africa by the AfDB could be a suitable substitute. Third, the cost for rehabilitation of paved roads by the AfDB is lower than other sources, ensuring that our estimates of the effects represent a lower bound to the potential effects. Hence, the total costs for the proposed road infrastructure improvements in both countries are based on the AfDB unit costs.

The proposed intervention is to rehabilitate all roads in poor condition. The total cost of rehabilitation is the product of the unit cost and the number of kilometers in need of rehabilitation by type of roads. Table 2-4 summarizes the proposed intervention and its cost

estimate for Ghana. The feeder roads are the most common type of roads that serve the rural population, and they are either unpaved dirt or gravel covered. Out of over 42,000 km of feeder roads in 2013, 32 percent of them were classified as being in poor condition, which indicates that the road is not passable for some time of the year. The trunk roads are major paved highways connecting all regions in the country, and 14 percent (2,082 km) were in poor condition. The urban roads are a mix of unpaved and paved roads serving the urban population, and 19 percent (2,660 km) were in poor condition. The unit cost of feeder road rehabilitation is an average of the unit costs of regraveling/periodic maintenance of unpaved roads of over and under 100 km. The unit cost for trunk road rehabilitation is an average of the unit costs of rehabilitation of paved roads over and under 100 km. The unit cost for urban road rehabilitation is an average of the unit costs of rehabilitation of paved roads under 100 km and regraveling/periodic maintenance of unpaved roads. We estimated that the total costs of the road rehabilitation amount to US$658.7 million (equivalent to about GH₵1.4 billion), or 1.4 percent of GDP in 2013.

Table 2-4 Total Costs of the Proposed Intervention of Road Improvement, Ghana

	Length (km), 2013	Roads in poor condition (percent)	Kilometers in poor condition	Cost per km (US$)	Cost (US$)
Feeder roads	42,190	32	13,500.80	10,450	141,083,360
Trunk roads	14,873	14	2,082.22	187,450	390,312,139
Urban roads	14,000	19	2,660	47,850	127,281,000
Total	71,063		18,243		658,676,499

The next step in our modeling is to estimate the impact of road improvement on time use patterns. Our approach is to exploit the regional variations in road conditions across the country. Specifically, we use the regional data on the current share of roads in good condition and estimate, using an econometric model, the elasticity of time spent on unpaid activities with respect to this share after controlling for a variety of other factors that affect the time spent, such as the number of children in the household. In the next step, we used the estimates from the model to quantify the impact of raising the share to a target percentage (e.g., 100 percent) on time allocated to household production activities.

Regional data on road conditions are required to implement our strategy. The government publication *Transport Indicators Database Report* (MRH 2011) presents regional data on road

conditions in the form of a breakdown by the type of road (paved, unpaved, trunk, feeder, etc.). For trunk and regional roads, these estimates come from the GHA's Annual Road Condition Survey. The GHA conducts the Annual Road Condition Survey between March and April of each year, during which each of the 2,400 segments of the network are rated for distress and roughness.

> Distress is measured via a "Windshield" visual road condition survey. In this survey, raters traveling in a slow-moving vehicle (at about 30km/h) observe the road surface for distresses and determine their severity and extent based on guidelines set by the GHA. The raters also disembark from the vehicle and inspect distressed sections on foot to get more detailed measurements of slight distresses (e.g., cracks), which are not visible from the moving vehicle. Roughness is measured using a RIDEMATE device, installed in a vehicle, which measures the severity of bumpiness in a given road segment. These two measures are combined to produce an annual condition score (0 to 100) for each road segment. Harding (2015)

However, according to the communication with Robin Harding, who used the data in his analysis of the relationship between road conditions and voting (Harding 2015), these numbers are not publicly available.[3]

We utilized the data from the National Household Transport Survey conducted in 2012 to measure regional disparities in road conditions. The survey asks every respondent a question regarding access to an all-season, passable road within two kilometers of their residence. Based on the responses to this question, we estimated the percentage of the population with access to an all-season, passable road within two kilometers of their home (table 2-5). As it demonstrates, whereas 90 percent or more of households in each region live within two kilometers of such a road, on average only 77 percent of households have the within-two-kilometer access to an all-season, passable road (in Upper East region, only 40.1 percent do).

[3] Another source of data is the World Bank–managed geocoded roads database for Ghana. The dataset covers the roads overseen by the GHA (21 percent of the classified road network) and refers to the year 2008. We decided to choose an alternative source of information, described above, because of the incomplete coverage of the dataset. The data is available at https://datacatalog.worldbank.org/dataset/ghana-roads-0. Another resource utilizing geocoding includes The Centre for Remote Sensing and Geographic Information Services at the University of Ghana, Legon, and their Ghana eMapping & Monitoring System for development activities (GHEMMS) project. Also, Research4cap has conducted several studies of the road conditions, including one that includes Ghana as a case study. In that study, high-tech approaches were used to measure the condition of about 150 km of roads in Ghana.

Table 2-5 Access to Roads, by Region, Ghana

	Households with roads within 2 km of their residence (percent)	Households with passable roads within 2 km of their residence (percent)
Ghana	**95.8**	**76.6**
Western	97.6	81.6
Central	98.4	78.7
Greater Accra	100.0	71.9
Volta	96.7	87.1
Eastern	95.6	78.3
Ashanti	92.8	78.6
Brong Ahafo	92.0	75.8
Northern	95.2	84.9
Upper East	89.9	40.1
Upper West	94.6	56.6
Addendum:		
Urban	99.2	90.7
Rural	93.0	66.6

Source: National Household Transport Survey (2012)

It is reasonable to think that there is a close link between reducing the percentage of roads in poor condition and increasing the access to an all-season passable road for the majority of households. Due to the lack of better information, we assumed that there is a one-to-one correspondence between the two to arrive at a measure of regional disparities in road conditions. Thus, our proposed policy intervention is to increase the share of roads in good and fair condition to 100 percent. It is relevant to note in this context that close to half of rural households in Ghana indicate that bad roads are the main transport problem they face (table 2-6).

Table 2-6 Incidence of Transportation Problems Faced by Households (percent), Ghana

Type of transportation problem	Households
Difficulty getting to school, all seasons	7.0
Difficulty getting to school, wet season	11.2
Bad roads, the main difficulty in going to the workplace	51.6
Bad roads, the main obstacle for going to the market	64.1
Bad roads, the main transport problem faced by households:	40.9
Urban	30.6
Rural	48.1

Source: National Household Transportation Survey (2012)

We integrated the information on regional disparities in road conditions into the time use survey for Ghana conducted in 2009. Our strategy was to assess the impact of the variations in road conditions on different aspects of time use. The details of these econometric investigations are discussed in appendix A. The conclusion that emerged from this exploration was that the most robust and reasonable impact was that on time spent on commuting by employed persons. We expect commuting time as well as the elasticity of commuting time to road improvements to differ systematically between those who are employed full time (40 hours or more per week) versus part time. Based on this consideration, we estimated separate Tobit models for full-time and part-time workers, the results of which are reported in appendix A, table A-2. Apart from the regional variations in road conditions, we also controlled for household size and composition, the relationship of the individual to the household head, and age and education of the individual. Our results show that commuting time is negatively correlated with the percentage of households in the region with access to passable roads in fair or good condition.

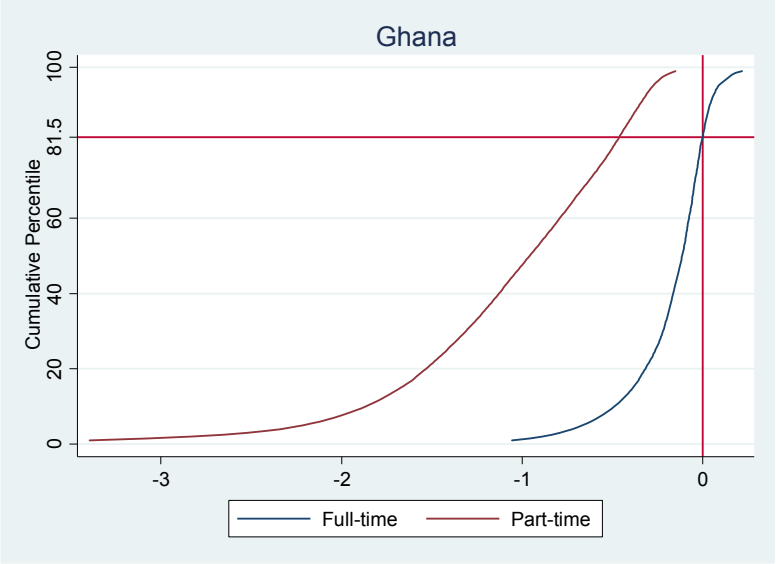
As noted in the introduction and discussed in section 4.1, changes in the time spent on commuting affects time deficits because it changes the threshold for commuting or standard commuting time (see equation 4.1). We found that the improvement of road conditions does not affect the commuting time substantially for full-time workers in both urban and rural areas (table 2-7). For part-time workers, the impacts are substantial, especially in rural areas, with an average reduction of 1.1 hours (or 19 percent). This sizeable drop may be attributed to the fact that a significant share (32 percent) of feeder roads are deemed to be in poor condition, as we noted above (table 2-4). The hours of employment and location may be correlated with each other in that part-time employment may be more prevalent in rural areas with poor road conditions than in rural areas with good road conditions. This correlation may be reflective of the underlying poor economic conditions of rural areas, which in turn would negatively affect road conditions. Regardless of the direction of causality, it is clear that the effect of road rehabilitation would most benefit rural part-time workers in terms of their time spent on commuting.

Table 2-7 Direct Effects of Road Improvements on Commuting Time (average weekly hours), Ghana

	Full time	Part time
Baseline		
Urban	7.0	3.2
Rural	8.4	5.7
With direct effects		
Urban	6.9	2.7
Rural	8.2	4.6

Figure 2-1 shows the cumulative distribution of the individual-level effect of the intervention on commuting time.[4] The horizontal axis denotes the number of weekly commuting hours reduced by the intervention, and the vertical axis denotes the cumulative percentile of individuals. Overall, the road rehabilitation lowers the commute time of 100 percent of part-time workers, compared to 81.5 percent of full-time workers. This finding indicates that the positive impact is driven by the pervasive benefit of rehabilitation, not by a small number of outliers.

Figure 2-1 Cumulative Distribution of Reduction in Commuting Time by Road Rehabilitation (weekly hours), Ghana



[4] The estimation of the confidence intervals of the impacts of the proposed policies on time use components uses a Monte Carlo–type simulation method to obtain the distribution of the predicted change in hours of household production conditional on individuals having any positive amount of time spent on household production or commuting time. This is done for two reasons: first, standard statistical software provides standard errors of the predicted latent variable, but not for the predicted hours of commute; second, we are interested in measuring the range of predicted variation in the impact of the policies at the individual level instead of the aggregate level.

2.1.2 Early Childhood Education

In identifying the scope for the proposed childcare expansion intervention, we first establish the current needs and constraints in Ghana. More than one-third of households in Ghana have children 0–4 years old (GSS 2012).[5] About 96 percent of primary providers of childcare are women (Maxwell et al. 2000). Qualitative and quantitative research on Ghana establishes a strong imperative for mothers to work to provide for their children (Anyidoho and Steel 2016; Maxwell et al. 2000).[6] Moreover, evidence suggests that women who have children tend to work more hours than women without children and that, based on findings from the Ghana Household Urban Panel Survey 2004–13 (Heath 2017), when women become mothers they tend to switch to self-employment due to its greater flexibility.

What childcare arrangements are used by working mothers of young children in Ghana? Several sources indicate that more than half of working mothers in Ghana with children under four years old look after their children themselves (Maxwell et al. 2000), close to a quarter use relatives as caretakers, and, in some cases, children are left alone. About 16 percent of respondents in the Ghana Living Standards Survey (2012) reported having left a child under five years of age alone in the past week, and another 8.5 percent reported leaving the child with another child younger than ten years old (GSS 2012; this document also has a breakdown by region). For our analysis, we highlight that fewer than 10 percent of working mothers use a crèche or other childcare centers for children 0–3 years of age (GSS and Macro International 1994; Maxwell et al. 2000).[7]

How are employed mothers able to combine work with childcare? About a quarter of employed mothers with children younger than four years old worked from home, and close to half of them brought children to work with them sometimes or always. Only 20 percent of working mothers never brought their children to work (GSS and Macro International 1994). In households with a coresident woman, mothers are more likely to choose less flexible but more

[5] In the United States, 7 percent of households have children 0–3 years old, according to US Census Bureau (based on the American Community Survey [2011]).
[6] Maxwell et al. (2000) uses the 1998 study of households in Accra.
[7] The utilization of formal childcare in Ghana was somewhat higher than in other Sub-Saharan African countries between 1990 and 1994, although the practice of a woman taking care of the child herself was widespread in all of them. Based on the 1995–2002 analysis of the Demographic and Health Surveys (DHS) of 31 developing countries, 39 percent of employed mothers with young children in the countries bring their children to work, 26 percent use relatives, 12 percent use another female child, and 4 percent use organized childcare/nursery (United Nations 2015).

lucrative jobs that do not allow them to bring young children to work (DeRose 2007). Over the last several decades, job growth appears to have taken place in the sectors compatible with care. As a result, increases in the employment rate in Ghana were associated with the rise in breastfeeding rates, unlike what has been seen elsewhere (DeRose 2007). This evidence suggests that alleviating the constraints imposed by care responsibilities may enable women to enter occupations and industries that may be less flexible but better remunerated.

As table 2-8 indicates, only about 11 percent of children 0–3 years old are enrolled in childcare in Ghana. It is notable that in Ghana, ECE is formally considered as preschool education and is separated into crèche (0–3 years old) and kindergarten (4–5 years old), the latter being free and compulsory.

Table 2-8 Basic Facts about Crèche Conditions in Ghana, 2013

	Crèche (for 0–3 year olds)	
Crèche enrollment rate (percent)		10.6
Enrolled in private crèche (percent)		90.6
	Public	**Private**
Trained teachers (percent)	34	4.5
Pupil-to-teacher ratio	34	27
Pupil-to-trained-teacher ratio	99	600
Schools with toilets (percent)	67	88
Schools with classrooms in need of major repairs (percent)	9	4

As part of the government initiative making kindergarten education free and compulsory, the government has established seven training colleges that specifically train teachers to work in the ECE sector, and two public universities also offer ECE-specific training. In addition to training new teachers, some projects, such as the Untrained Teachers Diploma in Basic Education (UTDBE), funded through the Global Partnership for Education (GPE), have focused on upgrading teachers' skills.

Some cost assessments of childcare provision focus on government expenditures on ECE, evaluating measures such as government spending per pre-primary student, which in 2014 was 91 in purchasing power parity (PPP) dollars (US$32) in Ghana, corresponding to about GH₵153 (2014 exchange rate: GH₵4.77 = US$1). However, government spending per pre-primary student is channeled through teacher salaries, and capitation grants to preschools do not account

for additional revenue sources of public preschools and are not directly linked to the cost of providing ECE.

To circumvent the data limitations, we collected cost information in a survey of 100 childcare centers in the metropolitan area of the capital city of Accra with the cooperation of the International Child Resource Institute, Ghana (ICRI). With a permit from the Ghana Education Service and consent from school supervisors before the survey, we worked with a team of ten field workers and their supervisor, and conducted a training workshop and field visits. The survey took place over a month and a half, from mid-January until the end of February 2017. Interviews were conducted in 100 schools from 10 districts. As many as 90 sites were integrated with kindergarten, primary, and low-secondary schools (a typical business model aimed at strong student enrollment and retention) and the remaining 10 sites offered exclusive crèche and nursery services for children ages 0–3. As table 2-9 demonstrates, the exclusive crèches are smaller, have a lower child-to-teacher ratio, and a smaller share of teachers with a college degree. They are also more expensive in terms of the annual fee, as well as the average cost per child, which is between three and five times as high as government spending per pre-primary student.

Table 2-9 Summary Statistics Based on Fieldwork Covering Childcare Centers, Ghana 2017

	Exclusive crèche (n=10)	**All (n=100)**
Average number of children	58.1	91.7
Average number of teaching staff	5.6	8.1
Children-to-teacher ratio	10	12
Share of teachers with a college degree	5.6	8.3
Average per child cost (GH₵,2016 exchange rate = GH₵4.17 /US$1)	822	515

Our proposed intervention is to raise the enrollment rate for 0–3 year olds to 31 percent and to have childcare centers with at least one teacher with university education. Our benchmark is South Africa, in which the pre-primary enrollment rate for children 0–4 years old was 31 percent in 2015. In the context of Ghana, the enrollment level in 2014 was 334,400 children and the target enrollment level is 947,443 children. To measure the total cost of reaching the target, we need the average cost per child at a facility with at least one teacher with a university

education. We estimated the average cost from our survey of childcare centers to be GH₵515. Since this estimate is for Accra, we adjusted it by the implicit spatial price deflator for urban and rural areas. In conjunction with the additional number of children that would have to be enrolled in the urban and rural areas, this leads to a total additional expenditure of approximately GH₵312 million (table 2-10) or about 0.12 percent of Ghana's GDP in 2015. Putting these numbers into context, the current spending on pre-primary education of children between 4–5 years of age in Ghana is 0.41 percent of Ghana's GDP and 1.5 percent of government expenditures. The additional expenditures on very young children (0–3 years of age) that we propose amount to roughly half of the amount that the government is currently spending on 4–5 year olds.

Table 2-10 Total Costs of Expanding ECE, Ghana

	Number of children	Total costs (million GH₵)	Total costs as a percent of 2015 GDP
Currently enrolled	334,400	170.5	0.12
Additional children to enroll (ages 0–3)	613,043	312.1	0.22
Rural	346,751	175.0	
Urban	266,292	137.1	

We expect that increased availability of childcare will be taken advantage of by households with very young children. Consequently, a reallocation of time by the members of such households ("beneficiary households") is very likely to emerge. The reallocation would affect not only the time spent on childcare but also several other tasks of household production, given their interdependence (Suh and Folbre 2016). In assessing the impact on time allocation, we followed the same methodology that we employed for evaluating the effects of road improvements, i.e., exploit regional variations in the availability of childcare along with time use data. Our information regarding regional disparities in the availability of ECE is for 2014–15. We estimated the enrollment rate in crèches by region and used this as our measure of regional disparity (table 2-10).

Table 2-11 Enrollment Rate in Crèches by Region, Ghana 2014–15

	Enrollment	Total number of children, 0–3 years old	Enrollment rate (percent)
Ashanti	84,011	625,322	13.4
Brong Ahafo	30,742	296,586	10.4
Central	43,318	298,443	14.5
Eastern	33,631	319,284	10.5
Accra	65,454	408,298	16.0
Northern	17,441	324,083	5.4
Upper East	6,807	121,710	5.6
Upper West	4,417	87,743	5.0
Volta	15,443	263,675	5.9
Western	33,135	311,121	10.7
Ghana	334,399	3,056,265	10.9

Source: Ghana Annual Schools Census, 2014–15

We know that the average time spent on household production is markedly different between the sexes, with girls and women spending more time on average than boys and men. It is reasonable to expect that the responsiveness of the time spent on household production to the increased availability of ECE will differ systematically among these groups based on sex and age. To account for these potential differences, we estimated separate Tobit models for girls, boys, women, and men in beneficiary households. The results are reported in appendix A, table A-1. We used a richer set of controls than those employed for the commuting regression model. In addition to the standard age and education characteristics, we also include controls for job characteristics, marital status, proxies for household bargaining structure (including relative age between husband and wife, and relative education), household size and composition, overall household consumption/income, and access to public services (e.g., electricity). We also control for the average distance to public services, including health facilities, primary and secondary school units, and the nearest market. Our results show that time spent on household production is negatively correlated with the regional enrollment rate in crèches for girls, women, and men.

Table 2-12 shows the impact of the expansion of early childhood care services on time spent on household production. Before the intervention, girls and boys spent, on average, 22.3 and 10.6 hours a week on household production, while women and men spent 36.1 and 10.6

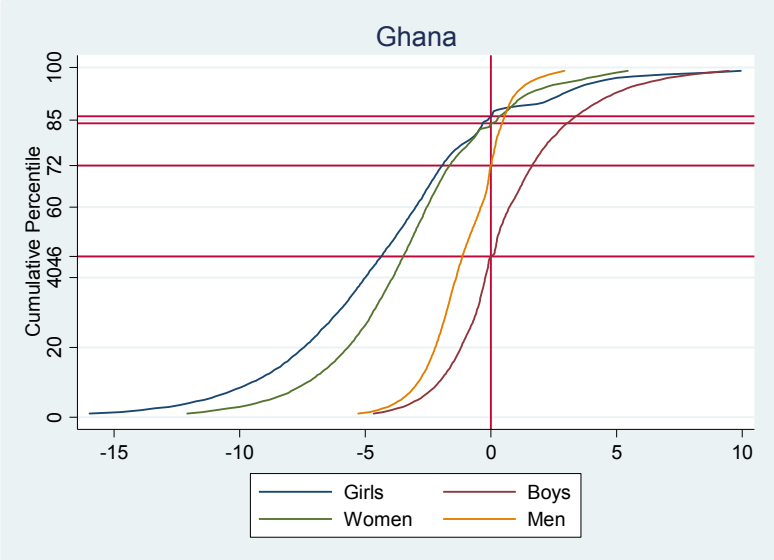
hours a week. The intervention would reduce the hours, on average, by 5.1 and 3.0 hours for girls and women, while the impact is smaller for boys and men, with a reduction of -0.5 and 1.2 hours. The gendered impact is reflective of the current care responsibilities borne out mostly by girls and women. Looking at the incidence of childcare also highlights gender inequality. More than 97 percent of girls and women reported having spent time on childcare, while 73.8 and 52.3 percent of boys and men have done so. The cumulative distribution of the impact on an individual level in figure 2-2 further highlights the gendered impact. It indicates that 86 and 84 percent of girls and women would experience a reduction in household production of between zero and 15 hours a week in response to the expansion of the care service. For men and boys, 72 and 46 percent would benefit from the intervention. Those who would not benefit, on the other hand, would spend more time on household production in response to the expansion, regardless of gender.

Table 2-12 Average Weekly Hours of Household Production, Before and After the Intervention, Ghana

	Girls	Boys	Women	Men
Baseline	22.3	10.6	36.1	10.6
With direct effects	17.2	11.1	33.1	9.4
Reduction	5.1	-0.5	3.0	1.2

Source: Authors' estimates.

Figure 2-2 Cumulative Distribution of the Reduction in Time Spent on Household Production (weekly hours), Ghana



2.2 Tanzania

2.2.1 Physical Infrastructure: Public Road Network

The national road network that includes trunk and regional roads is overseen by the Ministry of Works, Transport, and Communication (MoWTC) through the Tanzania National Roads Agency (TANROADS). The remaining network of urban, district, and feeder roads had, until the summer of 2017, been under the responsibility of the Prime Minister's Office of Regional Administration and Local Government (PMO-RALG) and is now under the President's Office of Regional Administration and Local Government (PO-RALG). In July of 2017, a new agency, the Tanzania Rural and Urban Road Agency (TARURA), located in Dodoma, was formed to oversee these roads. The Roads Fund allocates funding to TANROADS and TARURA at 70 and 30 percent, respectively.

The classified road network in Tanzania is comprised of trunk roads (15 percent); regional roads (24 percent); and district, urban, and feeder roads (61 percent) (table 2-12). Hence, in Tanzania trunk roads are a somewhat smaller share of the classified network than in Ghana, where the share of trunk roads is 21 percent. Also, the unclassified road network length is about 56,500km (Workman 2017). Hence, about 40 percent of the total road network length in Tanzania is unclassified.

Table 2-13 Road Network and Conditions by Agency in Tanzania

	Tanzania (All roads, AICD)	**TANROADS (source: Workman 2017)**	**PO-RALG**
Area	945,087 km2		
Classified road network	87,351 km	33,891	53,000
Trunk	12,786 km	12,786	
Regional	21,105 km	21,105	
District, urban, and feeder	53,460 km		53,000
Unclassified			56,500 (receive no funding)
Paved	19% of national 2% of district	11,000 (32.5%)	

Source: Gwilliam et al. (2009); Workman (2017); PO-RALG (2016).

The data on road conditions is scarce for the country because a household transportation survey has not been conducted. Instead, we use the data generated by the World Bank, namely the AICD (Gwilliam et al. 2009). The data is a compilation of the administrative data provided by the road agencies and the analysis of satellite images of roads to determine their condition. Table 2-13 shows the length of unpaved feeder, community, and urban roads by type and condition by region, excluding paved highway, regional, and urban roads. The exclusion is intended to focus on the intervention that may be relevant to those most vulnerable to hardships imposed by poor road conditions, in particular concerning their commuting. The original quality classification includes good/fair conditions in addition to poor condition. We modify this classification. The poor condition is reclassified to include gravel roads in poor conditions and all dirt roads (i.e., both in poor and good/fair condition).[8]

[8] Note that the data is missing for Dar es Salaam, as the original data excluded the city. We imputed the value for the length of poor roads in Dar es Salam. We assume that the percentage of roads in good condition is the maximum of all regions and the percentage of roads in poor condition is the minimum of all regions, in an attempt to underestimate the length of the poor roads in the city. As a result, 468 km of mixed gravel and dirt roads are designated as "poor" roads in Dar es Salaam.

Table 2-14 Length of Roads by Type and Condition by Region, Tanzania

Region	Gravel	Dirt	Poor roads (%)	Poor roads (km)
Dodoma	312	1,509	60	1,092
Arusha	487	703	48	570
Kilimanjaro	480	1,453	66	1,278
Tanga	366	1,848	75	1,658
Morogoro	335	1,256	74	1,177
Pwani	57	407	73	337
Dar es Salaam	-	-	-	468
Lindi	196	1,288	76	1,124
Mtwara	127	1,225	76	1,027
Ruvuma	115	531	63	408
Iringa	500	1,880	47	1,118
Mbeya	568	1,515	59	1,230
Singida	273	1,226	66	985
Tabora	226	1,610	58	1,058
Rukwa	511	1,312	66	1,202
Kigoma	137	636	42	327
Shinyanga	596	1,122	57	975
Kagera	610	883	33	499
Mwanza	473	1,529	77	1,542
Mara	316	630	63	599
Manyara	192	1,395	75	1,186
Tanzania	6,878	23,960		19,859

Source: Gwilliam et al. (2009)

The intervention that we model for Tanzania also involves the rehabilitation of all poor feeder roads in the country. The caveats that we noted earlier in our discussion of road improvements in Ghana, especially about the rehabilitation of poor roads being an essential ingredient though just one component of a comprehensive program for improving road conditions, also apply here. The unit cost for rehabilitation of feeder roads is US$10,450 per km—the same unit cost of rehabilitating unpaved feeder roads used in the case of Ghana (see table 2-4). We derive the total cost of the intervention as the product of the unit cost and the length of poor roads, which amounts to TZS329 billion or 0.47 percent of Tanzania's GDP in 2013. The cost of rehabilitation of all roads, including paved trunk and regional roads, should be much higher than the proposed amount. For instance, in the 2014/15 budget, the MoWTC was allocated TZS1.2 trillion (US$730 million, or 1.5 percent of Tanzania's GDP) for maintaining

and improving the road network in Tanzania. The difference in the cost and the budget highlights the government's priority of connecting all regions in the country rather than on improving feeder roads alone.

To assess the impact of road improvements on the time spent on commuting, we followed the same strategy that we employed for Ghana, namely, to combine information on regional disparities in road conditions with the Tanzanian time use data from 2006. The information on regional disparities was already shown above in table 2-13. The database contains several local sources, including the Road Maintenance Management System (RMMS) and the District Road Management System (DRMS). The RMMS is a database system that provides a repository for information on the road network and is administered and managed by TANROADS. The survey is done using a laser deflectometer and a falling weight deflectometer, which provide a laser profile of the paved road, as well as using visual inspections of unpaved roads (Workman 2017, 10). The DRMS is a database system for the Annual District Roads Inventory and Condition Survey that is supposed to be undertaken every year, commencing on August 1 and ending by the November 30 (Ministry of Works of the United Republic of Tanzania 2014, 9). In this system, a hand-held GPS is used to gather data on the road conditions from the center of the line. The Improvement of the Roads Maintenance System (DROMAS) aims to include all of the classified and unclassified roads maintained by PO-RALG and to be done with this process by the end of 2017 (Workman 2017, 11).[9]

We estimated separate Tobit models to quantify the responsiveness of full-time and part-time workers to road conditions, the results of which are reported in appendix A, table A-4. Our controls included variables for household size and composition, the relationship of the individual to the household head, and age and education of the individual. We found that conditional on the control variables, persons in regions with better road conditions tend to spend less time commuting than persons with worse road conditions.

Our measurement framework for time poverty captures the changes in commuting time on time deficits via the change in the threshold for commuting (section 4.1, equation 4.1). The

[9] These two databases (RMMS and DROMAS2) have been merged by the World Bank and made available in geocoded format at http://162.243.57.235/#download-761. Another geospatial resource, although with somewhat outdated data, is from the Food and Agriculture Organization (formerly http://www.africover.org, which is now http://www.fao.org/geonetwork/srv/en/main.home). For Tanzania, the data from the Food and Agriculture Organization is either for 2002 or 1997.

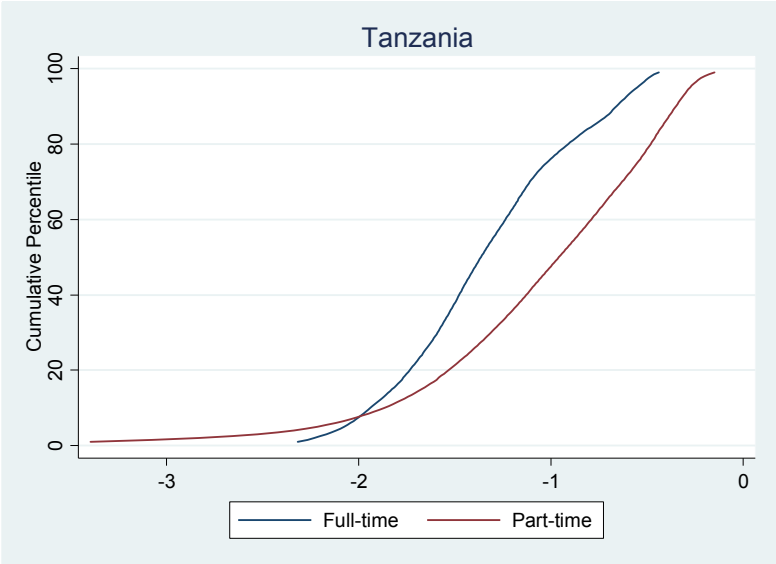
thresholds for commuting time for workers in rural and other urban areas decrease by around one hour per week, or 14–16 percent. On the contrary, the thresholds for workers' commuting time in Dar es Salaam go down only by about 30 minutes or less. This small decline in the city may be attributed to the underestimation of poor roads, as mentioned above. We found that the impact is stronger in the rural areas than in urban areas by 0.2–0.3 hours per week, indicative of the poor state of road infrastructure being a stronger constraint in the rural areas than in urban areas.

Table 2-15 Direct Effects of Road Improvements on Commuting (average weekly hours), Tanzania

	Full Time	Part Time
Baseline		
Dar es Salaam	8.4	3.9
Other urban	7.7	5.8
Rural	9.5	7.5
With direct effects		
Dar es Salaam	7.9	3.6
Other urban	6.6	4.9
Rural	8.2	6.3

Figure 2-3 shows the cumulative distribution of commuting time saved for full-time and part-time workers. The time saved among the full-time workers is concentrated between one and two hours (blue line), with 80 percent of the full-time workers experiencing more than a one-hour saving. Meanwhile, the time saved among the part-time workers is spread over a broader range, with only half of them saving more than one hour.

Figure 2-3 Cumulative Distribution of Reduction in Commuting Time by Road Rehabilitation (weekly hours), Tanzania



2.2.2 Early Childhood Education

In deciding on the early childhood sector intervention in Tanzania, we placed two considerations at the forefront. One was the availability of data, which is much more limited than in Ghana, and the second was the appropriateness of the intervention in the context of Tanzania's current childcare landscape and current goals of the government.

There is a complete absence of systematic data on the enrollments in childcare centers or childcare arrangements for children ages 0–4 years old, either from administrative data or from household or labor force survey data. Several surveys could, in principle, be used for obtaining the data on enrollment rates of young children, such as the Labor Force Survey (for 2014), the Household Budget Survey (for 2011–12), or the National Panel Survey (for 2012–13). However, all of them only report data for children ages five years and older. Another possible source of data is the DHS, which was most recently done in Tanzania in 2015–16. Unfortunately, recent surveys do not have information that is relevant to us any longer.

In contrast, the DHSs conducted in the 1990s had a question of potential interest: "While you are working, do you usually have your child with you, sometimes, rarely, or never." It reveals that in 1996, 47 percent of working women indicated that they usually bring their child with them to worksites. If we count mothers who reported to have brought their children with them sometimes, the percentage goes up to 72 percent (Kishor and Neitzel 1996). Thus, despite

the lack of direct evidence on the childcare utilization patterns, the scant available evidence suggests that childcare needs may be a constraint for a considerable portion of women in Tanzania.

Other than the information above, we have no national or regional data on the enrollment rates of children ages four and younger. The field survey of childcare centers that we conducted shows that 11 percent (1–2 year olds), 66 percent (2–3 year olds), and 96 percent (3–4 year olds) of centers in the greater Dar es Salaam had children ages 1–3 years old enrolled. It is, however, unrealistic to impute the enrollment rates for the whole nation using the field survey. The lack of information on the nationwide enrollment rates of children ages 0–4 years prevented us from modeling the impact of extending care services to this group of children as we did for Ghana. In Tanzania, appropriate data is available for children ages 5–6 years old and, hence, in the interest of modeling a tractable policy intervention, we focus on the expansion of pre-primary education to this group of children.

For the age group of our interest, we use three sources of enrollment data. The first source is the annual educational census that contains information on pre-primary enrollments of 5- and 6-year olds. We combine these data with the data from the 2012 population census. This allows us to obtain net enrollment rates in pre-primary schools by region and district. The second source of regional enrollment rate data is from the World Bank (2012), and the third source is the Education for All (EFA) report for Tanzania mainland by UNESCO (2014). Table 2-15 shows the national enrollment rates by different sources.

Table 2-16 Mean Enrollment Rates, Tanzania

Indicator	Source	Rate (percent)
Gross enrollment	World Bank (2012)	44.0
Gross intake for 5-year olds	UNESCO EFA (2014)	44.0
Gross enrollment	Tanzania Five-Year Development Plan 2011/12–2015/16 (PO-PC 2011)	33.4
Net enrollment	Our calculations for 2012	36.0

There is substantial regional variation in enrollment rates. The net enrollment rate varies from only 14 percent in Dar es Salaam to 54 percent in Mtwara according to the 2012 school census (table 2-16). Almost all (98 percent) pre-primary students are enrolled in government schools, and there is gender balance in the enrollment rates. For the estimation of the impact of

the expansion on time spent on household production, we exploit the regional variation, as we do in the case of Ghana.

Table 2-17 Enrollment Rates by Region, Tanzania (percent of children 5–6 years old)

Region	World Bank (2012) Gross enrollment rates, pre-primary	2012 School Census Net enrollment, pre-primary	UNESCO EFA (2014) Gross intake for 5-year olds
Tanzania	44.0	36.0	44.0
Arusha	38.0	39.5	47.6
Dar es Salaam	19.0	13.8	15.7
Dodoma	43.0	42.6	47.3
Geita		40.5	51.1
Iringa	70.0	53.0	45.3
Kagera	46.0	44.7	48.9
Katavi		19.3	38.9
Kigoma	25.0	20.2	32.3
Kilimanjaro	42.0	47.5	52.0
Lindi	40.0	36.9	43.5
Manyara	32.0	31.2	38.8
Mara	58.0	48.4	58.6
Mbeya	45.0	40.2	53.8
Morogoro	35.0	31.0	37.8
Mtwara	49.0	54.3	53.7
Mwanza	90.0	37.5	38.6
Njombe		25.7	65.3
Pwani	31.0	30.4	35.7
Rukwa	26.0	25.9	38.5
Ruvuma	58.0	49.2	52.5
Shinyanga	28.0	19.8	34.1
Simiyu		31.6	60.4
Singida	51.0	44.2	38.9
Tabora	31.0	26.0	32.6
Tanga	73.0	41.6	55.6

We conducted a field survey of one hundred childcare centers in all five districts of the metropolitan area of Dar es Salaam. We cooperated with the ICRI-Kenya and Zubeida Tumbo-Mazabo and Neema Kitundu at the Forum for African Women Educationalists (Tanzania chapter) and obtained a research permit from the Tanzania Commission for Science and Technology. We worked with a team of ten field workers and their supervisor and, before the survey implementation, conducted a training workshop and field visits. The survey took place between April and May 2017. Table 2-17 shows some of the basic statistics of 91 early childhood care (ECC) centers that provide only ECE and 9 integrated centers with primary education.

Table 2-18 Summary Statistics Based on Fieldwork Covering Childcare Centers, Tanzania 2017

	91 ECC	**9 Pre-primary+**
Average number of children (0–6 years old)	58.9	138.9
Average number of teaching staff for 0–6 year olds	3.3	10.7
Ratio of children to teacher	20.8	16.5
Share of teachers with a college degree	0.3 (17% has at least one)	1.1 (33% has at least one)
Average per child cost, in TZS (TZS2,177/US$1, 2016)	396,663	432,093

It appears that the average number of children in ECC centers in Dar es Salaam is similar to what we observe in Accra in exclusive crèches, but the average number of children in the nine pre-primary schools integrated with primary schools is much higher than the equivalent number of 91.7 in Accra (table 2-9). However, the ratio of children to teachers is twice as high in Dar es Salaam, whereas the share of teachers with a college degree is much smaller. The average cost per child in exclusive crèches is TZS396,663 or about US$182 and in integrated schools TZS432,093, or about US$198. Hence, the average per child cost tends to be higher in Tanzania than Ghana. To ascertain the total costs of the expansion of ECE, we choose to use the average cost per child of TZS396,663 in the 91 stand-alone ECC centers, as the cost per child of the integrated schools may include the cost for students in the primary schools. This per-child cost may be an overestimation of the actual cost of providing early education for 5–6 year olds, as caring for younger children costs more in general. On the other hand, the higher per-child cost of the integrated schools may suggest otherwise. Given the lack of alternative information, we

proceeded with our original estimate of TZS396,663. Since this is an estimate for Dar es Salam, we adjusted it by the implicit price deflators to obtain the estimates of per child costs for urban and rural areas.

The current poverty reduction strategy in Tanzania is encapsulated in table 18 of the National Strategy for Growth and Reduction of Poverty II (a.k.a. the MKUKUTA II document [Ministry of Finance and Economic Affairs 2010]). The stated goals in this document related to the childcare policy intervention that we are modeling are:

i. Early childhood development (ECD) facilities and the number of young children prepared for schools increased;
ii. Universal access for boys and girls to quality pre-primary and primary education achieved (net enrollment rate to be increased to100 percent for pre-primary and primary);
iii. Quality teachers trained, deployed, and retained to achieve recommended students-to-qualified-teacher ratio to be attained at different levels: primary=1:45, secondary=1:25, and pre-primary=1:40

Table 2-19 Operational Targets, MKUKUTA II

Operational Targets	Cluster Strategies	Intervention Packages	Key Actors
2.1.1. ECD and the number of young children prepared for schools increased	A.1. Effective implementation of integrated ECD policies	Community awareness on ECD issues (parental knowledge on nutrition and HIV/AIDS mainstreaming)	MCDGC,CSO, FBO
2.1.2. Universal access for boys and girls to quality pre-primary and primary education (100 percent enrollment rates for pre-primary and primary)	A.2. Rehabilitate and expand school infrastructure, especially ECD centers, construction of classrooms, laboratories, and dormitories for secondary schools that are also accessible to students with disabilities	classrooms, dormitories, and laboratories	MEVT, PMO-RALG, MFEA, private sector
	A.3. Achieve recommended inclusive classroom density at ECD, primary, and secondary education levels and building/renovation of classrooms	adequate desks/chairs	MEVT,PMORALG
	A.5. Improve hygiene and sanitation especially access to water, gender-friendly sanitation, and hygiene facilities that are also accessible to children with disabilities and ensuring achievement of recommended (pit) latrine ratio	water, hygiene	MWI, parents, community, MEVT, CSOs
	A.6. Implement school feeding programs at all levels in public schools with community involvement.	school meal programs	MEVT, PMO-RALG, communities
	A.9. Achieve appropriate/ recommended textbook-student ratios at pre-primary, primary and secondary education levels	textbooks, pricing, taxation regulation on publishers	MEVT

Notes: MEVT (Ministry of Education and Vocational Training); PMO-RALG (Prime Minister's Office–Regional Administration and Local Government); MCDGC (Ministry of Community Development, Gender, and Children); CSO (civil society organization); FBO (faith-based organization); MWI (Ministry of Water and Irrigation).

With the above targets in mind, our proposed intervention entails raising the net enrollment rate in pre-primary education for 5–6 year olds to 100 percent. Our findings suggest that the proposed intervention will cost 0.71 percent of the Tanzanian GDP (table 2-19). As a point of comparison, in the case of Ghana, the cost of the proposed ECD expansion (which included an increase in enrollment and improvement in the quality for 0–3 year olds) was 0.53 percent of GDP.

Table 2-20 Total Costs of Expanding ECE, Tanzania

Category	Amount or Share
Total population of 5–6 year olds in mainland Tanzania (2012 census)	2,755,525
Enrollment rate in 2014 (Nat'l five-year development plan)	37.8
Total number needed to enroll to reach 100 percent enrollment rate	1,705,168
Current cost @ TZS330,337 per child, or US$152	335.1 billion TZ
Intervention cost @ TZS396,663 per child	563.3 billion TZ
Current 5-year ECE budget in US$, 2016–21	67.5 billion TZ
Current 5-year ECE and primary budget in US$, 2016–21	871.8 billion TZ
Tanzania GDP, 2016	47.43 bill US$
Proposed intervention as a percentage of Tanzanian GDP	0.71

The next stage in our modeling is to ascertain the impact of the ECE expansion on time spent by persons in beneficiary households (i.e., households with children in the relevant age group) on household production. We employed the same strategy as we did for Ghana (i.e., to incorporate the information on regional disparities in enrollment rates with the time use data to estimate the responsiveness of time spent on household production to changes in enrollment rates). We estimated separate Tobit models for girls, boys, women, and men in beneficiary households, and the results are reported in appendix A, table A-3. The set of controls used in the regressions included some of those that were used for the Ghanaian models, namely age and education characteristics; variables for job characteristics and marital status; proxies for household bargaining structure (including relative age between husband and wife, and relative education); variables to represent the household size and household composition; and overall household consumption/income. However, unlike in the case of Ghana, we did not have information on the access to public services (electricity) and average distance to public services (e.g., health facilities) because the time use survey for Tanzania did not contain such information. We found that the time spent on household production is negatively correlated with

the regional enrollment rate in ECE for girls and women. A positive correlation emerged for boys and men, though the associated coefficients were not statistically significant. With the target rate of 100 percent enrollment, we estimated a fairly large decline in the time spent on household production by girls and women (3.2 and 6.9 hours a week, respectively), as they are likely to be the primary caregivers. Hence, as in the case of Ghana, the gendered impacts are reflective of the underlying gender inequality in household production, including childcare.

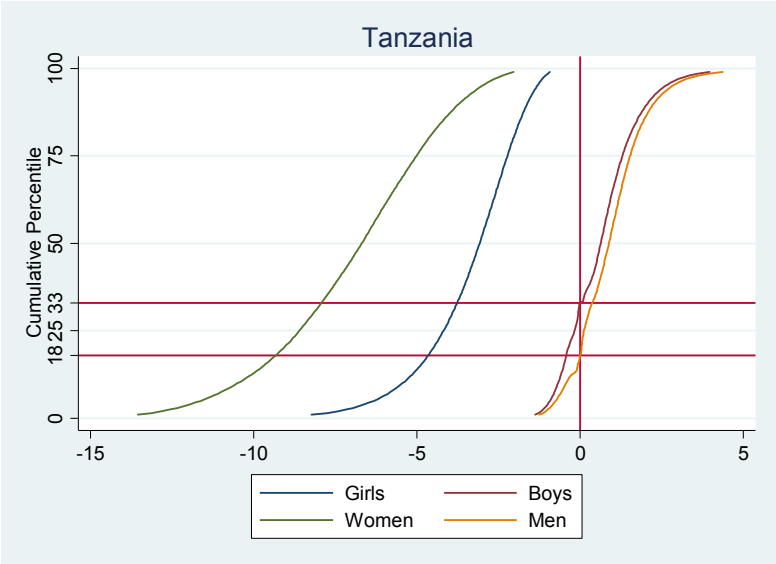
Table 2-21 Average Weekly Hours of Household Production, Before and After the Intervention, Tanzania

	Girls	Boys	Women	Men
Baseline	18.0	10.6	35.5	10.3
With direct effects	14.8	11.1	28.6	11.0
Reduction	3.2	-0.6	6.9	-0.7

The cumulative distribution of the change in household production time demonstrates the potential positive impact of the service expansion on girls and women (figure 2-4). The impact is spread over 2–14 hours for women and 1–9 hours for girls, with 47 percent of them having a higher-than-average amount of time saved. On the other hand, only one-third of boys and 18 percent of men would experience the reduction, and the rest would spend more time on household production in response to the expansion, though only marginally in most cases.

The large impact on girls and women may be indicative of their childcare responsibilities occurring simultaneously with other household activities. For instance, due to childcare responsibilities, they might have chosen to stay at home and have engaged in other household activities as well. Once the care responsibility is removed, girls and women would spend time outside their home and engage in nonhousehold activities more so than their counterparts.

Figure 2-4 Cumulative Distribution of Reduction in the Time Spent on Household Production (weekly hours), Tanzania



3 MACROECONOMIC IMPACTS

This section presents the computable general equilibrium (CGE) model that we used for our simulations. As in any CGE model, we start with a discussion of the social accounting matrices (SAMs) that were used as the primary database and defined the structure of the model. We explain how we aggregated these matrices for the two countries. Besides the aggregation, we made two other significant changes. First, we distinguished between capitalist and noncapitalist sectors. Second, we added a synthetic care sector. We also explain the structure of the model and the main closure assumptions. As opposed to most of the literature, we adopt a Keynesian closure, where an increase in investment and more generally in demand is accommodated through an endogenous adjustment of output with the saving rate remaining constant. Finally, we present the main macroeconomic implication of the two policy options we propose.

3.1 Social Accounting Matrices (SAMs)

Our model for Ghana utilizes the 2013 SAM for the economy of Ghana published by the Ghana Statistical Services, the Ghanaian Institute for Statistical, Social and Economic Research, and the International Food Policy Research Institute (IFPRI) (2017). The SAM also serves as the primary

database for the model. Similarly, we used the 2015 SAM published by the IFPRI for the economy of Tanzania (Randriamamonjy and Thurlow 2017).

3.2 Capitalist and Own-Account Sectors

The first step toward building a CGE model is the specification of the institutional structure of the economy. Institutions and social relations of production shape macroeconomic processes and outcomes. In economies like those of Ghana and Tanzania, the private sector is populated mainly by own-account producers (self-employed, including unpaid family workers), with capitalist units that employ wage labor (both corporate and unincorporated) constituting only a minority. Outside of the private sector, there are public enterprises and agencies of general government that provide public services (e.g., healthcare).

The SAMs for the two countries do not provide information that would facilitate the separation of capitalist and own-account units in the private sector industries. However, the SAM does give a breakdown of the gross value added in each industry among labor, land, and capital. Since the private sector is populated mainly by own-account producers, it is impossible to arrive at such a breakdown for every activity without imputations of income that accrues to each of the "factors of production."[10] Since the employment of wage and salary workers is perhaps the most defining characteristic of capitalist production, we chose to use *the share of imputed labor income in the total labor income* of each industry as a proxy for the prevalence of capitalist production. Since no amount of labor income will be imputed in an industry with only capitalist units and all of the labor income will be imputed in an industry with no capitalist units, the proxy is inversely related to the prevalence of capitalist production relations. However, some arbitrary cutoff will have to be chosen for several industries. In what follows, we describe the steps we took for Ghana; the process and the eventual separation of the sectors were similar for Tanzania.

Our use of the proxy is best described in terms of its behavior among the broad sectors of the economy (table 3-1). In Ghanaian agriculture as a whole (consisting of 22 industries), the value of the proxy is only 3 percent, confirming the well-known fact that agricultural production

[10] This statistical procedure with respect to the division of national income is motivated by the marginal productivity theory of distribution and obscures the differentiated structure of production relations in a peripheral economy. Unfortunately, the documentation of the SAM does not provide any information on how the imputations were carried out.

is carried out mainly by peasant producers rather than capitalist farms. We therefore characterize the entire agricultural sector as own-account production.[11]

Turning to manufacturing (made up of 18 industries), 9 industries had values less than 40 percent for the proxy. We considered these industries as characterized by capitalist production. The remaining 9 industries had values exceeding 74 percent for the proxy. We categorized them as own-account manufacturing.

The construction sector (with a single industry) had a value of 52 percent for the proxy and we consider it as a capitalist sector. The utilities sector had two industries and was mostly characterized by wage labor, since the providers are mainly public sector enterprises. The mining sector, with two industries, also had a very high incidence of wage labor and we consider it as a capitalist sector, even though the production of crude oil is carried out by public enterprises. The rationale is that in spite of public ownership, the fortunes of the enterprise and its workers are intimately tied to the conditions of the world oil market (over which the Ghanaian state has little control), unlike the public sector enterprises that provide utilities.

The services sector is constituted of eleven industries in the SAM. Of these, we consider three as belonging to the public sector with only wage employees. The remaining eight industries are split equally among capitalist production and own-account production segments. Similar to the case of manufacturing, the industries classified in the category of capitalist production had values that were less than 43 percent for the proxy (three out of four had values less than 8 percent). Those in the own-production category had values that were higher than 48 percent for the proxy (three out of four had values exceeding 84 percent).

[11] The reason for the less-than-100-percent value in agriculture is mainly due to the prevalence of substantial wage labor in two industries: poultry and forestry. Together, they account for a little less than 10 percent of the aggregate value added in agriculture.

Based on the above, we could map each industry in the SAM to one of the following sectors:

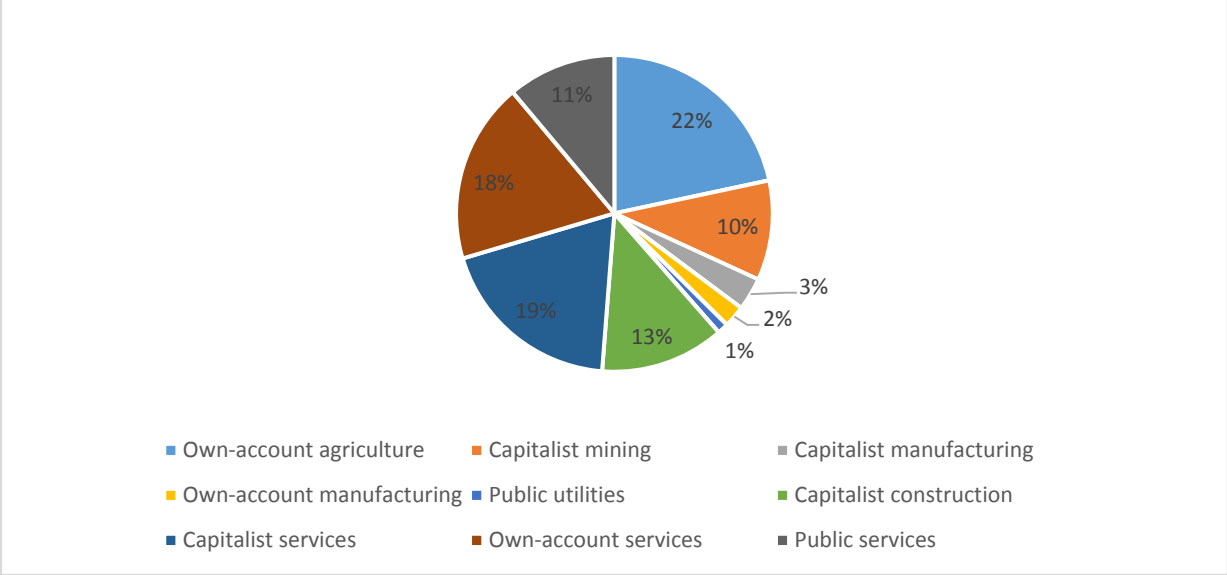
1. Own-account agriculture
2. Capitalist mining
3. Capitalist manufacturing
4. Own-account manufacturing
5. Capitalist construction
6. Capitalist services
7. Own-account services
8. Public utilities
9. Public services

The distribution of gross value added in 2013 across the sectors is shown in figure 3-1 and details can be found in table 3-1. Almost 90 percent of the entire gross value added in 2013 is split nearly evenly between the capitalist and own-account sectors. The remainder is mainly accounted for by public services. Because of the very small size of the public utilities sector, we eventually chose to merge it with public services.

Table 3-1 Mapping between the Industries in the SAM and Sectors (percentage of gross value added in aggregate gross value added), Ghana

Code	Sector/Industry name	Share in gross value added	Code	Sector/Industry name	Share in gross value added
	All industries	**100.00%**		**Own-account manufacturing**	**2.23%**
	Own-account agriculture	**21.65%**	meat	Meat, fish, and dairy	0.06%
maiz	Maize	2.30%	foil	Fats and oils	0.32%
sorg	Sorghum and millet	0.73%	gmll	Grain milling	0.49%
rice	Rice	0.96%	food	Other foods	0.28%
puls	Pulses	0.23%	beve	Beverages	0.38%
gnut	Groundnuts	0.41%	clth	Clothing	0.12%
oils	Other oilseeds	0.73%	leat	Leather and footwear	0.01%
cass	Cassava	1.54%	nmet	Non-metal minerals	0.44%
root	Other roots	2.00%	oman	Other manufacturing	0.13%
vege	Vegetables	2.88%		**Public utilities**	**1.12%**
sugr	Sugar cane	0.03%	elec	Electricity, gas, and steam	0.46%
toba	Tobacco	0.01%	watr	Water supply and sewage	0.66%
cott	Cotton and fibers	0.09%		**Capitalist construction**	**12.70%**
frui	Fruits and nuts	2.78%	cons	Construction	12.70%
coco	Cocoa	2.31%		**Capitalist services**	**19.15%**
coff	Coffee and tea	0.00%	trn	Transportation and storage	11.58%
ocrp	Other crops	0.08%	comm	Information and communication	1.90%
catt	Cattle	0.50%	fsrv	Finance and insurance	3.61%
poul	Poultry	0.54%	bsrv	Business services	2.06%
oliv	Other livestock	0.36%		**Own-account services**	**18.50%**
fore	Forestry	1.69%	trd	Wholesale and retail trade	6.14%
fish	Fishing	1.49%	hotl	Accommodation and food services	5.90%
	Capitalist mining	**10.20%**	real	Real estate activities	2.07%
coil	Crude oil	8.96%	osrv	Other services	4.39%
omin	Other mining	1.23%		**Public services**	**11.10%**
	Capitalist manufacturing	**3.35%**	padm	Public administration	6.20%
fveg	Fruit and vegetable processing	0.05%	educ	Education	3.79%
sref	Sugar refining	0.02%	heal	Health and social work	1.11%
ptob	Tobacco processing	0.01%			
text	Textiles	0.22%			
wood	Wood and paper	0.56%	*Addendum:*		
petr	Petroleum	1.23%		Capitalist sector	45.39%
chem	Chemicals	0.76%		Own-account sector	42.38%
metl	Metals and metal products	0.45%		Public utilities	1.12%
mach	Machinery and equipment	0.05%		Public services	11.10%

Figure 3-1 Distribution of Gross Value Added by Major Sector, Ghana



In terms of the SAM, the above categorization means that in the own-account sectors the amount of the value added that is attributed to capital or land (in agriculture) is distributed among the various kinds of labor in proportion to their own shares in aggregate labor income. To keep the SAM consistent, these adjustments require equiproportionate changes to the payments of the factors to the institutions (households and enterprises).

3.3 Inclusion of an ECE Sector

In this section, we explain the method applied to include a childcare sector account into an existing SAM that is designed to delineate the economic structure of a country by compiling market transactions of goods and services among firms, households, and government in a double-entry accounting practice. In the modeling of the multiplicative impact from sectoral linkages, it is crucial to use accurate data on the input composition of the sector that the policy intervention seeks to expand (in our case, the ECE sector). Such information is not available in the SAM. We constructed this information from the field surveys of childcare centers (described in section 2) in Ghana and Tanzania.

The primary objective of the field survey was to collect operational cost structure information to construct an input-output account of the ECE sector. There are 20 items in the survey that interviewees (limited to school managers or principals) were asked to respond to as percentage shares. The shares were added up immediately following the response at the site, and,

if the sum was off by more than 10 percentage points, the interviewee was asked to review and revise their response accordingly. Additionally, the total annual expenses of a center—and average annual fee per student—were collected, and estimation of the expenditure and revenue of the ECE provision could be completed with the information.

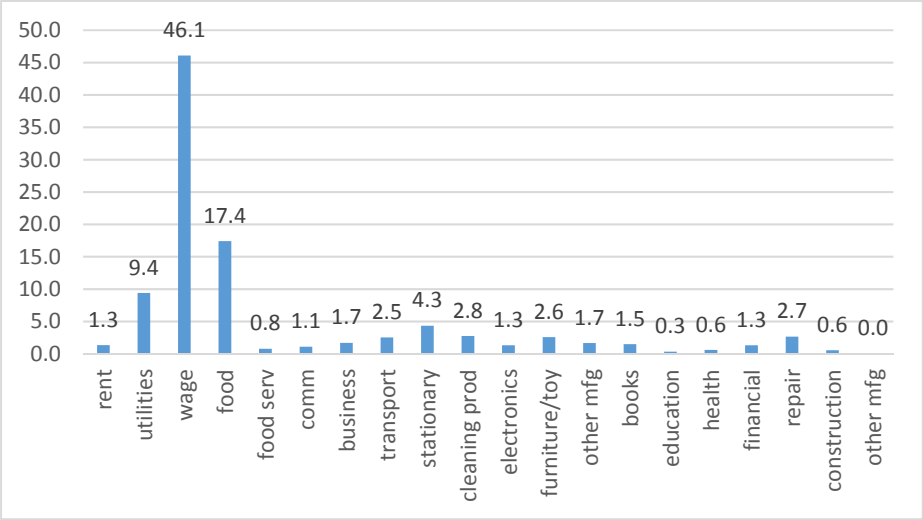
The secondary objective was to collect background information, such as student enrollment status and personal characteristics of teaching and nonteaching staff, to gain insights into the operation of the ECE centers. The collected information includes the composition of students by age; composition of teaching and nonteaching staff by occupation, sex, age, and marital status; and educational attainment of the staff.

3.3.1 Ghana

The original SAM for Ghana 2013 is compiled by the IFPRI, with an emphasis on representing diverse agricultural production. The information on the ECE sector is not explicitly present in the matrix. It is possible that some childcare centers were captured in a business census on which input-output accounts were based. Even so, the information might be aggregated into a relevant sectoral account, in this case health and social works activities, and it is not feasible to disaggregate the information to construct a separate childcare sectoral account. Hence, the input composition, per-child cost, and current enrollment information from the survey and publicly available data are used to construct the input-output account of the sector.

To construct the intermediate input account, expenditure on 20 items from the survey are mapped to 58 commodities classified in the SAM. Most of the agricultural goods (except other foods and beverages) are excluded in the mapping, as the detailed food items were not collected in the survey. The expenditure on intermediate inputs is denoted in purchasers' prices that include trade and transport margins and indirect taxes associated with the expenditure. It is necessary to convert the information in purchasers' prices to basic prices—which excludes the margins and indirect taxes—in the SAM. The price conversion is conducted using the 2004 supply table with the accompanying price conversion table for each commodity in the SAM. The trade margins are reallocated to the whole/retail sale sectors, and transport margins are reallocated to transportation and storage services. The indirect taxes, including the value added taxes, are allocated to the government's tax revenue. The input composition of childcare centers in Ghana as a percentage of total expenditure is presented in figure 3-2.

Figure 3-2 Input Composition of Childcare Centers in Ghana (percent of total expenditure)



Expenditure on labor is recorded in the survey, which amounts to 41 percent of total expenditure on average. The wage bill is then decomposed by the level of educational attainment of workers—less than primary, primary, secondary, and university—following the classification of labor in the SAM. In addition, the labor accounts are decomposed by rural and urban areas in the SAM. The spatial decomposition is not recorded in the survey, as the scope of the survey was limited to the greater Accra region. Hence, it is assumed that the expenditure on workers in the childcare sector follows the spatial distribution of the current enrollment of children in preschools recorded in the Ghana Annual School Census for 2012–13. The census indicates that 48.7 percent of children 3–5 years old enrolled in preschools were residing in rural areas, while the remaining 51.3 percent were in urban areas. This spatial breakdown also assumes that the student-to-teacher ratios in both areas are the same, which may result in overcounting of workers in rural areas. We should note that the spatial distribution of our target age group, 0–3 year olds, is not available from the census data and, hence, we use the preschool enrollment rate.

The survey did not inquire about operating surplus or profit to minimize the chances of nonresponses. Instead, one of the expense items is a write-in item, asking for any other important input items not listed in the questionnaire and its share. On average it amounts to 0.6 percent of total expenditure. Though an actual profit margin may be higher than that, as the childcare centers interviewed in the survey were all private entities, the low rate of 0.6 percent was chosen to be our imputed value.

The wage payments made by the childcare sector are distributed to various household accounts by following the distribution of labor income by location, education of workers, and their household income recorded in the SAM. The capital income of the sector is distributed across enterprise accounts associated with rural nonfarm and urban households.

The value of the gross output of the childcare sector is a product of the average per-child cost from the survey and the number of children 0–3-years old enrolled in crèche from the education census. The per-child cost is estimated to be GH₵515 per year per student. For rural areas, the cost is deflated using a composite regional price index of 0.98. According to the census, there were 344,400 young children enrolled in crèche, among which 163,000 were in rural areas and the remaining 171,000 were in urban areas. As a result, the imputed value of the gross output of the childcare sector amounted to GH₵170.5 million in 2013.

The final consumption of the ECE is distributed across various household accounts by location (urban/rural), farm/nonfarm, and household income quintile for each location–farm/nonfarm household group. In total, 15 household accounts spend part of their income on childcare services and receive some of their earnings from the sector as well. The consumption of the ECE is assumed to follow the spending on education by household type in the SAM. The imputed gross output of the sector in rural areas is proportionately distributed among ten rural farm/nonfarm household accounts. Similarly, the imputed gross output of the sector in urban areas is distributed across five urban household accounts. It is also assumed that the government spends the amount it receives as tax payments from the childcare sector's activity (i.e., indirect tax payments from the intermediate input expenditure described above) on childcare service. The treatment of the government's expenditure on childcare is intended to account for enrollment in public crèche/nursery schools, which account for approximately 10 percent of total enrollment, according to the census.

These steps describe those taken to include the childcare sector account in the existing SAM for Ghana. The discrepancies stemming from the inclusion are balanced using a cross-entropy approach.

We determined the cost of expanding ECE by multiplying the per-child cost with the number of children necessary to reach the policy target of a 30 percent enrollment rate in both rural and urban areas, amounting to approximately 346,000 and 266,000 children, respectively

(see section 2 for details). As a result, the estimated GH₵312 million is the additional amount necessary for meeting the policy goal.

3.3.2 Tanzania

The original SAM for Tanzania 2015 was compiled by the IFPRI with an emphasis on representing various agricultural production activities. In total, there are 70 sectoral accounts, along with 13 factor accounts; 15 household accounts by location, farm/nonfarm, and household income quintile; and other accounts. In the case of Tanzania, the information on the childcare sector for children 5–6 years old is aggregated into an education sector account. To overcome the data shortage, a field survey of 100 childcare centers within the greater Dar es Salaam region was conducted in 2017. The input composition, per-child cost, and current enrollment information from the survey and publicly available data are used to construct the input-output account of the sector.

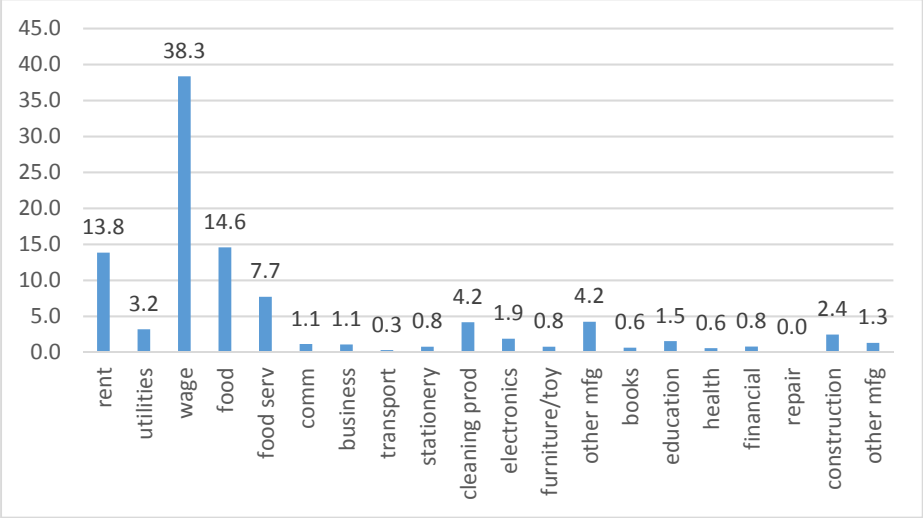
The field survey in Tanzania was designed to collect the same set of information as in Ghana. In the case of Tanzania, the price conversion into basic prices was carried out using the 2007 supply table and the accompanying price conversion table from the National Bureau of Statistics of Tanzania.

The input composition of childcare centers in Tanzania is mostly similar to Ghana. Some of the differences are the slightly lower wage share (at 38.6 percent) and food (at 14.6 percent). Rents account for 13.8 percent of the input composition in Tanzania, which may be reflective of the public ownership of land in the country, as opposed to the private ownership in Ghana.

The steps taken to include the childcare sector into the SAM are identical to the steps described above in the case of Ghana. Some of the technical differences are regional price deflators and the treatment of government expenditure on pre-primary education. The price deflators for Tanzania are specified for three contexts: Dar es Salaam (1), other urban areas (0.93), and all rural areas (0.80). The per-child cost from the field survey is estimated to be TZS396,663 in Dar es Salaam. In Tanzania, the government's role in pre-primary education is quite significant, accounting for 95 percent of total enrollment. In light of the predominant position of government, we assume that the same percent of the sector's gross output is purchased by the government while the remaining 5 percent is distributed across 15 household

types based on their relative share of spending on education as a proxy. Figure 3-3 presents the input composition of childcare centers in Tanzania as a percentage of total expenditure.

Figure 3-3 Input Composition of Childcare Centers in Tanzania (percent of total expenditure)



The current enrollment data is from the Ministry of Education and Vocational Training (2014), and it shows that in total just over one million 5–6 year olds (or an enrollment rate of 37.8 percent) were enrolled in pre-primary schools in the country where over 925,000 children were located in rural areas. As a result, the sector's current gross output is estimated to be TZS335.1 billion. With a target enrollment rate of 100 percent, there needs to be an additional 1.7 million children enrolled at a cost of TZS563.3 billion.

3.3.3 Balancing the SAM

The addition of the care sector created some imbalances in the SAMs of the two economies, despite our effort to adjust as many accounts as possible. For that reason, we used cross-entropy methods to balance the SAM (Robinson and El-Said 2000).

3.4 The Model

The basic structure of the model follows the standard structure of CGE models (Lofgren, Harris, and Robinson 2002). However, our model differs in two significant ways: i) the technology of production; and ii) the closure rules we choose for the realignment between investment and savings.

The usual assumption in the CGE literature is a nested production function for the gross output of each activity. At a higher level, value added is combined with an aggregate intermediate input in fixed proportions. At the lower level, the aggregate intermediate input is the result of the combination of intermediate inputs of various commodities in fixed proportions. Value added itself is produced according to a constant elasticity of substitution (CES) production function using different types of labor and capital as inputs.

For our model, we also chose to model the value added using a Leontief production function. In other words, value added is produced using different types of labor and capital in fixed proportions as inputs. As a result, gross output is produced using intermediate inputs, capital, and labor in fixed proportions. However, we should mention that our results—at least for the scenarios simulated here and the rules of the closure we adopt—do not change significantly due to the different specification of production.

Based on the SAM, we distinguish eight different kinds of labor. These are rural and urban labor, each subdivided into uneducated labor and labor with primary, secondary, and tertiary education. Although the SAM has four different kinds of capital, we decided to aggregate them into just one. Each activity produces only one commodity (hence the distinction between activities and commodities becomes unimportant).

The output of each sector is allocated between exports and domestic sales, assuming that producers maximize their total revenue for any given level of output subject to a constant elasticity of transformation (CET) function; this function expresses the imperfect ability to transform exports into domestic sales and vice versa. Export demand is infinitely elastic at international prices. These export prices are transformed into domestic prices using the exchange rate and adjusted for transaction costs and export taxes. The quantity of output that is not exported is supplied in the domestic market.

Domestic supply and imports are aggregated into a composite commodity using an Armington (1969) function. This is the total domestic supply of each commodity, which is then

equal to total domestic demand. Domestic demand is in turn composed of intermediate demand, consumption on behalf of the households, investment, and government expenditure.

Households are aggregated into two main categories: rural and urban households. Their main sources of funds are income received from the factors of production, and transfers from other domestic institutions (i.e., enterprises and government) and the rest of the world (RoW). Households pay taxes to the government. Consumption demand on behalf of the households for each commodity is determined based on a linear expenditure system (Stone 1954), and the parameters of the system are estimated with information from households budget surveys.[12] The part of household disposable income that is not consumed is saved.

Enterprises receive profits (capital income), which they use for investment, paying taxes, and saving. The government collects taxes and transfers from other institutions. The various tax rates are assumed to be constant. Government also transfers funds to other institutions and purchases commodities (government consumption). In the SAMs for Ghana and Tanzania, government investment is recorded as part of the overall investment. The difference between overall government expenditure and income is equal to government saving.

The transactions with the RoW include trade transactions (exports and imports) as well as income transfers to and from the RoW. The overall balance is the total saving of the RoW.

3.5 Closure Rules

Closure refers to the choice between the endogenous and exogenous variable of the model. As Taylor and Lysy (1979, 15), who first coined the term, emphasized the assumptions regarding the closure of the model have severe implications for the results the model generates. As a result, the modeler "may well be assuming at the beginning of its analysis precisely what he wants it to say!"

[12] The linear expenditure system can be understood based on the so-called Stone-Geary utility function: $U = \sum_{i=1}^{N} m_i \log(C_i - \theta_i)$ where C_i is consumption for commodity i, θ_i is the minimum level of consumption for commodity i, and m_i is the marginal budget share. Consumers derive utility from the difference in consumption from its minimum required level. Solving a standard consumer optimization problem with this utility function results in a set of consumption demand functions $C_i = \theta_i + m_i(D - F)/P_i$ where F is the value of the minimum (or what is called "floor") consumption basket, and D is the level of overall income. For a more detailed discussion, see also Deaton and Muellbauer (1980). In the context of CGE models, the linear expenditure system is discussed in Lluch, Powell, and Williams (1977) and Taylor (1979).

There are four main closure decisions one needs to make. These are related to government savings, the RoW's savings, the functioning of the labor market, and the relation between investment and savings.

The closure rules we have chosen are:

i. Flexible government saving (with fixed direct tax rates).
ii. Flexible foreign savings.
iii. We do not assume full employment. The demand for the factor determines the employment level. Distribution among the various factors is determined according to rules we specify separately for different sectors.
iv. Investment is exogenous. Hence, it is overall savings that adjust endogenously.

In much of the literature (e.g., Lofgren, Harris, and Robinson 2002), when investment is treated as exogenous the saving *rates* of some or all nongovernment institutions adjust to bring savings into equality with investment. As a result, the effect of a shock to demand on output is small.

We implement a more Keynesian closure. The adjustment between the exogenous investment and savings takes place through changes in output, keeping the saving rate constant. In other words, when there is an exogenous shock to demand, output changes to bring savings in line with investment. The multiplier effects of this sort of closure are in line with what one would expect.

Regarding distribution, we make the following assumptions:

a) In capitalist sectors (capitalist manufacturing, capitalist services, and construction) we assume that the nominal remuneration of the various types of labor is given exogenously. The price level is determined based on a constant (exogenous) markup on the unit cost of production, which includes the unit labor cost and the unit cost of intermediate inputs. The markup determines the distribution between labor and capital and the profit rate.
b) In mining, we also assume that the nominal remuneration of the various types of labor is given exogenously. The price level is proportional to the international price. As a

result, the share of profits and the profits rate increases (decreases) as the international price increases (decreases).

c) In own-account sectors (agriculture, own-account manufacturing, own-account services) the nominal remuneration of the various types of labor is given exogenously.

d) In public services, the nominal remuneration of all types of factors is given exogenously.

The consumer price index (CPI) is chosen as the numeraire. Hence, all values changes are relative to the CPI.

3.6 Calibration and Estimation

As we mentioned above, we used the SAM as the main database for each country. Based on the SAM we calculated several parameters (e.g., tax rates, input-output coefficients) that did not change during our simulation.

The parameters for the linear expenditure system that determine the consumption behavior of households were estimated from the household budget surveys of the two countries. Their values are presented in table 3-2. For the childcare sector, because of the lack of data, we used the elasticities of the public services sector.

Table 3-2 Linear Expenditure Model: Income Elasticities

	Ghana		Tanzania	
	Urban	**Rural**	**Urban**	**Rural**
Agriculture	0.7559	1.0299	0.5717	0.6256
Capitalist manufacturing	1.4686	1.1354	1.4160	1.0957
Own-account manufacturing	0.8863	0.7925	0.6877	0.7605
Construction	1.0648	1.3602	1.9563	1.2551
Capitalist services	1.2502	0.9960	1.1398	1.7016
Own-account services	0.8633	1.0501	1.8900	1.8702
Public services	1.3570	1.4011	1.6089	2.0303
Childcare	1.3570	1.4011	1.6089	2.0303

3.7 Scenarios

We simulate three scenarios for each country. In scenario 1, we increase government investment in road construction. In the SAMs for the two countries, government investment is lumped together with private investment in the investment account and is not included in the government consumption account. Hence in scenario 1, we shock investment in the construction sector.

Scenario 2 examines the effects of the increase in government expenditure on ECE. In this scenario, we increase government consumption in the care sector. Scenario 3 combines the first two scenarios. The size of the interventions is presented in table 3-3.

Table 3-3 Magnitude of the Shocks in the Scenarios (in national currency and as a percentage of GDP)

	Ghana		Tanzania	
	Amount	Percent of GDP	Amount	Percent of GDP
Scenario 1	1,405	1.48	329	0.38
Scenario 2	312	0.33	563	0.66
Scenario 3	1,717	1.74	892	1.04

Note: The numbers for Ghana are in million Ghanaian cedis (GH₵) and for Tanzania in billion Tanzanian shillings (TZS).

3.8 Results

The results of our simulation are presented in tables 3-4 through 3-7. Tables 3-4 and 3-5 summarize the results for Ghana, while tables 3-6 and 3-7 present the results for Tanzania. We discuss these results separately for the two countries in the following subsections.

3.8.1 Ghana

Table 3-4 presents the macroeconomic effects of the three scenarios for the economy of Ghana. GDP increases by 3.5 percent, 0.8 percent, and 4.3 percent, respectively, in the three scenarios. Given the magnitude of the shocks to demand, these increases imply multipliers of around 2.35, 2.50, and 2.40.

The increase in GDP is accompanied by increases of a similar magnitude in domestic absorption and consumption. Total consumption increases 3.4 percent, 0.8 percent, and 4.2 percent, respectively, in the three scenarios. The percentage increase in urban consumption relative to rural consumption is higher in scenario 1 than scenario 2. This is not surprising given

that construction is more intensive in its use of urban labor. Also, the construction sector has strong backward linkages to manufacturing, which is also relatively more intensive in urban labor.

Government deficit increases by GH₵982 million, GH₵226 million, and GH₵1,208 million, respectively. Given the magnitude of the intervention, these numbers imply that because of the multiplier effects, the increase in output leads to an increase in government revenue of GH₵418 million, GH₵86 million, and GH₵509 million, which partly compensates for the cost of the programs.

Finally, we see that both exports and imports increase. Exports increase because domestic production increases and more output is available to be allocated between domestic sales and exports (with the use of the CET function). Overall, the trade deficit increases by GH₵184 million, GH₵56 million, and GH₵240 million, respectively. The increase is less than the increase in the government deficit, which implies that the saving of the domestic private sector also increases.

Table 3-4 Macroeconomic Effects in Ghana

		Levels			Changes		
		Scenario			Scenario		
	Base	1	2	3	1	2	3
GDP	93,602	96,882	94,375	97,655	3.505	0.826	4.330
Domestic absorption	98,718	102,183	99,546	103,011	3.510	0.839	4.349
Consumption	61,526	63,590	62,032	64,096	3.356	0.823	4.178
Rural	22,151	22,797	22,360	23,007	2.918	0.944	3.862
Urban	39,375	40,793	39,672	41,090	3.602	0.754	4.356
Gov't balance	-5,893	-6,875	-6,118	-7,100	-982	-226	-1,208
Exports	39,552	40,781	39,857	41,086	1,229	305	1,534
Imports	44,669	46,082	45,029	46,442	1,413	361	1,774
Trade deficit	5,116	5,300	5,172	5,356	184	56	240

Note: The changes for GDP, domestic absorption, and consumption are percentage changes, while the changes for government balance, exports, imports, and trade deficit are level changes. The figures, except for the percentage changes, are in millions of Ghanaian cedis.

Table 3-5 shows the percentage change in the level of output by sector for each of the three scenarios. The largest increases are recorded in the sectors that are directly shocked—construction and childcare. However, other sectors benefit from the increase in demand through backward linkages with the directly affected sectors. It is noteworthy that in scenarios 2 and 3 the percentage increase in the value added of the childcare sector is very large (134 and 139 percent, respectively). The reason for that is that the size of the sector in the SAM is small, hence the demand shock is large relative to it.

Table 3-5 Percentage Change of Output by Sector in Ghana

	Base	Scenario 1	Scenario 2	Scenario 3
Agriculture	19,562	2.926	0.781	3.707
Mining	8,798	3.205	0.728	3.932
Capitalist manufacturing	4,113	3.313	0.803	4.116
Own-account manufacturing	2,161	3.103	0.801	3.904
Construction	10,876	9.181	0.189	9.369
Capitalist services	16,587	3.099	0.917	4.016
Own-account services	15,793	2.752	0.796	3.548
Public services	9,472	0.821	0.279	1.1
Childcare	90	3.836	134.964	138.8

Finally, we should note that the assumption of Leontief technology implies that the percentage changes in the scenario columns of table 3-5 also reflect the increase in the demand for the factors (including labor) that are employed in these sectors.

3.8.2 Tanzania

The results for the Tanzanian economy are presented in tables 3-6 and 3-7. Not surprisingly, the results are analogous to the results for Ghana since the specification of the model is similar.

Table 3-6 presents the macroeconomic effects of the three scenarios for the economy of Tanzania. GDP increases by 0.7 percent, 1.6 percent, and 2.3 percent, respectively, in the three scenarios. Given the magnitude of the shocks to demand, these increases imply multipliers of around 1.9, 2.4, and 2.3. The multiplier effects of the construction shock are slightly lower relative to Ghana.

Total consumption increases at roughly the same rate in the three scenarios. As in Ghana—and because of the same reasons—the percentage increase in urban consumption relative to rural consumption is higher in scenario 1 than scenario 2.

Government deficit increases by TZS233 million, TZS392 million, and TZS625 million, respectively. As in the case of Ghana, this implies an increase in government revenue of around 30 percent of the total expenditures for the intervention, which partly compensates for the cost of the policy interventions.

Finally, we see that both exports and imports increase. Overall, the trade deficit increases by TZS62 million, TZS69 million, and TZS131 million, respectively. As in Ghana, the increase is less than the increase in government deficit, which implies that the saving of the domestic private sector also increases.

Table 3-6 Macroeconomic Effects in Tanzania

		Levels			Changes		
		Scenario			Scenario		
	Base	1	2	3	1	2	3
GDP	85,864	86,493	87,240	87,868	0.732	1.602	2.335
Domestic absorption	90,027	90,718	91,472	92,163	0.767	1.605	2.372
Consumption	52,819	53,177	53,686	54,044	0.678	1.641	2.319
Rural	28,909	29,083	29,435	29,609	0.601	1.820	2.421
Urban	23,910	24,094	24,250	24,435	0.772	1.425	2.197
Gov't balance	297	64	-95	-328	-233	-392	-625
Exports	18,996	19,139	19,305	19,448	143	309	452
Imports	23,159	23,364	23,538	23,742	205	379	583
Trade deficit	4,163	4,225	4,233	4,294	62	69	131

Note: The changes for GDP, domestic absorption, and consumption are percentage changes, while the changes for government balance, exports, imports, and trade deficit are level changes. The figures, except for the percentage changes, are in millions of Tanzanian shillings.

Table 3-7 shows the percentage change in the level of output by sector for each of the three scenarios. The results are similar to Ghana. In both scenarios, the largest increases are recorded in the sectors that are directly shocked, with additional benefits for other sectors as well. Also like in Ghana, the size of the childcare sector in the SAM is small. Hence in scenarios 2 and 3, the percentage increase in the value added by that sector is huge. Finally, for the same

reasons as in Ghana, the demand for the various factors in each activity is proportional to the level of output.

Table 3-7 Percentage Change of Output by Sector in Tanzania

	Base	Scenario 1	Scenario 2	Scenario 3
Agriculture	31,039	0.507	1.261	1.767
Mining	2,927	1.087	0.85	1.938
Capitalist manufacturing	6,464	0.953	1.514	2.467
Own-account manufacturing	6,943	0.618	1.847	2.465
Construction	33,630	1.246	0.195	1.441
Capitalist services	27,344	0.793	1.752	2.546
Own-account services	27,990	0.844	2.325	3.169
Public services	14,271	0.169	0.561	0.73
Childcare	375	0.251	150.776	151.027

4 EFFECTS ON TIME AND CONSUMPTION POVERTY

4.1 Measurement Framework

Our conceptual framework for the measurement of time and consumption poverty has been discussed extensively elsewhere. We will therefore only outline the major elements here.

We start with an equation for the potential time available to a person for employment after setting aside the minimum time necessary for personal maintenance and meeting the responsibilities for household production from the total number of hours in a week:

$$A_{ij} = 168 - M - \alpha_{ij} R_j \tag{4.1}$$

We have denoted the time available to person i in household j as A_{ij}. The time necessary for personal maintenance (sleep, eating, drinking, etc.), denoted by M, is assumed to be uniform across individuals. Time required for the fulfillment of household production responsibilities are specified at the level of the household (R_j) because they are assumed to represent the collective needs of the members of the household; in principle, the identity of the household member should not matter for the task to be performed, although it can matter for the efficacy. The household-level requirements or thresholds of household production are defined as the level of

household production required for a household with income or consumption expenditures around the official poverty line to reproduce itself. However, in multiperson households, the share of household production responsibilities fulfilled by a person (α_{ij}) can be different across persons—most saliently, as a manifestation of the gender inequality within the household.

Generally, an employed person experiences a potential time deficit (X_{ij}) when the hours at the job (L_{ij}) plus the "normal" commuting time (T_{ij}) exceed the time available to them:

$$X_{ij} = \min\left(0, A_{ij} - L_{ij} - T_{ij}\right) < 0 \tag{4.2}$$

Our primary interest in time deficits, as indicated by the thresholds we defined above for household production, is to examine their impact on the household's ability to attain a minimum standard of living. Since that minimum standard of living is generally defined at the level of the household, we need a household-level measure of time deficits. We obtain that by adding up the time deficits of individuals in the household and we indicate that sum as X_j. We consider a household to be time-poor if $X_j < 0$, thus allowing for the possibility that a time-poor household may have individuals with no time deficits.

It is reasonable to suppose that a household with a time deficit is failing to attain a minimum standard of living if it does not have the resources to replace the shortfalls in household production. Official poverty lines implicitly assume that all households either have sufficient time to satisfy their needs of household production or enough resources to meet them via the purchase of market substitutes. We modify the official poverty line by adding the monetized value of the time deficits of the household to its poverty line to lay bare this implicit assumption:

$$P_j^M = P_j^O - pX_j, \tag{4.3}$$

where P_j^M is the modified poverty line, P_j^O the official poverty line, and p the unit replacement cost of household production. Because the modified poverty threshold can only be higher than the official threshold, households that have consumption expenditures below the official threshold will be considered poor by either yardstick. The category of "hidden poor" consists of

individuals in households with consumption expenditures equal to or greater than the official poverty line but lower than the modified poverty threshold:

$$P_j^O \leq C_j < P_j^M \tag{4.4}$$

Our expanded category of poor individuals encompasses the hidden poor in addition to those under the official poverty line, i.e.,

$$C_j < \max\left(P_j^o, P_j^M\right) \tag{4.5}$$

We can now discuss the impacts of policy interventions in terms of our measurement framework. Turning first to the improvement of roads, we had argued in the section 2 that the most significant impact is on reducing the time spent on commuting. The decline in commuting time leads to a fall in the threshold or "normal" commuting time (T_{ij} in equation [4.2]) and therefore to a reduction in time deficits of individuals (X_{ij} in equation [4.2]) and households (X_j). Next, as we demonstrated in the previous section, the proposed expansion of ECE would help reduce the time spent on household production by those in beneficiary households. As a result, the time spent on household production per household will fall—including among those households that are in the reference group for constructing the thresholds for household production because they are also among the beneficiaries. In turn, this will lead to a reduction in the thresholds of household production (R_j in equation [4.1]) for those with young children.[13] The result will be an increase in the time available to individuals in beneficiary households. For those that are employed among them and currently experience time deficits, the increase in available time (A_{ij}) will lead to a fall in their time deficits (see equation [4.2]). How far the reductions in the size of time deficits generated by the policy interventions will go toward reducing the incidence of time poverty is an empirical question that we address later.

The reduction in the threshold commuting time will affect *all* employed individuals, including employed persons in the ranks of the hidden and officially poor. Consequently, those

[13] Furthermore, because the expansion of ECE benefits females more than males, the share of household production responsibilities borne by females will also decline (α_{ij} in equation [4.1]). However, in the case of Ghana and Tanzania, we found this impact to be rather small and, hence, we do not discuss it further here.

in the double bind of consumption and time poverty will experience a fall in the monetized value of their time deficits (pX_j in equation [4.3]) and a fall in the poverty gap (the gap between the poverty line and consumption expenditures of the household). Similar effects are also expected for those in the double bind and benefit from the expansion of ECE. However, the reduction or even elimination of time deficits can facilitate a transition out of consumption poverty only for the hidden poor. Those below the official poverty line will not experience any change in their consumption poverty status since their consumption expenditures will continue to be under the official threshold in spite of any decline in the monetized value of their time deficits. Thus, the direct effect of the interventions on the consumption poverty rate will operate via a reduction in the hidden poverty rate.

The effects that we discussed so far are the *direct effects* of the proposed policy interventions on time and consumption deficits. However, as outlined in section 3, the increased government expenditures associated with the interventions result in changes in employment, earnings, and household consumption expenditures. These changes, in turn, unleash another set of effects on time and consumption deficits that constitute the *indirect effects* of the proposed policy interventions. The primary impetus to the indirect effects stems from the changes in employment. Those who experience a change in their employment status and those who enter into employment can encounter time deficits depending on their hours of employment and commuting (L_{ij} and T_{ij}, respectively; see equation [4.2]). Furthermore, our modeling framework allows for the effects of the changes in the hours of employment on the intrahousehold division of household production responsibilities. That is, the α_{ij}s in equation (4.1) can change for those who experience changes in their hours of employment and for the other members of their household. Changes in the time available to individuals can thus emerge along with changes in their time deficits.

Our discussion of the direct effects of the policy interventions showed that they would generally reduce time and consumption deficits. While the extent to which such reductions would translate into declines in the rates of time and consumption poverty is an empirical matter, it is clear that it is very likely that both types of poverty will fall and we can be certain that neither type of poverty will increase. Unfortunately, no such certainty is available for the indirect effects. It is impossible to know a priori the combined effect of a change in own hours of employment and own share of responsibilities of household production on the time deficit of an

individual who changed jobs or entered into employment. Likewise, it is also impossible to ascertain a priori the effect of a change in the intrahousehold division of household production responsibilities on the time deficit of an individual that lives in a household with a member that changed jobs or entered into employment.[14]

Unlike the uncertain indirect effects on time deficits, the indirect effects on household consumption expenditures are certain: as a result of the additional earnings being added to the household budget, expenditures will increase in households with individuals that have newly found jobs. It is also certain that some of the newly created jobs will accrue to those in households that are either hidden poor or officially poor. Hence, their consumption expenditures will also increase, thus helping them to reduce their poverty gap. However, for some consumption-poor households, the new jobs may very well be accompanied by an increase in time deficits, as discussed above.

Consequently, their poverty line would rise (see equation [4.3]). The additional household earnings may be offset either partially or even completely by the increase in the monetized value of time deficits. As a result, their poverty gap would not show a one-to-one change with respect to household consumption expenditures because the poverty line itself has increased. Thus, while the indirect effect on the household consumption expenditures of a consumption-poor household can be determined a priori, the indirect effects on the same household's poverty status cannot be known beforehand and depend on the particular circumstances of the individual household.

Although the nature of the indirect effects of the policy interventions on an individual household is impossible to predict, we can form reasonable expectations about the averages. Our expectations are partly based on the previous work on simulating the effect of increased *wage* employment in the two countries (Masterson 2018; Masterson and Zacharias 2018). The results indicated that the majority of consumption-poor households that had at least one person receiving wage employment in the simulation were able to escape consumption poverty. At the

[14] Consider the hypothetical example of a married-couple household that consists only of an employed husband and nonemployed wife in the baseline scenario. Suppose that the policy interventions lead to the employment of the wife. If the newly found job requires more time than what is available to her in terms of commuting and hours at the job, she will incur time deficits. Alternatively, the new job may not push her into time deficit, but, if the intrahousehold division of the responsibilities for household production change in her favor, that may push her already-employed husband into time deficit. A third possible outcome is that both the husband and wife incur time deficits in the new scenario. It is also possible that the new scenario leads to neither of them incurring time deficits, with both of them able to strike a perfect balance between household and job responsibilities.

same time, the majority of such job recipients did end up with time deficits; indeed, the incidence of time deficits was especially higher among those who were not able to exit out of consumption poverty in the simulation in spite of wage employment. Our results regarding employment from our macroeconomic simulation (reported in section 3) show an expansion of employment not just among wage workers but also among the self-employed. However, it is reasonable to expect that the findings regarding consumption poverty and time deficits would be similar to our earlier findings. The critical factor behind the reduction in consumption poverty is the growth in earnings, and this does take place in our current simulation. Likewise, the principal determinant behind the high incidence of time deficits among the newly employed is the prevalence of long hours at the job coupled with, for women, the disproportionate share of household production responsibilities. We would expect those factors to be at work in the current simulation, too.

In sum, the direct effects of both policy interventions will be to reduce time deficits and poverty gaps. The indirect effects can, on the other hand, increase time deficits primarily because those with newly found jobs can encounter time deficits. However, the average poverty gap and consumption deficits are likely to decline due to the indirect effects because, on average, the gains from additional earnings tend to offset the increase in the monetized value of the time deficits. We next turn to a description of the empirical methodology used to implement the measurement framework outlined above.

4.2 Empirical Methodology

Our measurement framework imposes specific and substantial data requirements for its implementation. We need good microdata on employment, time allocation, and earnings, as well as information to ascertain poverty status. No single microdata file typically supplies all the required information; we therefore imputed information regarding household production to individuals in the survey used for official estimates of poverty from the time use survey in each country. The imputation procedure was carried out via statistical matching, as discussed in Rios-Avila (2016). In Ghana, this procedure involved statistical matching between the Ghana Living Standards Survey (GLSS) 2012–13 and the Ghana Time Use Survey 2009. For Tanzania, we used the Tanzania Household Budget Survey (THBS) 2011/12 and the Integrated Labour Force Survey, Time Use Module 2006 (details regarding the surveys can be found in Zacharias et al. [2018, table 3-1]).

We estimated time deficits for individuals 15–70 years of age. As outlined in the previous section, the estimation procedure requires the threshold or minimum required hours for personal maintenance, household production, and commuting. The minimum required weekly hours of personal maintenance were estimated as the sum of minimum necessary leisure (assumed to be 10 hours per week), nonsubstitutable household activities (assumed to be 7 hours per week), and the weekly average of the time spent on personal care by individuals aged 15–70 years computed from the time use survey (table 4-1).[15] We assume that these thresholds do not change as a result of the policy interventions.

Table 4-1 Thresholds of Personal Maintenance (weekly hours)

	Tanzania	Ghana
Personal maintenance	**98**	**93**
Personal care	81	76
Sleep	62	61
Eating and drinking	11	11
Hygiene	8	4
Necessary minimum leisure	10	10
Nonsubstitutable household activities	7	7

The thresholds for household production hours of the household represent, as noted in the previous section, the average amount of household production that is required to subsist at the poverty level of consumption expenditures. Our reference group for estimating the thresholds consists of households with at least one nonemployed adult and consumption around the poverty line. Unfortunately, our preferred source of data for estimating the thresholds, the time use survey, did not contain any information regarding consumption or poverty status of households. Therefore, we had to estimate the thresholds from the matched data file because it contains information on consumption expenditures, poverty status, and (imputed) time allocation. We defined households with consumption expenditures not less than 75 percent and not more than 150 percent of their poverty line as subsisting at a poverty level of consumption expenditures. We then selected households with at least one nonemployed adult (a person 18 years or older) from this group to constitute our reference group.

[15] The assumptions regarding minimum requirements of time for leisure and nonsubstitutable household activities are in line with previous studies (Vickery 1977: 32–33).

In our previous work, we arrived at the thresholds by calculating the averages for 12 subgroups of households in the reference group, differentiated on the basis of the number of adults and children, and then setting the calculated averages as thresholds for the same groups of households in the population (Zacharias et al. 2018, 20–22). We adopted a different approach in the present study, as discussed in detail in appendix B. A key motivation behind the revised approach is that one of the objectives of the present study is to assess the impact of improving ECE. The direct impact of that intervention will be on the household production requirements of households with young children. Therefore, it makes sense to have distinct thresholds for this subgroup.

Our estimates are now formed on the basis of a nonlinear regression model that allows the thresholds to be more sensitive to the location and composition of the households. We now differentiate thresholds between rural and urban areas. We also differentiate thresholds on the basis of the number of younger (under 7 years of age) and older (7–18 years of age) children in the household, as well as on the basis of the number of younger (between 18–59 years of age) and older (60 years or older) adults in the household.[16] The model is estimated separately for the urban and rural subsamples of the reference group. While this procedure results in a larger number of thresholds than our previous approach, we believe that it may be more accurate.

After we estimated the threshold hours of household production, we determined each individual's share of their household's actual household production (α_{ij} in equation [4.1]). In the absence of better information, we assumed that an individual's share in the threshold hours would be equal to the share of that individual in the observed total hours of household production in their household.

As discussed in section 2, we modeled the impact of expanding ECE on time spent by individuals in beneficiary households based on the time use surveys. However, since we are using the synthetic (i.e., statistically matched) data file that combines time use and household budget surveys, we had to impute the likely changes in the time spent on household production for those in beneficiary households. The imputation process has four steps. We first predict the

[16] The equation that is used in the estimation takes the form: $R_j = a_0\left(A_{j,18-59} + a_1 C_{j,0-6} + a_2 C_{j,7-17} + a_3 E_{j,60p}\right)^b$, where R_j is the threshold for household j, $A_{j,18-59}$ is the number of adults between 18–59 years of age, $C_{j,0-6}$ is the number of children under the age of 7 years, $C_{j,7-17}$ is the number of children between the ages of 7–18, and $E_{j,60p}$ is the number of adults aged 60 years or more. The estimates of the parameters a_0, a_1, a_2, a_3, and b are reported in appendix B.

time spent on household production in the synthetic data using the regression model calibrated with the time use survey with actually observed rates of crèche enrollment. Next, using the same regression model as in the first step, we predict the time spent on household production in the synthetic data with rates of enrollment targeted by our policy intervention. In the next step, we calculate the proportionate rate of change in the time spent on household production by each individual that is implied by the first two steps. Finally, we apply the estimated rate of change to the actual time spent on household production to obtain the time spent on household production by persons in beneficiary households after the policy intervention. Evidently, these changes would also change the intrahousehold division of household production responsibilities. Additionally, these changes, we assume, also lead to a change in the thresholds of household production for the beneficiary households. We estimated the new thresholds using the nonlinear regression model described above and discussed in detail in appendix B. The extent of the reduction in thresholds and their impact on time and consumption deficits are discussed later in this section.

We derived the thresholds for commuting time to work from the time use surveys. The baseline thresholds and thresholds with the direct effects of road improvements were reported in section 2 (see table 2-7 for Ghana and table 2-15 for Tanzania).

The estimation of time deficits also requires the hours of employment for the individual (see equation [4.2]). By and large, we used the hours that were reported in the household budget survey (GLSS for Ghana and THBS for Tanzania) for our calculations, though imputation of missing values was required for some records.

We also required an estimate of the unit replacement cost of household production. As is done in most studies that attempt to value household production in monetary terms, we assumed that the hourly value of the time deficit is equal to the average hourly wage of domestic workers. The details regarding constructing the occupational category of domestic workers in the two countries are discussed elsewhere (Zacharias et al. 2018, 30–32). Domestic workers were differentiated by location to account for potential differences in cost across geographical regions (table 4-3). We assumed that the policy interventions have no impact on the unit replacement cost of household production.

Table 4-2 Hourly Wages of Domestic Workers by Area (nominal amount in national currency)

Tanzania (TZS)	
Dar es salaam	424
Other urban	210
Rural	183
Ghana (GH₵)	
Urban	1.14
Rural	1.04

The final set of considerations arises with the modeling of the effects of the policy interventions on job creation. We model changes in the hours of employment and hours of household production of those who entered into employment or changed jobs, changes in the household production hours of other members of the household of those who entered into employment or changed jobs, and changes in the household consumption expenditures of the households in which there was at least one person who entered into employment or changed jobs. The details of the microsimulation model are discussed in appendix C.

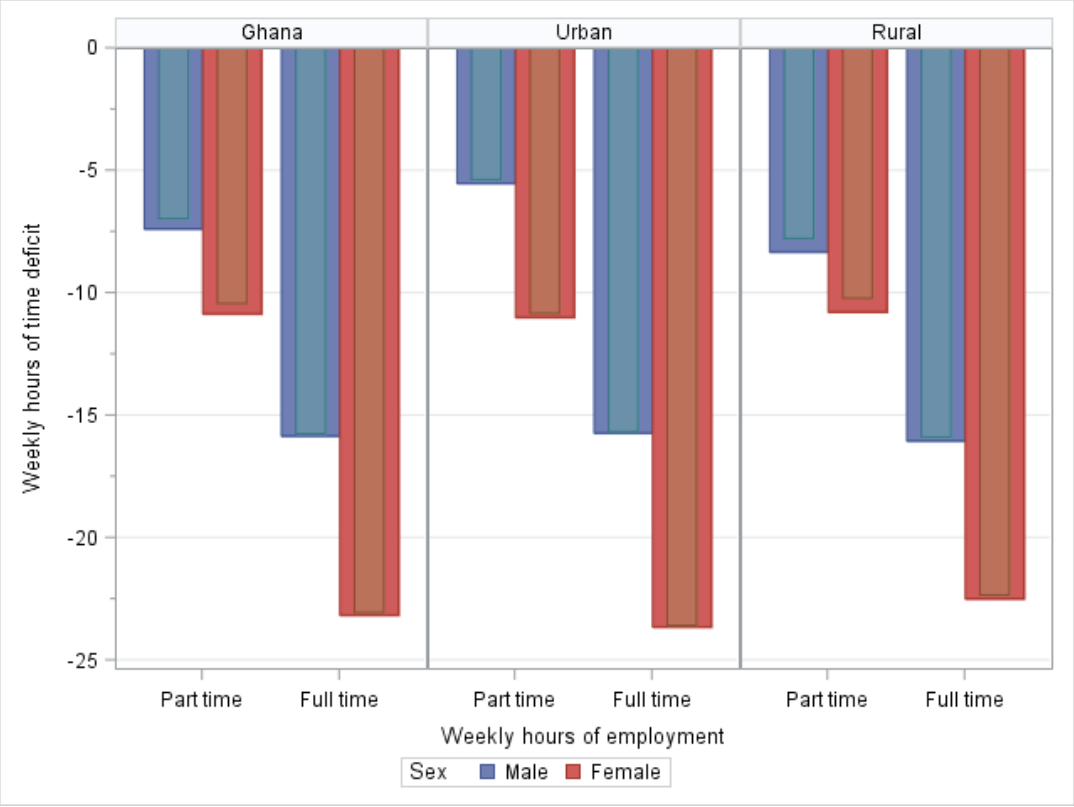
4.3 Direct Effects of Policy Interventions

We now turn to an examination of the direct effects of the improvement of roads and the expansion of ECE on time and consumption deficits. As we discussed in section 4.1, the direct effects stem from the change in the thresholds of commuting, thresholds of household production, and changes in the intrahousehold division of the responsibilities of household production. In turn, the changes in time requirements will lead to reductions in the time deficits of time-poor individuals that are directly affected by the interventions (e.g., all employed, time-poor individuals will experience a decline in their time deficit because of a fall in the commuting threshold) and facilitate a transition out of time poverty for some individuals and households. Concomitantly, the households with these individuals will experience a decline in the monetized value of their time deficits. For the consumption-poor among them, this would mean a reduction in their poverty gap, and for the hidden-poor among them it represents a potential escape from consumption poverty. The extent of these changes is discussed in the next two sections—first for Ghana and then for Tanzania.

4.3.1 Ghana

We did not expect any substantial direct effects from the road improvements because their impact on the thresholds of commuting time was quite small in Ghana. As we reported in section 2, the decline in the weekly time requirement amounted to only a few minutes in general, with rural part-time workers experiencing the largest decline of approximately 34 minutes (see table 2-7). However, the majority of employed, time-poor individuals were full-time workers (95 percent and 87 percent, respectively, in the urban and rural areas). The road improvements could make a dent in the time deficits of rural part-time workers, the vast majority (96 percent) of whom are women. Compared to their time deficits, the dent (a reduction of roughly half an hour per week on the average) was rather small (figure 4-1).

Figure 4-1 Direct Effect of Road Improvements on Time Deficits of Time-Poor Employed Persons (15–70 years of age), by Location and Full-Time Status (average weekly hours), Ghana



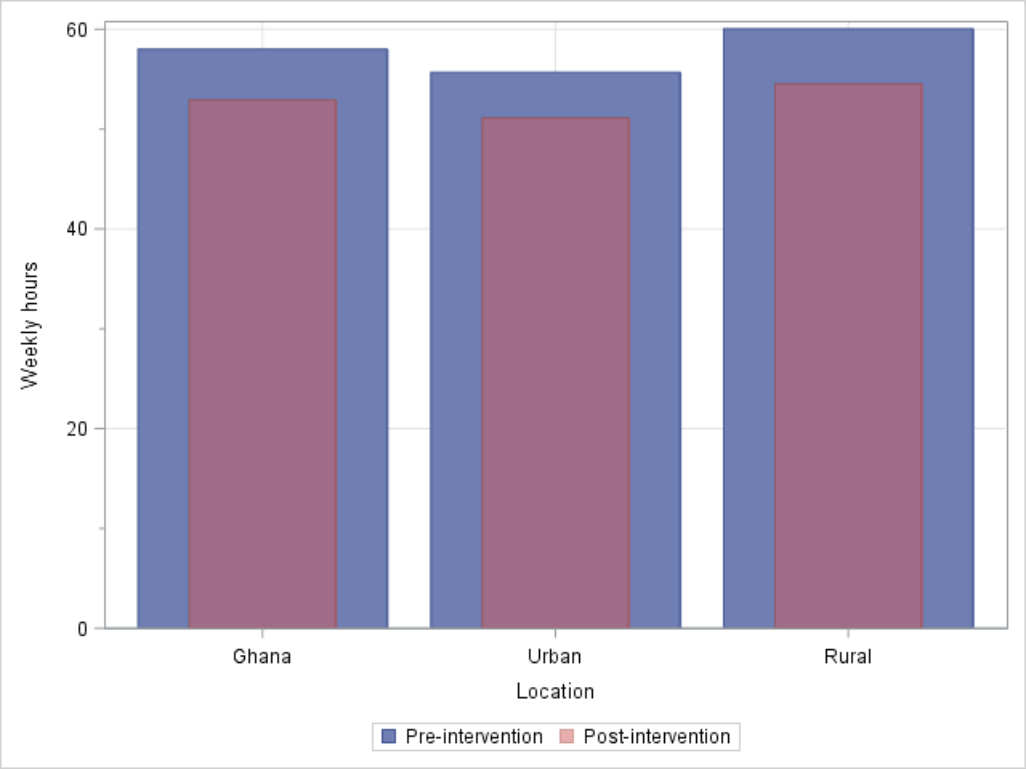
Note: For each category, the preintervention value is shown by the wider bar and the thinner bar represents the postintervention value. We consider 40 hours or more per week as full time.

Accordingly, there was only a very small reduction in the number of time-poor employed people (less than 1 percent, or about 33,000, among which 20,000 were women), leaving the rate of time poverty virtually unchanged at 34 percent. Most of those who became time-nonpoor (70 percent) were from consumption-nonpoor households. And, those from consumption-poor households experienced little change in their time deficits. Consequently, there was no change in the consumption poverty rate among individuals and households as a direct effect of road improvements.

Turning to the policy intervention of expanding ECE, let us first note that a little over one-third of all employed households (or 2.04 million households) are potential beneficiaries, i.e., households with children 3 years of age or younger.[17] As we discussed before (see section 4.1), the immediate effect of this policy intervention will be a reduction in the thresholds for household production. In Ghana as a whole, the average thresholds for households with young children fell by about 5 hours per week, from 58 hours to 53 hours, with urban and rural areas registering similar declines (figure 4-2).

[17] We define "employed households" as households with an employed head, spouse, or both (the employed person should also be between 15–70 years of age—the age group for our estimates of time deficits).

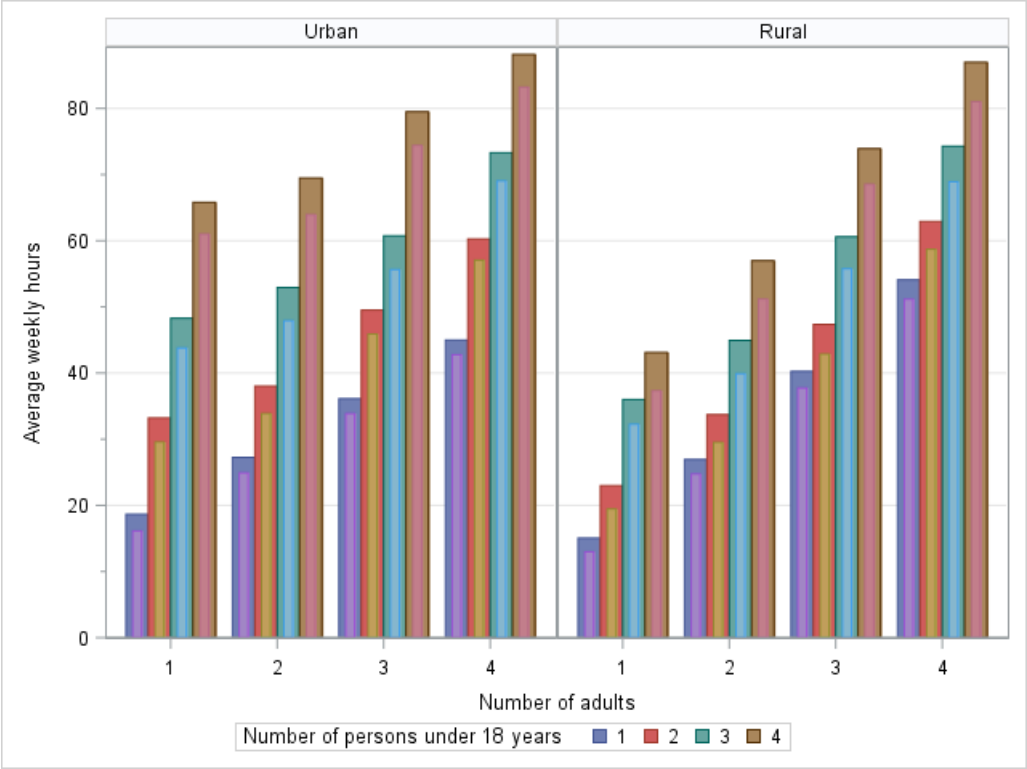
Figure 4-2 Effect of the Expansion of ECE on the Average Thresholds of Household Production per Household for Households with Young Children by Location (weekly hours), Ghana



Our thresholds are differentiated not by the rural/urban location alone; they also differ along the axes of the number of working-age adults (18–59 years), older adults (60 years or older), young children (children under 6 years), and older children (7–17 years).[18] Some indication of the effect of the policy intervention on the thresholds of various groups can be gained by examining the average thresholds for households differentiated by the number of children and adults. The declines shown in figure 4-3, below, generally translate into a higher proportionate change for the rural beneficiary households than their urban counterparts. In both locations, the largest proportionate change was observed for households with a single adult.

[18] The number of older adults was the least relevant factor behind the differences in thresholds among the households because only 12 percent of them had elderly adults as members of the household.

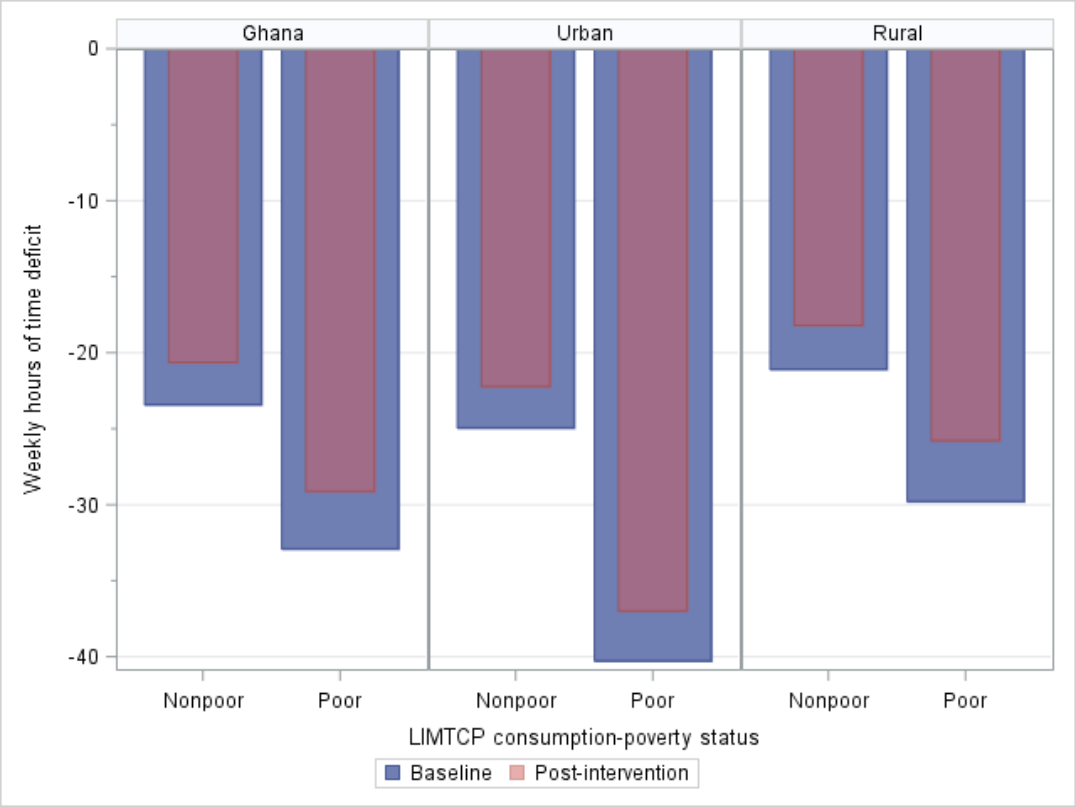
Figure 4-3 Effect of the Expansion of ECE on the Average Thresholds of Household Production per Household for Households with Young Children by Location, Number of Adults, and Number of Children (weekly hours), Ghana



Note: For each category, the preintervention value is shown by the wider bar and the thinner bar represents the postintervention value.

The reduction in the thresholds will lead to a fall in time deficits, as households are not required to spend as much time as before on the minimum required household production tasks. We found that average time deficits for time-poor households were lower by about 3 hours and 12 minutes per week (or about 12 percent) among all the beneficiary households in Ghana. The decline in average time deficits was larger among consumption-poor households in both the urban and rural areas than among nonpoor households, with poor rural households showing the largest decline per household of 4 hours per week (figure 4-4).

Figure 4-4 Effect of the Expansion of ECE on the Average Time Deficit per Household of Time-Poor Households with Young Children by Location and LIMTCP Consumption Poverty Status (weekly hours), Ghana



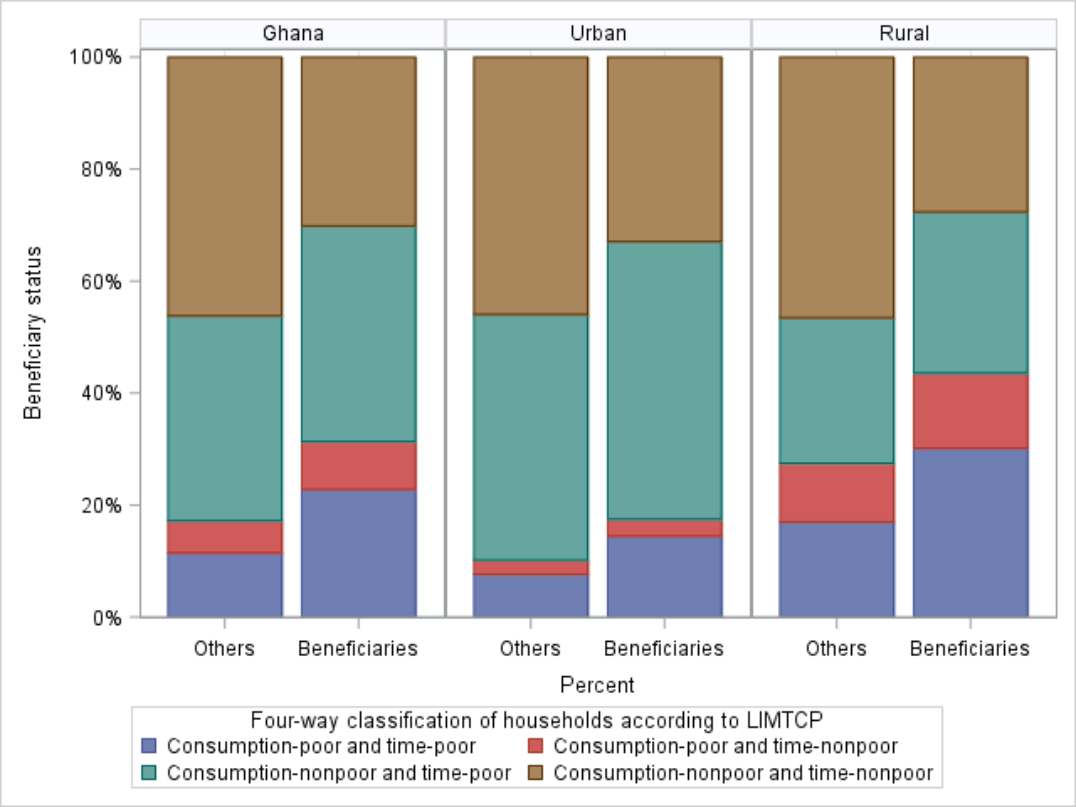
Note: Levy Institute Measure of Time and Consumption Poverty (LIMTCP) consumption poverty status refers to the official poverty line adjusted by the monetized value of time deficits.

Looking at the change in the average time deficits of those who were time-poor in the baseline situation is not sufficient for capturing the direct effects of the ECE expansion. We also have to take into account the fact that the reduction of time deficits can also affect the consumption poverty status of the household in our framework. We now consider that aspect.

Let us begin by noting the actual (or baseline) distribution of the Levy Institute Measure of Time and Consumption Poverty (LIMTCP) status of beneficiary households (figure 4-5). As in many other parts of the world, households with young children are much more prone to consumption poverty in Ghana. The rates of consumption poverty in Ghana as a whole that are associated with that of the urban and rural households shown in the figure indicate that the rate is almost twice as high among beneficiary households as other households (32 percent versus 17 percent). Viewed through the lens of the LIMTCP, we can discern that they are also more vulnerable to the double bind of time and consumption poverty. In rural Ghana, the rates are 30

percent versus 17 percent, respectively, while in the urban areas they were 14 percent versus 8 percent, respectively. We also observed that the households with young children are less likely, especially in rural areas, to encounter neither time nor consumption deficits than other households (28 percent versus 47 percent, respectively, in the rural areas and 33 percent versus 46 percent, respectively, in urban Ghana). These statistics paint a grim picture of a substantial proportion of young children growing up under conditions of material duress and potential parental neglect due to overwork.

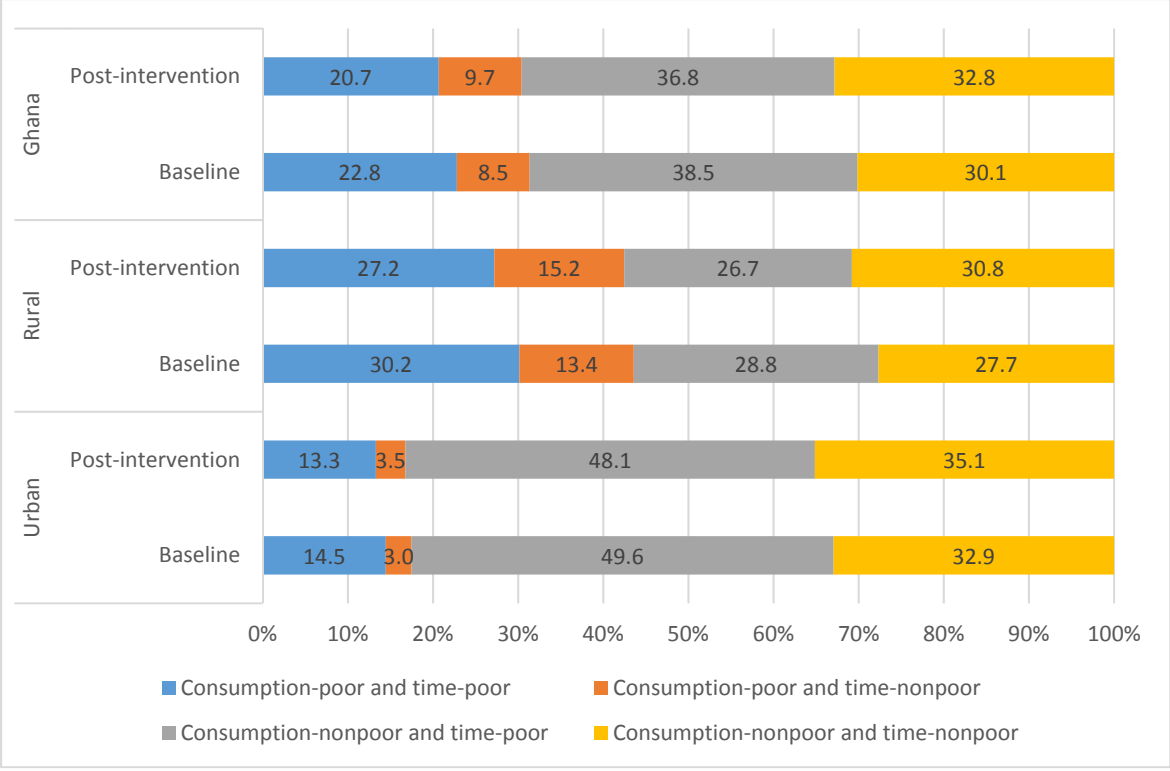
Figure 4-5 LIMTCP Distribution of Employed Households by Potential Beneficiary Status (percent), Ghana



The direct effects on the beneficiary households are most visible in the decline in the percentage of households in the double bind of time and consumption poverty, which fell by 2.1 percentage points for Ghana as a whole (figure 4-6), translating into a decline of about 43,000 households. Rural households experience a greater decline than urban households in the incidence of the double bind (3 percentage points versus 1.2 percentage points, respectively), in line with their role as the predominant subgroup in the ranks of the households in the double

bind. The decline in the incidence of time poverty among the poor leads to a reduction in the rate of consumption poverty: about a percentage point overall for the country, with rural areas experiencing a higher drop than the urban areas (1.1 percentage points versus 0.7 percentage points, respectively). A large proportion (56 percent) of consumption-poor households who escaped the double bind still could not escape consumption poverty, i.e., they remained in the category of "consumption-poor, time-nonpoor," and this explains why the reduction in consumption poverty is more modest than that in the incidence of the double bind. This is understandable once we recognize that the direct effects of the policy intervention only reduce the size of the monetized value of the household's time deficit. However, those in the double bind include households below the official poverty line and that, even for some in the "hidden poor" category, the decline in time deficits triggered by the intervention may not be sufficient to overcome their poverty gap.

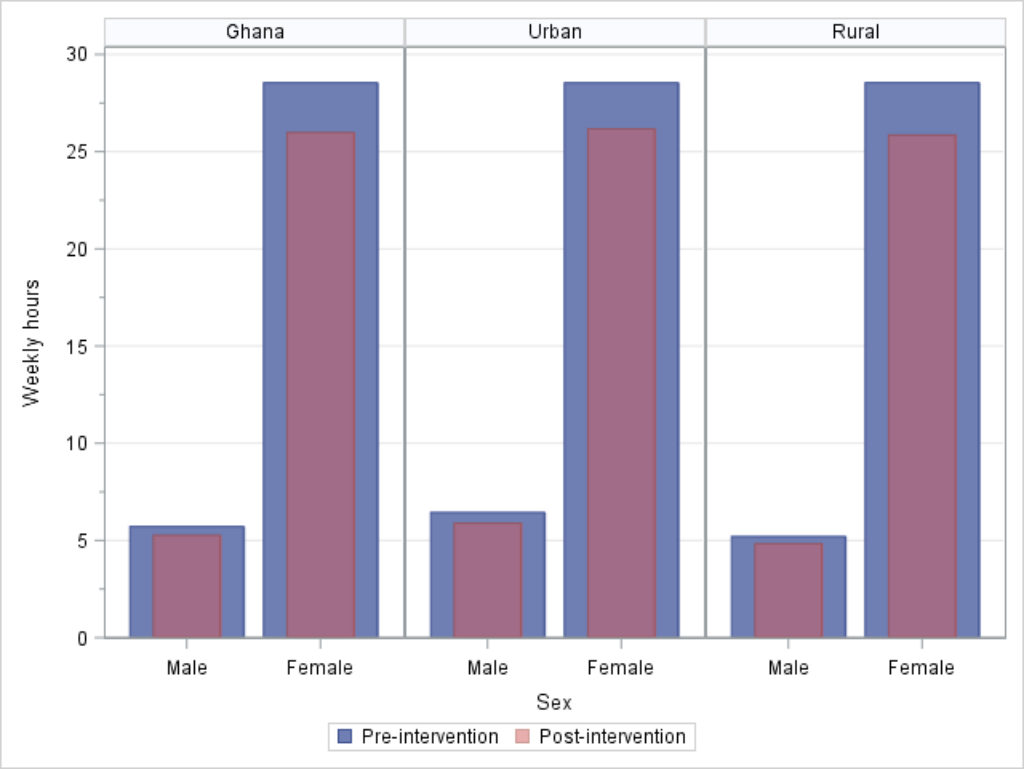
Figure 4-6 Direct Effect of the Expansion of ECE on the LIMTCP Distribution of Employed Beneficiary Households by Location (percent), Ghana



We should also note that the intervention reduces the incidence of time poverty among the consumption-nonpoor: the share of households that belong to the category of "consumption-nonpoor and time-poor" falls by 1.8 percentage points for Ghana (a decline of roughly 36,000 households). As we saw before, the nonpoor households also experience a decline in their time deficits (see figure 4-4). Thus, the overall decline in the household time poverty rate in the country as a result of the policy intervention is about 3.9 percentage points, or a decline of approximately 79,000 households. The fall in time poverty among the nonpoor is to be expected since the expansion of ECE that we are proposing is not meant to be available only to the poor. Of course, we must be cognizant that nonpoor households can, in principle, substitute for the shortfalls in household production via market provisioning. In practice, such substitution is viable for most middle-class families only if they were to cut back on current consumption expenditures on other essentials or take on additional debt because the size of the monetized value of time deficits is quite substantial relative to their consumption expenditures, as we have discussed elsewhere (see Zacharias et al. 2018, 81–82).

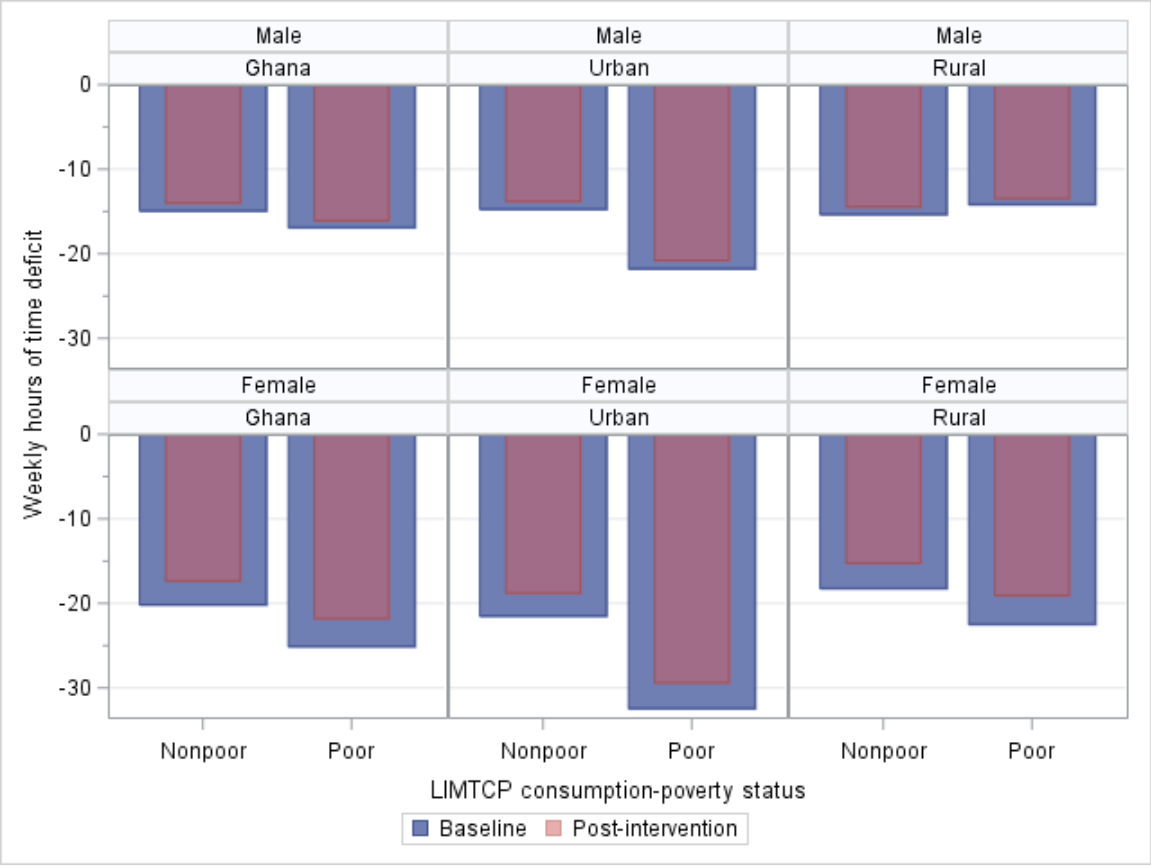
We now turn to examining the direct effects of the expansion of ECE on the employed persons (15–70 years of age) in the beneficiary households, restricting our attention as above to employed households. Our main goal here is to identify the gendered nature of these effects. As we noted before (section 4.1), the immediate impact of the intervention is on the required hours of household production that are borne by the individuals. We found that the average decline was slightly more for rural women than urban women (about 20 minutes more per week) and, for employed women in Ghana as a whole, the average decline was approximately 2 hours and 30 minutes per week, or about 9 percent lower than the preintervention average value. The proportionate reduction for men was also about the same on average, although because of the much smaller time requirements they face, the amount of the reduction was only about a half an hour (figure 4-7).

Figure 4-7 Effect of the Expansion of ECE on the Average Required Hours of Household Production for Employed Persons (15–70 years of age) in Households with Young Children by Sex and Location (weekly hours), Ghana



As we would expect, the fall in required hours of household production led to a fall in the time deficits of employed individuals; since the decline in required hours was higher for women than men, the reduction in time deficits was also more substantial for women than men (figure 4-8). The fall was the greatest for consumption-poor women, with an average decline of almost 3 hours and 20 minutes per week; the average decline for consumption-nonpoor women was slightly less, at 2 hours and 50 minutes per week. While urban consumption-poor women incurred higher time deficits than their rural counterparts, the decline in time deficits was greater for the latter. The direct effects of the intervention do not alter differentials based on gender and poverty status. Consumption-poor women continued to incur higher time deficits than consumption-nonpoor women after the intervention, and the same disparity was also evident among men, too. Among the poor and nonpoor, women also remained prone to higher time deficits than men.

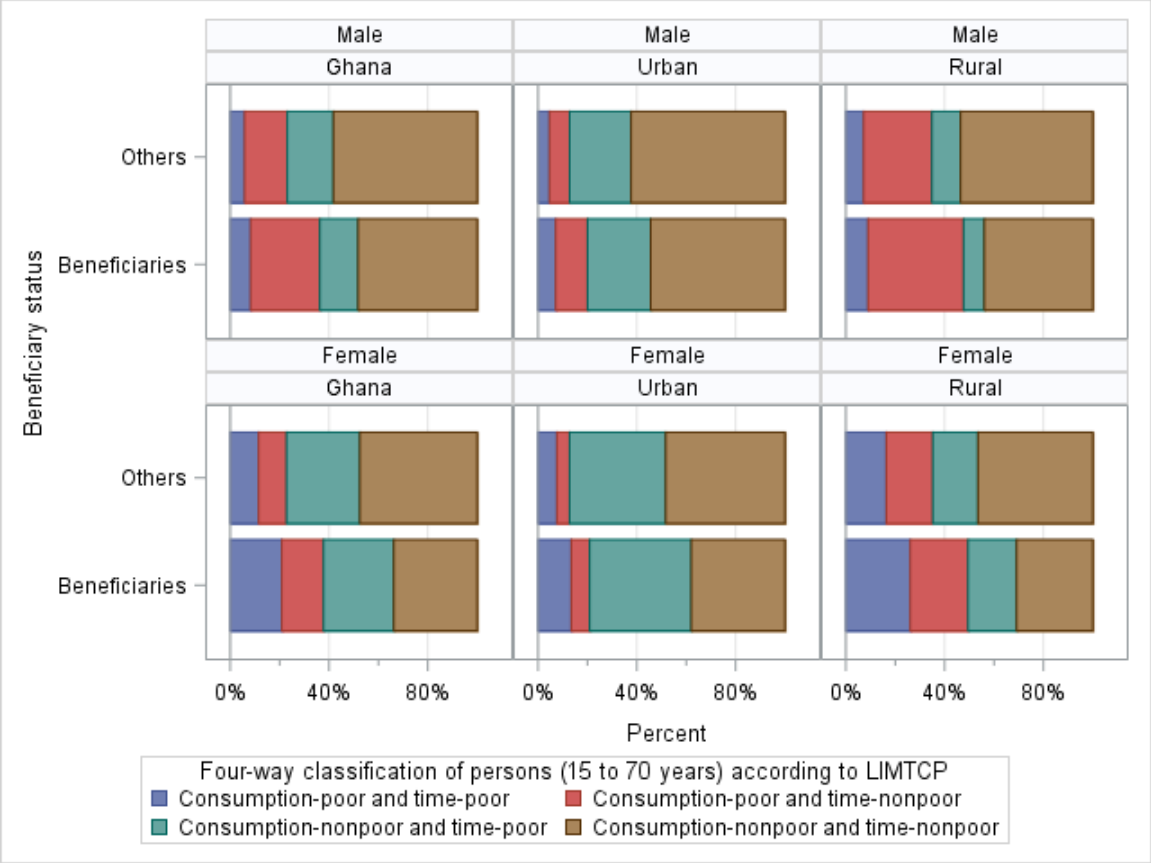
Figure 4-8 Effect of the Expansion of ECE on the Average Time Deficits of Employed Persons (15–70 years of age) in Households with Young Children by Sex and Location (weekly hours), Ghana



Consistent with the household-level comparisons we conducted above (figure 4-5), we found that the employed persons in beneficiary households (households with young children) are more prone to consumption and time deficits than their counterparts in nonbeneficiary households (figure 4-9). In Ghana as a whole, the rate of consumption poverty among beneficiary women was 38 percent compared to 23 percent among other employed women. The incidence of the double bind of consumption and time deficits was also higher among the former than the latter (21 percent versus 12 percent). Employed men in beneficiary households were also more susceptible to consumption poverty and the grip of the double bind than other employed men. However, the incidence of the double bind is notably higher among women than men in the beneficiary households (21 percent versus 8 percent). The disparity between those in the beneficiary households and nonbeneficiary households in the rates of consumption poverty and time poverty is much more pronounced in rural areas than urban areas. Employed parents of

young children are thus, on average, substantially worse off than the rest of the employed in both dimensions of deprivation.

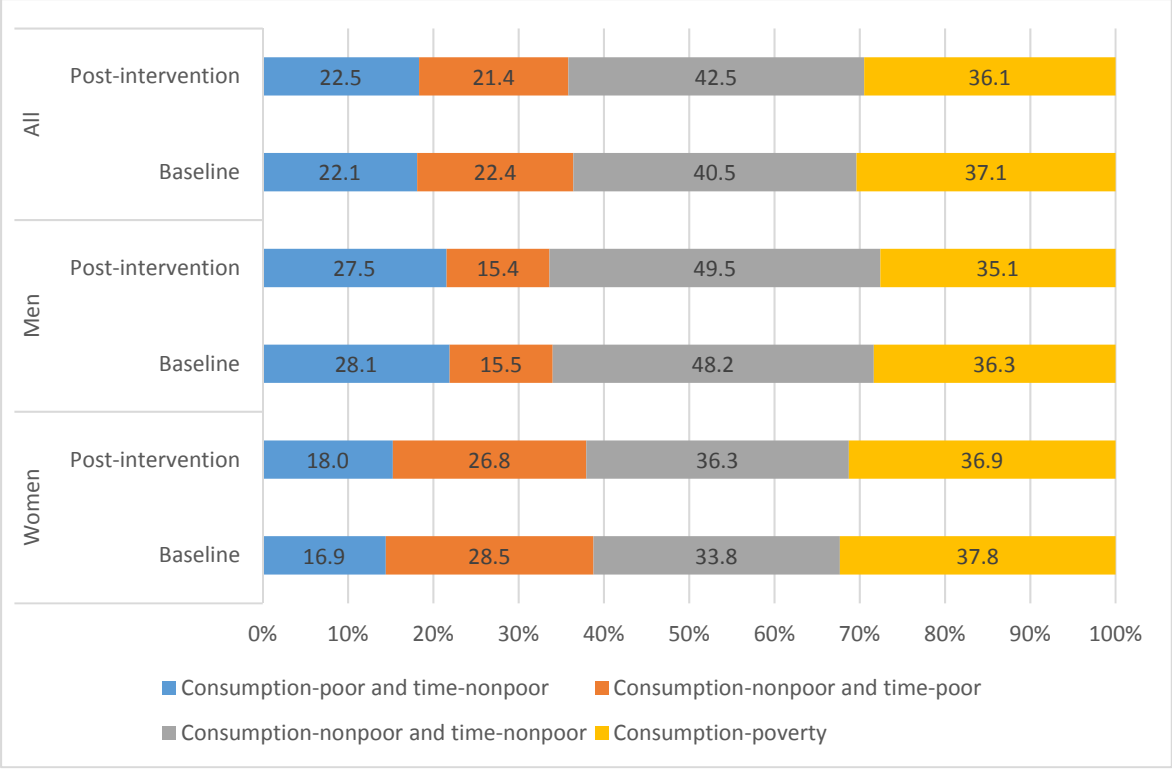
Figure 4-9 Distribution of Employed Persons (15–70 years of age) by Potential Beneficiary Status and Sex (percent), Ghana



The question that we now address is the extent to which the direct effects of the ECE expansion ameliorate these deprivations. For the country as a whole, the rate of consumption poverty among the employed fell by about 1 percentage point, representing a decline of about 45,000 persons, out of which 24,000 were men and 21,000 were women. The incidence of the double bind declined by a greater extent: it fell by 1.3 percentage points, or about 60,000 persons, among which 12,000 were men and 48,000 were women (figure 4-9; absolute numbers are not shown). The gender disparity in time poverty among the consumption-poor partly accounts for why the decline in consumption poverty for women was only about half of the decrease in the number of women in the double bind, while for men the reduction in consumption poverty exceeded the fall in the double bind by a considerable margin. In terms of

the number of people, 27,000 of the 48,000 women who escaped the double bind remained consumption-poor; for men, in addition to the 12,000 who exited from the double bind, another 12,000 made a transition from the "consumption-poor and time-nonpoor" category to "consumption-nonpoor and time-nonpoor" category. The outcome is indeed a spillover benefit for men since the change in consumption poverty status could have occurred for them only via changes in the time deficits of other individuals in their households (mostly the wives). In terms of the percentages shown in the figure, the disparity between men and women in this respect can be seen in the rise for women and fall for men in the "consumption-nonpoor and time-nonpoor" category. The proportion of those with neither time nor consumption deficits increases by about 2 percentage points as a result of the intervention (about 86,000 persons, made up of 60,000 women and 26,000 men). As can be observed from the figure, the percentage of those with neither deficits increased among men and women.

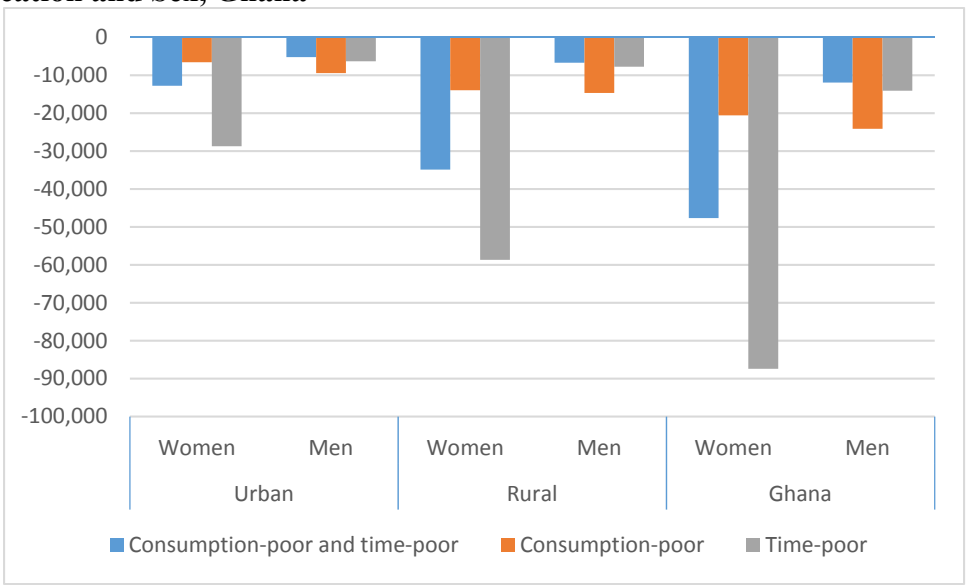
Figure 4-10 Direct Effect of the Expansion of ECE on the LIMTCP Distribution of Employed Persons (15–70 years of age) in Beneficiary Households by Sex (percent), Ghana



The distribution of the gains from the intervention is broken down by urban and rural areas in figure 4-11. Because the majority of those who suffer from time deprivations are in rural areas, it is not surprising to find that the ECE expansion has a larger impact in terms of the number of people in the rural areas. Two-thirds of the nearly 90,000 women that made the transition out of time poverty (representing a decline of 3.7 percentage points in the rate of time poverty) were found in rural areas.

Similarly, the majority of the women suffering from the double bind are also in rural areas. We estimate that nearly three-fourths of those who escaped it lived in the rural areas, which is practically identical to the share of rural women in the total number of women in the double bind before the intervention. Turning to the reduction in consumption poverty, the share of rural women among all women that escaped consumption poverty as a result of the intervention was approximately 67 percent, which is lower than the share of consumption-poor women (77 percent). The spillover benefits for men that we observed for Ghana as a whole prevail in both the rural and urban areas: the number escaping consumption poverty exceeds the number escaping the double bind for men and vice versa for women. Apart from the spillover benefits, men also benefit (though to a lesser degree than women) from the reductions in their own time deficits and the concomitant declines in their time and consumption poverty.

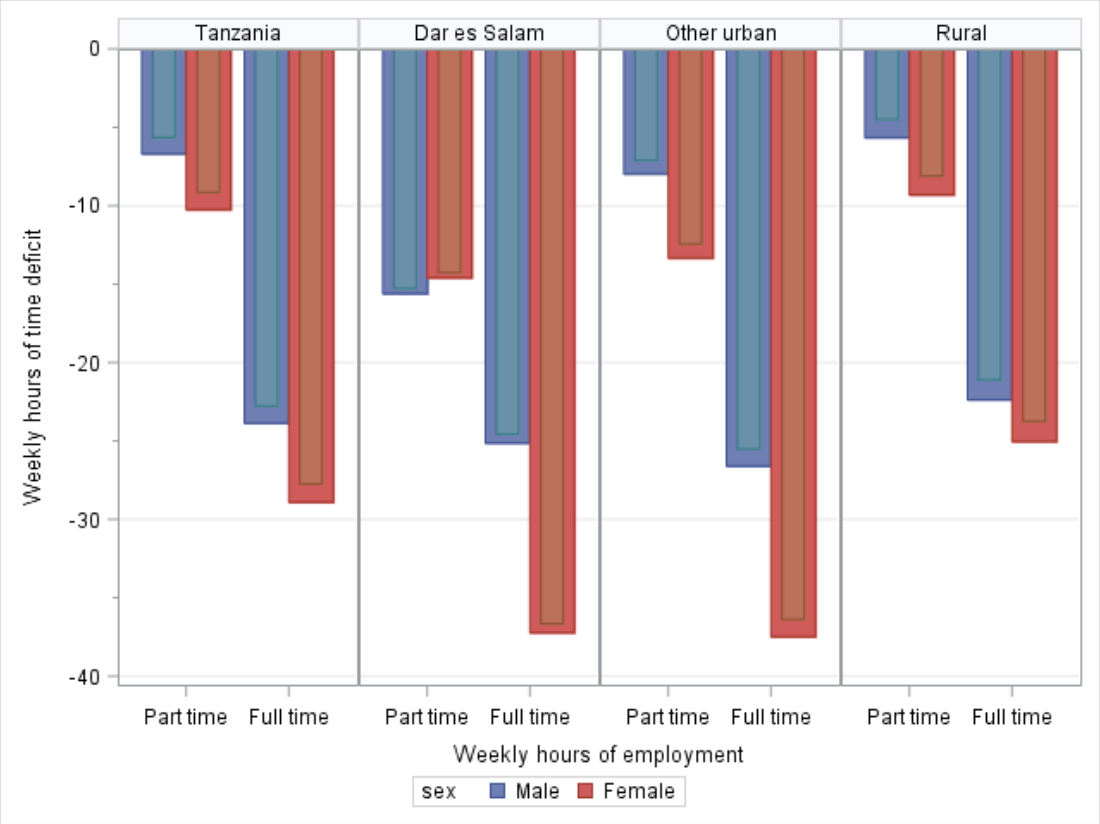
Figure 4-11 Reduction in the Number of Employed Persons in the Double Bind of Consumption Poverty and Time Poverty as a Result of the Direct Effects of the Expansion of ECE by Location and Sex, Ghana



4.3.2 Tanzania

Just as we did in the case of Ghana, we begin by examining the direct impact of road improvements. In contrast to Ghana, and as we reported in section 2, the decline in the weekly time requirement for commuting was an hour or more for those outside Dar es Salam, while for those in Dar es Salam the fall was only 30 minutes or less (see table 2-15). Compared to Ghana, we therefore expect to observe more substantial direct effects from road improvements. The immediate impact of the improvements is on the time deficits of employed individuals. We found an average reduction of 1 hour and 7 minutes for Tanzania as a whole. The highest decline was for rural full-time workers (1 hour and 15 minutes) and was only a few minutes off from the national average, while the decrease for those in Dar es Salam was much lower than the national average (under 30 minutes) because of the minor impact of the road improvements on commuting thresholds in that area (figure 4-13). Clearly, the reduction in time deficits is quite small compared to the time deficits faced by most workers, as 87 percent of all workers in Tanzania are full-time workers.

Figure 4-12 Direct Effects of Road Improvements on Time Deficits of Time-Poor Persons (15–70 years of age), by Location and Full-Time Status (average weekly hours), Tanzania



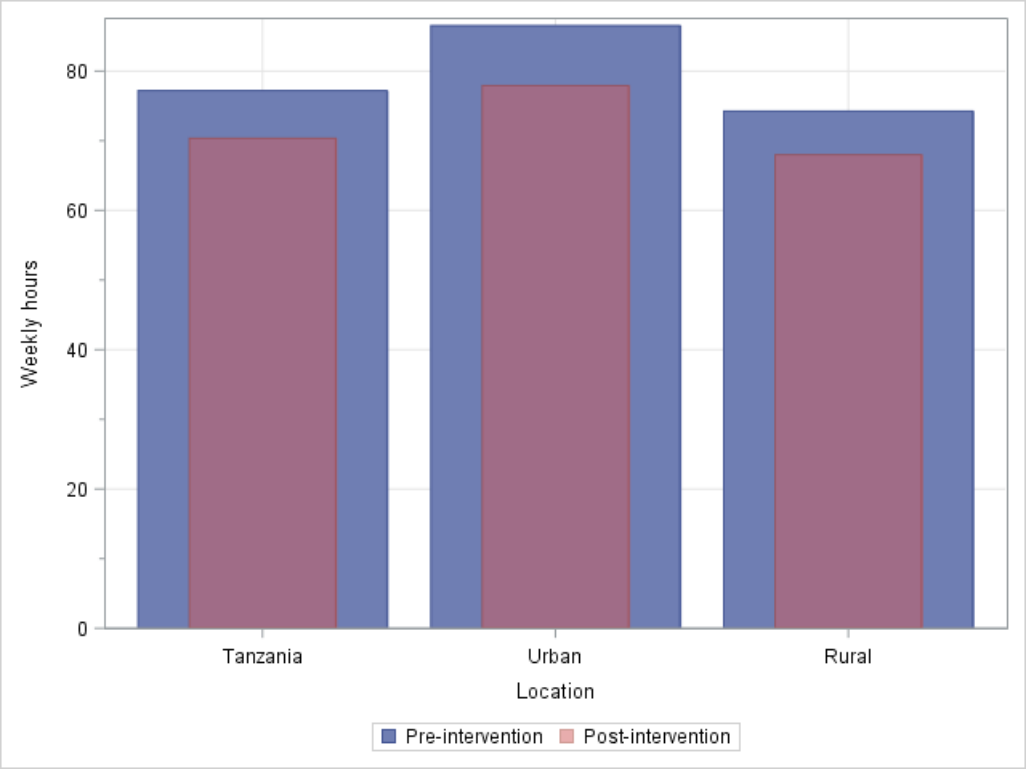
Note: For each category, the preintervention value is shown by the wider bar and the thinner bar represents the postintervention value. We consider 40 hours or more per week as full time.

Nevertheless, there were about 304,000 individuals for whom the decline facilitated an exit out of time poverty, implying that the road improvements led to a drop of 1.6 percentage points in the rate of time poverty and a 3.5 percent decline in the number of time-poor employed individuals. There was no notable gender disparity in the reductions, with women constituting a thin majority among those who made the transition. Because of the rather small decline in time deficits and because the majority (65 percent) of those who became time-poor belonged to consumption-nonpoor households, there was only a minimal decline (0.3 percentage points, or about 69,000 persons) in the consumption poverty rate.

Let us now examine the direct effects of increasing the availability of ECE. In terms of its scope, we should note that potential beneficiaries, i.e., households with children 3 years of age or younger, constitute about 41 percent (as compared to 35 percent in Ghana) of all employed households (or 3.21 million households). For these households, the immediate impact of the

policy intervention will be a fall in the required (threshold) hours of household production (see section 4.1). We found that the thresholds fell from 77 to 70 hours per week in Tanzania (compared to a decline of 5 hours per week in Ghana). Rural areas displayed a notably lower amount of reduction than urban areas (a difference of about 2 hours and 20 minutes), but, as can be observed in the figure, the average thresholds are considerably higher in the urban areas (figure 4-13).

Figure 4-13 Effect of the Expansion of ECE on the Average Thresholds of Household Production per Household for Households with Young Children by Location (weekly hours), Tanzania

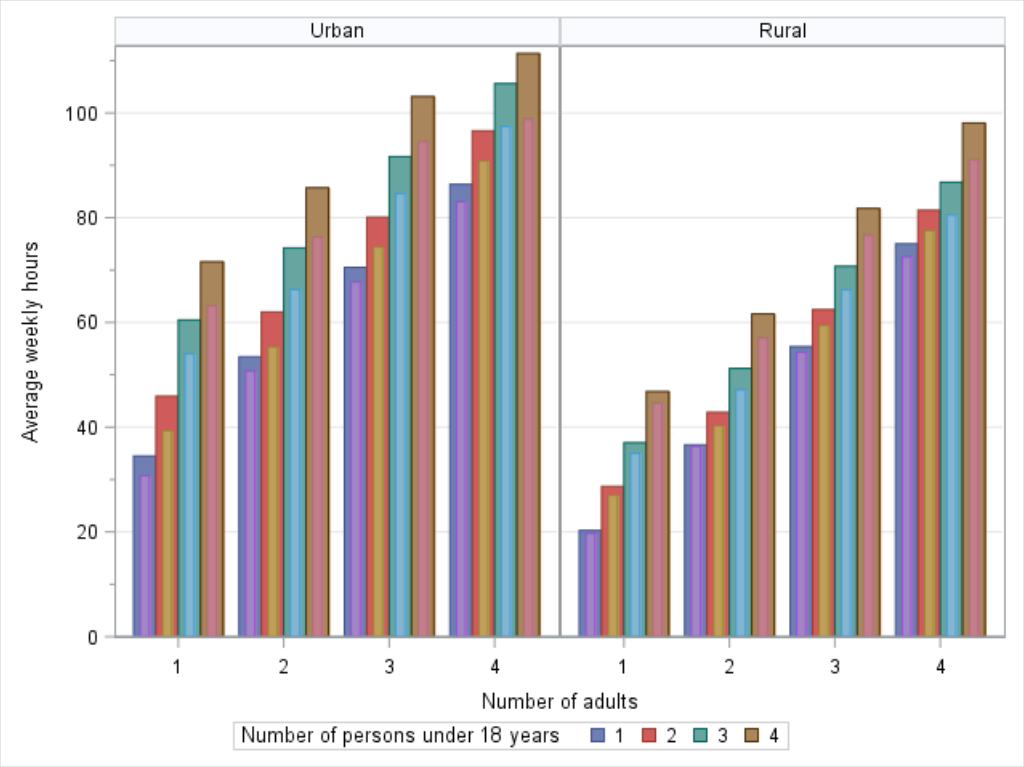


Because our thresholds are also differentiated by household composition—namely, the number of working-age (18–59 years) adults, older adults (60 years or older), young children (children under 6 years), and older children (7–17 years)—it is also important to examine the changes in the threshold by the principal dimension along which household composition varies, i.e., the number of children and adults (figure 4-15).[19] The decline in the urban areas generally

[19] About 16 percent of beneficiary households had elderly adults as members of the household, suggesting that the variation in thresholds along this axis is likely to be small.

exceed that the rural areas (both in terms of proportionate and absolute decrease) within every household subgroup of beneficiary households. The finding is in contrast to Ghana where the drops were more pronounced among the rural beneficiary households. In urban Tanzania, we observe a higher average proportionate decline for single-adult and two-adult households, while the reductions are slightly higher for the larger-sized households in rural areas.

Figure 4-14 Effect of the Expansion of ECE on the Average Thresholds of Household Production per Household for Households with Young Children by Location, Number of Adults, and Number of Children (weekly hours), Tanzania

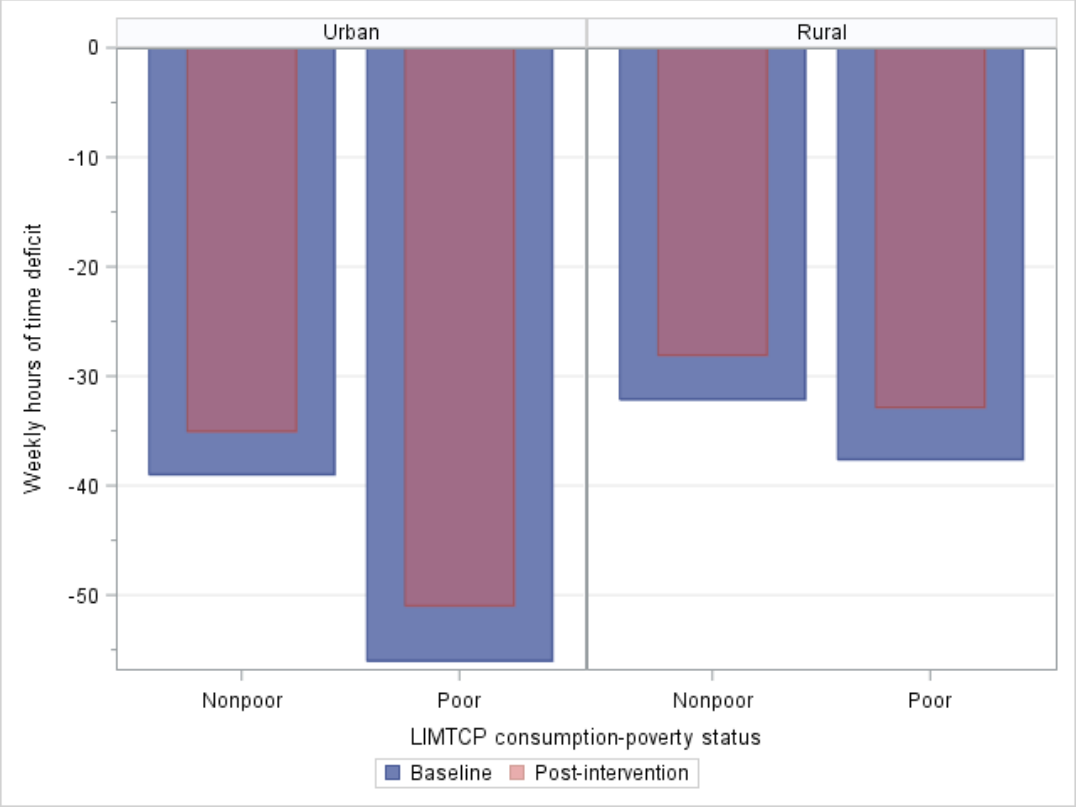


Note: For each category, the preintervention value is shown by the wider bar and the thinner bar represents the postintervention value.

We expect household time deficits to fall in response to the reduction in the thresholds because households are not required to spend as much time as before on meeting their minimum household production needs. Our estimates showed an average decline of 4 hours and 18 minutes per week for beneficiary households that were time-poor in the baseline. Consumption-poor households experienced a higher drop than consumption-nonpoor households in both urban and rural areas (figure 4-15). Urban consumption-poor households that suffer from the highest

amount of time deficits (before and after the intervention) experienced the largest decline, about 5 hours per week.

Figure 4-15 Effect of the Expansion of ECE on the Average Time Deficit per Household of Time-Poor Households with Young Children by Location and LIMTCP Consumption Poverty Status (weekly hours), Tanzania



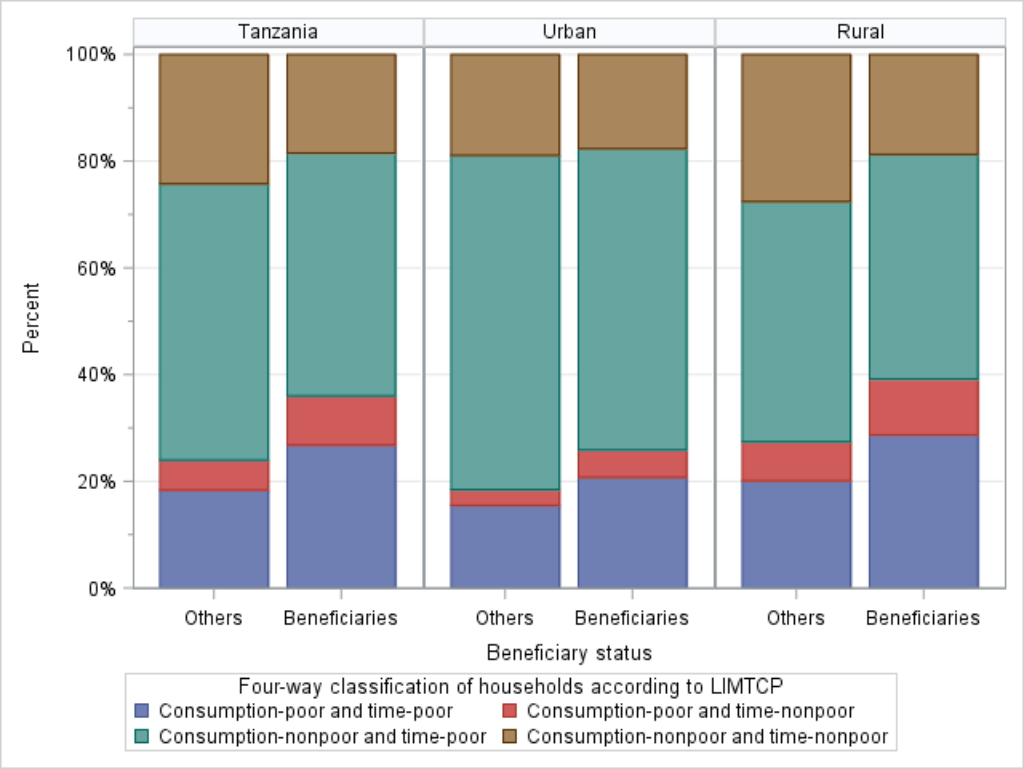
Note: LIMTCP consumption poverty status refers to the official poverty line adjusted by the monetized value of time deficits

Reduction in time deficits would naturally translate into a decline in the monetized value of time deficits. For consumption-poor households that are time-poor, this would mean an increase in the resources that they can set aside for their unmet needs, or equivalently a fall in their modified poverty line (section 4.1). Indeed, for some households, the poverty line falls to the level or below the level of their household consumption expenditures, thus marking a transition to consumption-nonpoor status.

The need for such a transition is, in fact, pressing for a sizeable proportion of our beneficiary households. Households with young children, i.e., beneficiary households, face a higher rate of consumption poverty than the nonbeneficiaries (36 percent versus 24 percent,

respectively) in Tanzania. The same disparity between the two groups is evident in the urban (26 percent versus 19 percent) and rural (39 percent versus 27 percent) areas, although the extent of the disparity is less in urban Tanzania. Furthermore, the beneficiary households are also subject to the double bind of consumption and time poverty to a greater extent than others. The incidence of the double bind among the beneficiary households was 29 percent and 21 percent, respectively, in the urban and rural areas. In contrast, the rates for nonbeneficiaries were 20 percent and 16 percent, respectively (figure 4-16). Beneficiaries were also less likely to encounter neither type of poverty than other households. These patterns are similar to those we observed for Ghana.

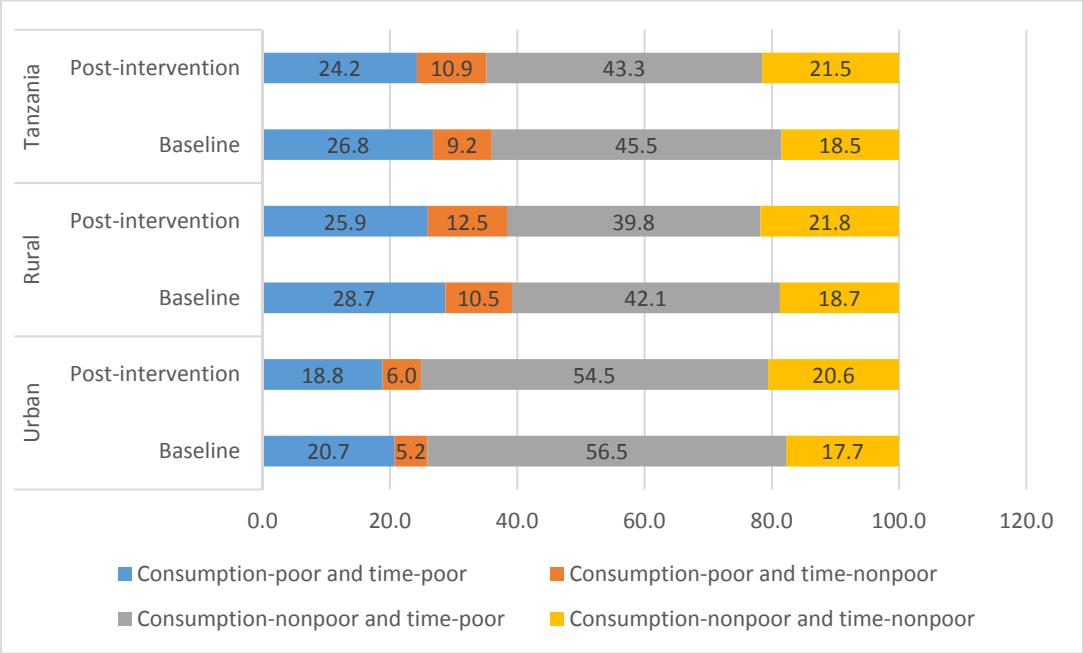
Figure 4-16 LIMTCP Distribution of Employed Households by Potential Beneficiary Status (percent), Tanzania



Similar to our findings for Ghana, we observed that the incidence of the double bind of consumption and time poverty among beneficiary households in Tanzania declined by 2.6 percentage points, or about 82,000 households. Most of those households (68,000) that made the transition were in rural areas. The percentage point decline in the rural areas was also higher than urban areas (2.8 percentage points versus 1.9 percentage points, respectively). However, a large

proportion of those who escaped the double bind were able to avoid only time deficits; they remained consumption-poor. This is reflected in the fact that the decline in consumption poverty was about 1 percentage point (from 36 percent to 35 percent) or about 27,000 households, of which approximately 19,000 were in the rural areas. It is also reflected in the increase of those in the "consumption-poor and time-nonpoor" category by nearly 2 percentage points. As we noted in our discussion of Ghana, the decline or even the elimination of time deficits is not enough to make a substantial dent in the consumption poverty of those who are below the official poverty line and among those in the "hidden poor" category.

Figure 4-17 Direct Effect of the Expansion of ECE on the LIMTCP Distribution of Employed Beneficiary Households by Location (percent), Tanzania



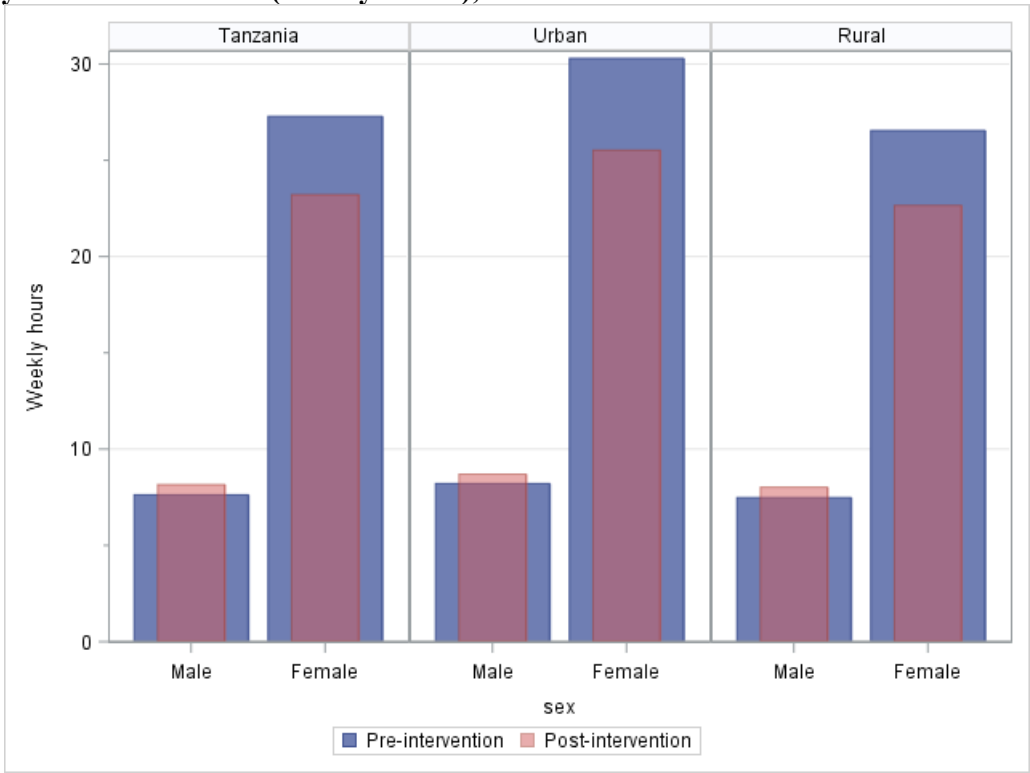
Our estimates shown in figure 4-15 indicate that average time deficits fell by about five and three hours, respectively, for the rural and urban consumption-nonpoor households. This was accompanied by a reduction in time poverty among the consumption-nonpoor, as reflected in the decline of about 2.2 percentage points (about 70,000 households) in the share of households that fall in the "consumption-nonpoor and time-poor" category (figure 4-17). Combining the reduction among the nonpoor and poor, we see that the ECE expansion leads to a decline of 4.8 percentage points in the time poverty rate, which translates into approximately 152,000 households. The potential negative effects of time deficits on the standard of living are lower

among the consumption-nonpoor than consumption-poor households because of their better ability to procure market substitutes. However, it ought to be reckoned that a substantial share of the household budget will have to be devoted to this purpose for households taking that route and, therefore, it involves trade-offs with essential household spending, as we have discussed elsewhere (see Zacharias et al. 2018, 108–12).

We now turn to assessing the gendered nature of the direct effects of the ECE expansion on employed people (15–70 years of age) in beneficiary households with an employed head or has an employed spouse of the head ("employed households"). As we discussed in section 2, our estimates of the impact on average hours of household production show a slight increase in the time spent on household production by males in beneficiary households in Tanzania. In our model, this results in a redistribution of the threshold hours of household production per household among the members of the household, although given the rather small increase in men's hours we could see only negligible redistribution.[20] We reported earlier that the policy intervention did reduce the threshold hours of household production per household (figure 4-13). But the intrahousehold redistribution generated an opposite effect on males and females: the average required hours showed a slight increase for men (about 30 minutes) while declining by a little over 4 hours for females in Tanzania (figure 4-18). The decline for urban females was about an hour (53 minutes) more than rural females.

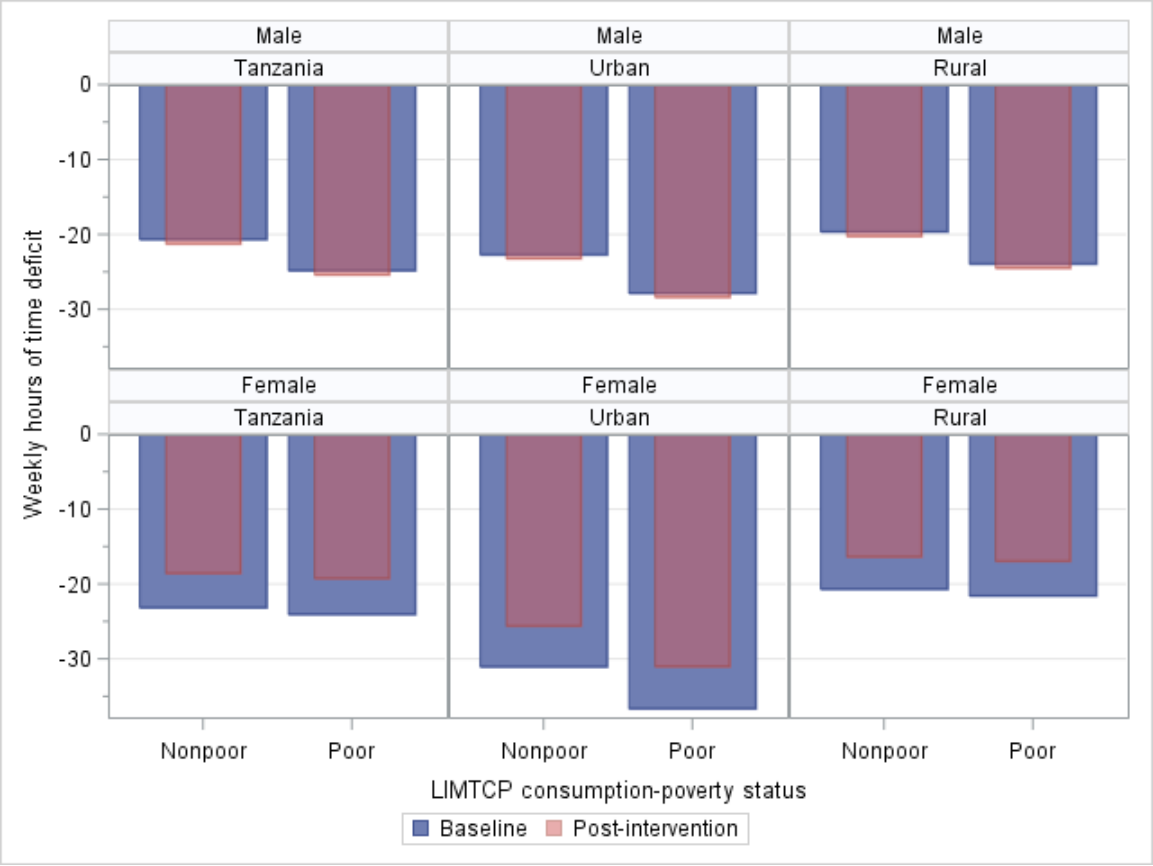
[20] For an average employed male, the share in the household production responsibilities borne by them went up from 6 percent to 7 percent, while for an average employed female the share declined from 32 percent to 29 percent.

Figure 4-18 Effect of the Expansion of ECE on the Average Required Hours of Household Production for Employed Persons (15–70 years of age) in Households with Young Children, by Sex and Location (weekly hours), Tanzania



Time deficits are differentiated along the lines of gender and consumption poverty status, with women tending to incur higher deficits than men and the poor facing higher deficits than the nonpoor (figure 4-19). The contradictory effect on time requirements we just saw above would naturally lead to a reduction in average time deficits for women as opposed to a slight increase for men. We found that the average increase in Tanzania for consumption-poor and consumption-nonpoor men was only about 15 minutes and 33 minutes, respectively. For women, the average decline in the consumption-poor and consumption-nonpoor groups was approximately 5 hours and 4.5 hours, respectively. In both Ghana and Tanzania, urban women face greater time deficits than rural women. But, unlike in Ghana, the decline in time deficits in Tanzania was higher by about an hour for urban women versus rural women.

Figure 4-19 Effect of the Expansion of ECE on the Average Time Deficits of Employed Persons (15–70 years of age) in Households with Young Children, by Sex and Location (weekly hours), Tanzania

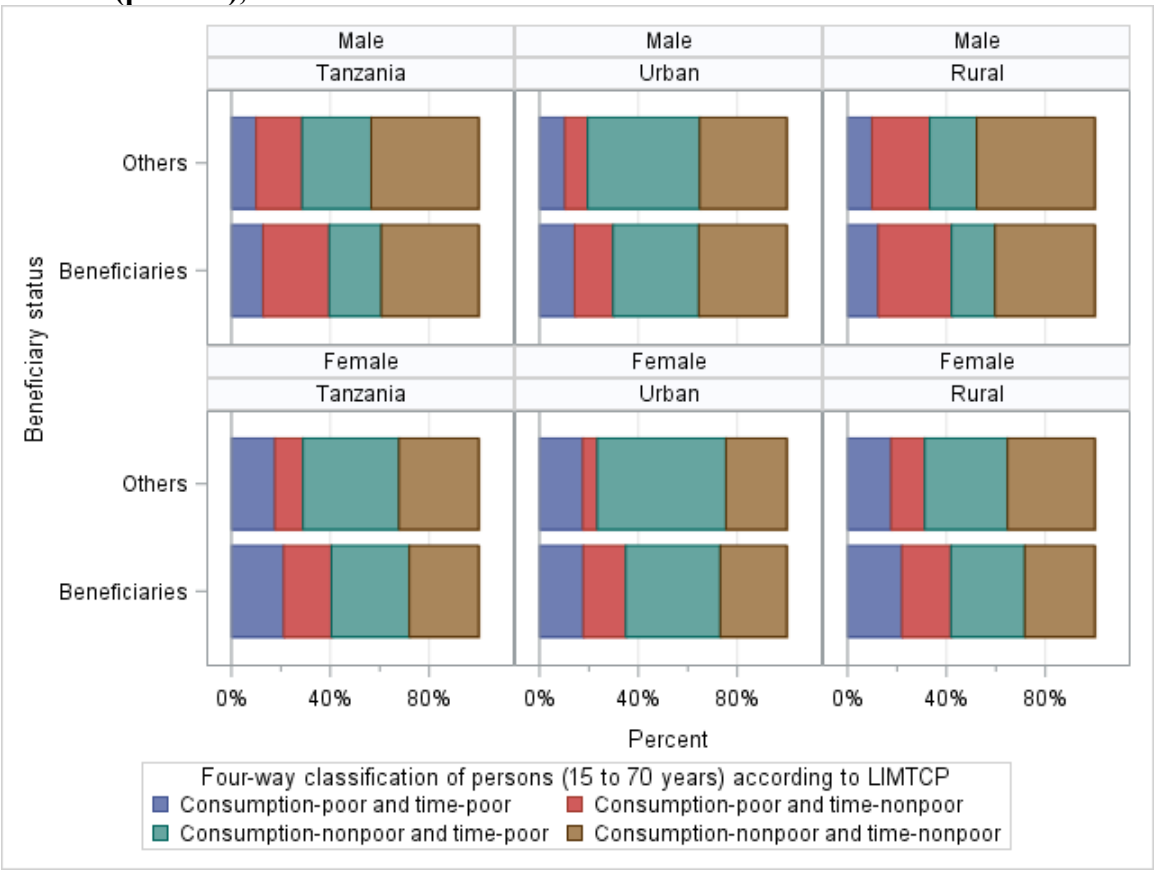


Note: LIMTCP consumption poverty status refers to the official poverty line adjusted by the monetized value of time deficits.

Gender disparities are quite marked in the incidence of the double bind of consumption and time poverty (figure 4-20). It appears that the vulnerability to the double bind is also higher for the beneficiary households than for others. Compared to women in other households, employed women in beneficiary households are more prone to the double bind (21 percent versus 18 percent, respectively) in Tanzania. The same disparity is also evident among employed men (13 percent versus 10 percent). However, the geographical pattern of the gap differs across the sexes. The incidence of the double bind is almost identical between women in beneficiary and other households in the urban areas, while it is considerably higher for those in the former group in the rural areas. For men, we find precisely the opposite pattern: men in beneficiary and other households face roughly the same rate in the rural areas, while the men in beneficiary households encounter higher rates in urban areas. Considering deprivation only along the axis of

consumption showed that those in beneficiary households face a higher poverty rate than others (40 percent versus 29 percent—the incidence of consumption poverty is almost identical for men and women).

Figure 4-20 Distribution of Employed Persons (15–70 years of age) by Potential Beneficiary Status and Sex (percent), Tanzania



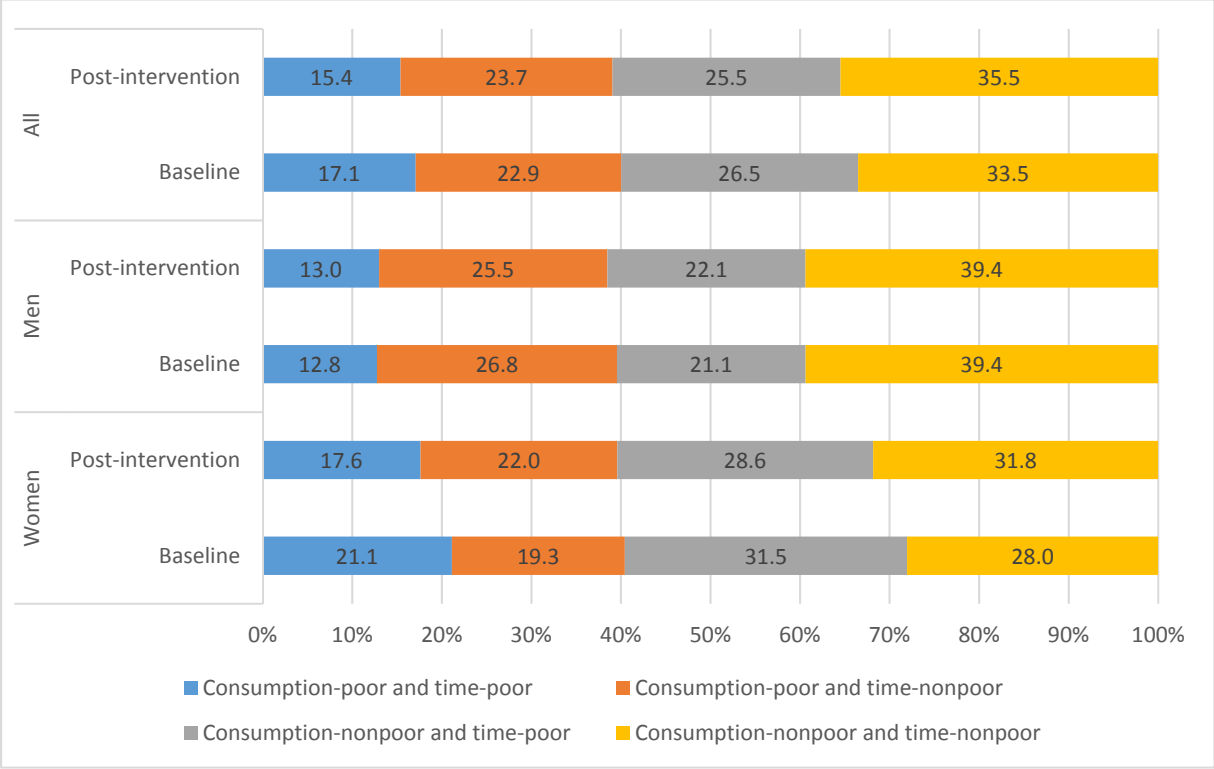
As we saw, the ECE expansion reduces time deficits among women in beneficiary households, but it does increase time deficits among men slightly. We now turn to examining the extent to which the joint distribution of time and consumption poverty have changed among men and women from the direct effects of the policy intervention (figure 4-21).

The incidence of the double bind declined among employed women by 3.5 percentage points (about 154,000 persons). We also found that the percentage of women in the "consumption-nonpoor and time-poor" category fell by 2.9 percentage points (129,000 persons). These findings are consistent with the reduction in time deficits among poor and nonpoor women

that we reported earlier (figure 4-19). They point to a marked reduction in the time poverty rate of women by 6.4 percentage points (283,000 persons).

On the other hand, mirroring the slight increase in time deficits among men, the percentage of men in the double bind and in the "consumption-nonpoor and time-poor" group increased slightly by 0.2 points and 1.1 points, respectively. As a result, the time poverty rate among men increased slightly, by 1.3 percentage points (53,000 persons). These numbers indicate that the decline among women in both the time-poor categories was more than sufficient to offset the slight increases among men. Overall, therefore, the direct effects of the policy intervention led to a decline in the incidence of time poverty, especially among the consumption-poor women.

Figure 4-21 Direct Effect of the Expansion of ECE on the LIMTCP Distribution of Employed Persons (15–70 years of age) in Beneficiary Households by Sex (percent), Tanzania



Turning to the effects on consumption poverty, we found an overall decline of 1 percentage point, with men experiencing a slightly larger decline than women (by about 0.3 percentage points). The greater decline among men is explained by the spillover effect they

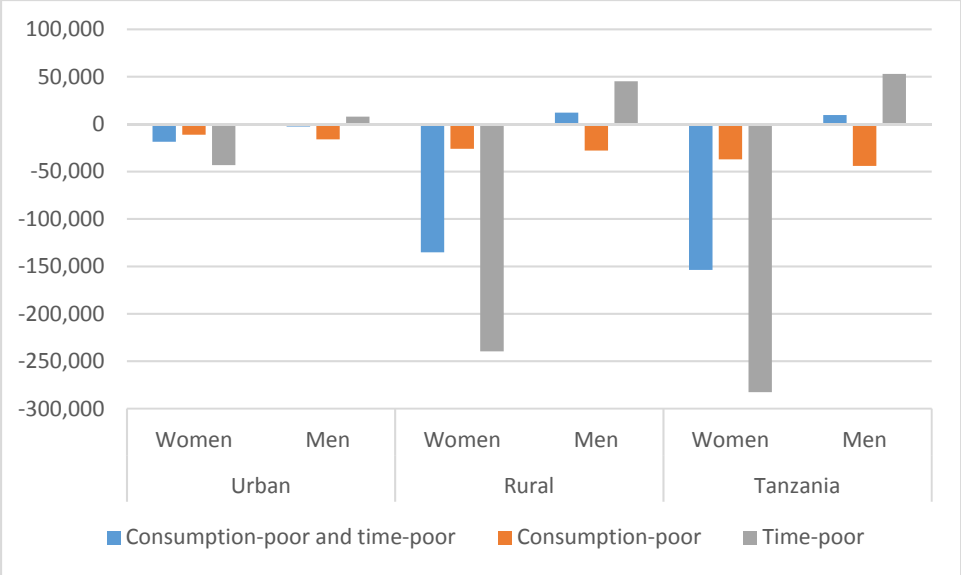
enjoyed, which we identified in our discussion of Ghana. That is, the consumption poverty status of men changes from poor to nonpoor because the policy intervention eliminates the impoverishing effects of time deficits of women in their households. We can observe the reflection of this outcome in the decrease in the percentage of men in the "consumption-poor and time-nonpoor" category.

On the other hand, the percentage of women in this group increases as a result of the fact that a substantial proportion of women in the double bind are escaping only the predicament of time poverty and continue to remain consumption-poor. Consequently, the observed increase in the proportion of women with neither deficit (up by 3.8 percentage points, or 166,000 persons) is mainly driven by the decline in time poverty among consumption-nonpoor women, as reflected in the fall of the percentage of women in the "consumption-nonpoor and time-poor" group (down by 2.9 percentage points, or 129,000 persons). For men, there is no change in the proportion of them falling in the category with neither deficit, but there is a slight increase (1.1 percentage points, or 43,000 persons) in the "consumption-nonpoor and time-poor" category.

Just as in Ghana, the majority of the consumption-poor and majority of the time-poor live in the rural areas of Tanzania. Accordingly, we also expect to see the majority of those who escape these deprivations belonging to rural households (figure 4-22). However, the rural share in the decline in the number of consumption-poor households was lower than the rural share in the actual number of consumption-poor households (66 percent versus 84 percent). The reason behind this discrepancy is the lower percentage of women that make the transition from the double bind to consumption-nonpoor status in rural areas compared to urban areas. This can be seen in the figure by comparing the size of the "consumption-poor" bar relative to the size of the "consumption-poor and time-poor" bar in the two areas. The opposite pattern prevailed for time poverty: the rural share in the decline in the number of time-poor was higher than its share in the actual number of time-poor (85 percent versus 76 percent). We can attribute this finding to a faster decline in the double bind among rural women. Although the percentage decline in the number of time-poor women among the consumption-nonpoor was higher in urban than in rural areas, it was more than offset by the more rapid decline in time poverty among consumption-poor women in rural than in urban areas. We should also note that the latter was large enough to overwhelm the slight increase in the number of rural men in the double bind. The spillover effect for men that we noted above is starkly evident here in that in spite of the increase of those in the

double bind, the number of consumption-poor men fell. As demonstrated in the figure, the same phenomenon also exists for rural men.

Figure 4-22 Reduction in the Number of Employed Persons in the Double Bind of Consumption Poverty and Time Poverty as a Result of the Direct Effects of the Expansion of ECE, by Location and Sex, Tanzania



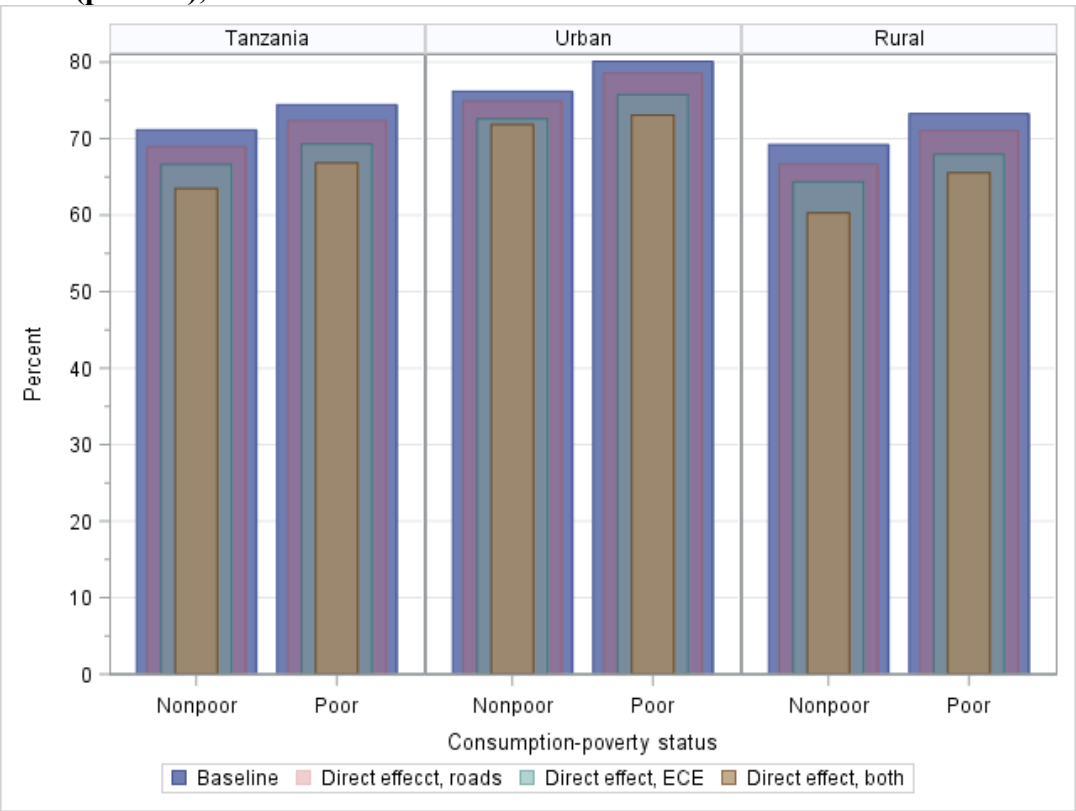
The households with young children also potentially benefit from the road improvements via the lowering of commuting thresholds. We can therefore view the direct effects of the two interventions on time poverty and consumption poverty in a comparative light. We can also examine their combined effects on households with young children.[21] As we have seen, the direct effects of road improvements are quite small in both countries, although the effects in Tanzania were less small. Hence, we conduct this analysis only for Tanzania.

We estimate that the combined effect of the policy interventions, if they were to coincide, will be to reduce the number of time-poor households with young children by 10 percent (about 244,000 families) in Tanzania. The time poverty rate of households falls by 7.6 percentage points to 64.7 percent. Rural nonpoor families experience a slightly larger decline in the incidence of time poverty than poor families (in both urban and rural areas), while urban nonpoor families

[21] We cannot conduct such an exercise for all employed households meaningfully because the potential direct benefits from expanding ECE are limited to households with young children. Consequently, any combined direct effects that we observe for all employed households are merely a mechanical reflection of the influence of households with young children on the outcomes for all households taken together.

encounter a notably smaller decline (figure 4-23). Rural nonpoor households benefit disproportionately in the sense that their share in the total reduction in the number of time-poor households is above their share in the total number of time-poor households in the baseline (54 percent versus 44 percent, respectively). In the same vein, the urban nonpoor households fail to gain proportionately (19 percent versus 10 percent), while the poor households in rural and urban areas maintain their shares in the baseline (30 percent and 7 percent). As the estimates make clear, the impact of expanding ECE exceeds that of road improvements in reducing time poverty rates.

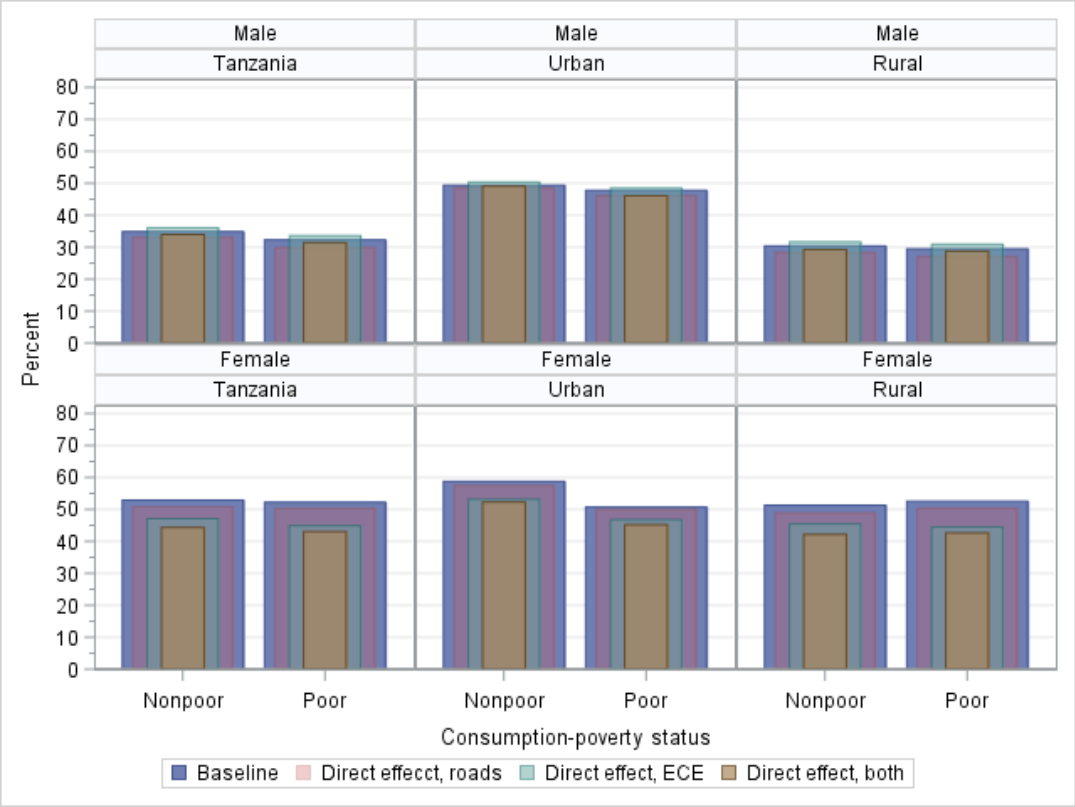
Figure 4-23 Direct Effects of Road Improvements and Expansion of ECE on the Rate of Time Poverty among Employed Beneficiary Households, by Location and Consumption Poverty Status (percent), Tanzania



Note: The figure compares the actual rate of time poverty ("baseline") to simulated scenarios with alternative policy interventions. "Direct effect, roads" refers to the time poverty rate that would prevail with improvements in the quality of roads *alone*, while "direct effect, ECE" indicates the rate associated with expanding ECE *alone*. Finally, the time poverty rate associated with the *simultaneous* implementation of both interventions is indicated by "direct effect, both."

Since a household is considered time-poor only if it has at least one time-poor person, the driving force behind the decline in household time poverty is the decline in the time poverty of individuals. We found that the simultaneous implementation of both policies would result in about 422,000 employed persons in households with young children becoming free of time deficits. The fall represents a decline of 11 percent in the number of time-poor persons and a fall of 5 percentage points in the rate of time poverty among employed persons. The decrease was heavily concentrated among women: 92 percent of all those who escaped time poverty were women, while they account for a much lower share (59 percent) of the baseline number of (actual) time-poor persons. Accordingly, the rate of time poverty among women fell by nearly 9 percentage points to 44 percent, while for men the decline was only by 1 percentage point, to 33 percent. As we saw before (figure 4-22), the result of the expansion of ECE alone was an *increase* in the number of time-poor men. Thus, the decline in the number of time-poor men resulting from the simultaneous improvement in the availability of childcare services and road conditions must be the result of the latter. The evidence regarding men's rates of time poverty confirms this notion (figure 4-24). For women, each policy intervention taken individually results in a decline in their rate of time poverty. Among women, those in consumption-poor households experienced a slightly higher reduction in the incidence of time poverty than those in consumption-nonpoor households (9.2 percentage points versus 8.6 percentage points).

Figure 4-24 Direct Effects of Road Improvements and Expansion of ECE on the Rate of Time Poverty among Employed Persons (15–70 years of age) in Beneficiary Households, by Sex, Location, and Consumption Poverty Status (percent), Tanzania



Note: The figure compares the actual rate of time poverty ("baseline") to simulated scenarios with alternative policy interventions. "Direct effect, roads" refers to the time poverty rate that would prevail with improvements in the quality of roads *alone*, while "direct effect, ECE" indicates the rate associated with expanding ECE *alone*. Finally, the time poverty rate associated with the *simultaneous* implementation of both interventions is indicated by "direct effect, both."

We had discussed before (section 4.1) that the direct effect of both interventions on the rate of consumption poverty would be via reducing the number of the hidden poor, i.e., those who have consumption expenditures that are above their official poverty line but below their poverty line modified by the monetized value of their time deficits. Both interventions serve to reduce the time deficits incurred by households, but even if the time deficits were to disappear for those below the official poverty line, their consumption poverty status would not change. However, those in the ranks of the hidden poor can exit out of consumption poverty if the direct effect of the policy interventions were to eliminate their time deficits.

Our estimates showed that the simultaneous implementation of the two policy interventions cut the number of hidden poor households by 19 percent (42,000 households) in

Tanzania, where the hidden poverty rate falls from 6.9 percent to 5.6 percent among households. Accordingly, we can also observe declines in the incidence of hidden poverty among children as well as employed males and females. The families that exited hidden poverty consisted of 69,000 employed males, 62,000 employed females, and 153,000 children under the age of 15 years. In terms of proportionate change, the groups of individuals displayed rates of decline that were approximately the same as that of households (around 20 percent). Most of the fall appears to be driven by the ECE expansion rather than improvements in road conditions, which is consistent with our findings regarding the reductions in time poverty.

Table 4-3 Direct Effects of Road Improvements and Expansion of ECE on the Rate of Hidden Poverty among Beneficiary Households and Individuals (percent), Tanzania

		Baseline	Direct effect, roads	Direct effect, ECE	Direct effect, both
Tanzania	Households	6.9	6.5	6.1	5.6
	Employed male	8.1	7.6	7.0	6.4
	Employed female	6.7	6.3	5.9	5.3
	Children	6.9	6.5	6.0	5.5
Urban	Households	9.9	9.8	8.9	8.8
	Employed male	11.7	11.3	9.8	9.6
	Employed female	10.0	9.8	8.7	8.6
	Children	10.0	9.8	8.7	8.5
Rural	Households	6.0	5.5	5.2	4.6
	Employed male	7.2	6.7	6.3	5.6
	Employed female	5.9	5.5	5.2	4.5
	Children	6.1	5.8	5.4	4.8

Note: The table compares the actual rate of hidden poverty ("baseline") to simulated scenarios with alternative policy interventions. "Direct effect, roads" refers to the hidden poverty rate that would prevail with improvements in the quality of roads *alone*, while "direct effect, ECE" indicates the rate associated with expanding ECE *alone*. Finally, the hidden poverty rate associated with the *simultaneous* implementation of both interventions is indicated by "direct effect, both." Employed persons as defined in the table are employed persons ages 15 to 70 years. Children are defined as persons below the age of 15 years.

4.4 Total Effects of Policy Interventions

We identified the indirect effects of the policy interventions earlier (section 4.1). The indirect effects stem from the job creation associated with policy interventions. Job creation potentially affects the time allocation between household production and employment of *all* individuals in households with the newly employed individual(s). In turn, the changes in time allocation can lead to changes in the time deficits of individuals and households. From our standpoint, the

central issue here is whether the new employment carries with it the penalty of time poverty. For households that experienced changes in time allocation and ended up with time deficits, their adjusted poverty line (P_j^M) will also change. Of course, the other side of job creation is the generation of additional income for the household that goes toward increased consumption expenditures. For households that are actually below the poverty line, the crucial question we ask is: Does the additional income allow them to escape consumption poverty? Households with no time deficits in the new scenario would only need to overcome their poverty gap relative to their official poverty line, while for those with time deficits in the new scenario, the additional earnings should be able to outstrip the sum of their official poverty line and monetized value of their household time deficit.

It is essential to bear in mind that the potential effects of the policy interventions are dissimilar between households with young children and other households. The direct effects of the expansion of ECE are confined to families with young children. These effects are generated by changes in the required hours of household production of the individual due to changes in both household-level thresholds of household production and the intrahousehold division of household production. Further, employed time-poor persons in households with young children also experience a decline in their time deficits from the direct effects of the road improvements via the lowering of commuting thresholds. The indirect effects of job creation associated with policy interventions will also be found among households with young children, as they were as likely as other households to have newly employed persons in our study.

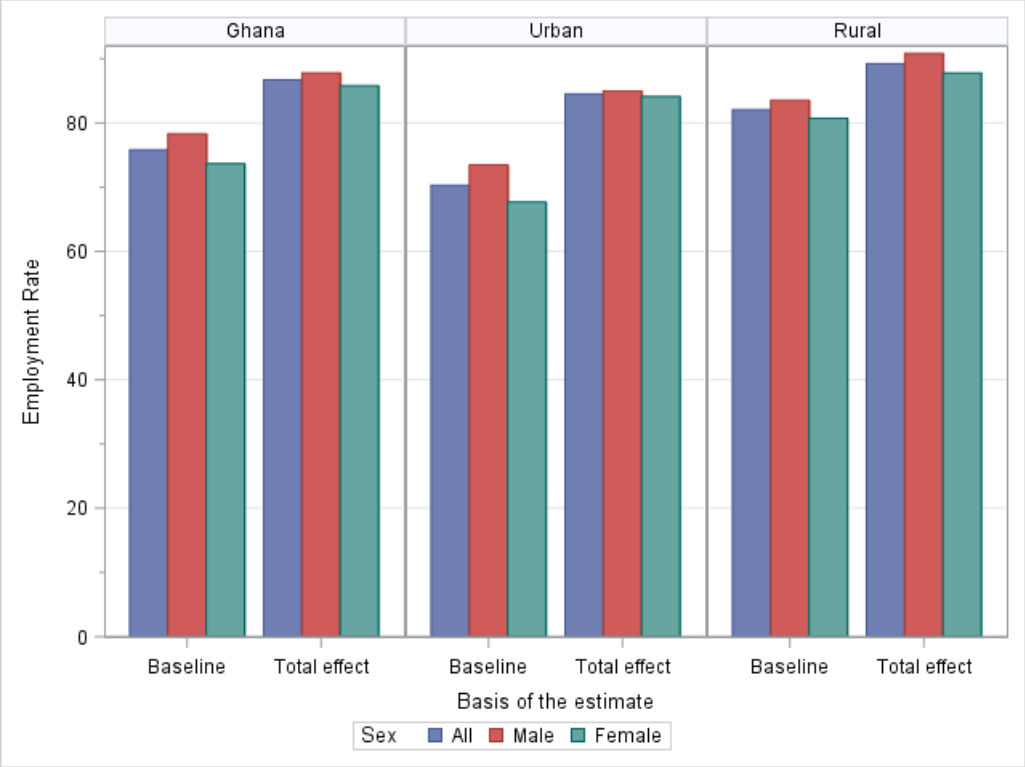
In sum, the total effect of the policy interventions on households with young children is an amalgamation of the effects of: (a) the expansion of ECE on their household-level thresholds of household production; (b) the improvement of roads on the time deficits of employed persons in their households via the lowering of commuting thresholds; (c) changes in the intrahousehold division of labor due to the ECE expansion and additional employment; and (d) job creation on hours of employment and household income (consumption expenditures). For other households, there is no direct effect from the ECE expansion (i.e., their household-level thresholds of household production are unchanged). Also, the changes in the intrahousehold division of household production among them are solely due to additional employment. Of course, the direct effects of road improvements and effects of job creation are also found among them.

4.4.1 Ghana

The phenomenon of time deficits is almost exclusively found among employed persons. Job creation, therefore, carries with it the possibility of increasing the number of time-poor persons. We found that the policy interventions reduced the percentage of persons ages 15–70 years without employment from 24 percent to 13 percent in Ghana. The change represented an addition of about 1.68 million persons to employment.[22] Among the employed, the incidence of time poverty is higher for women given their higher share of household production responsibilities. Since underemployment and nonemployment are more prevalent among women, it is not surprising that women gained a larger share of new employment (60 percent) compared to men; this is higher than their share in baseline employment (52 percent). It is also notable that among women, those in urban areas experience a much sharper increase than those in rural areas. About 73 percent of the new female employment was in urban areas. The resulting changes in the employment rate broken down by sex and urban/rural location indicate that the gender disparity in the employment rate almost vanishes with the job-creation effect, labeled as "total effect" in figure 4-25.

[22] In addition, we estimate that about 68,000 persons that were self-employed or unpaid family workers switched employment to become wage/salary workers.

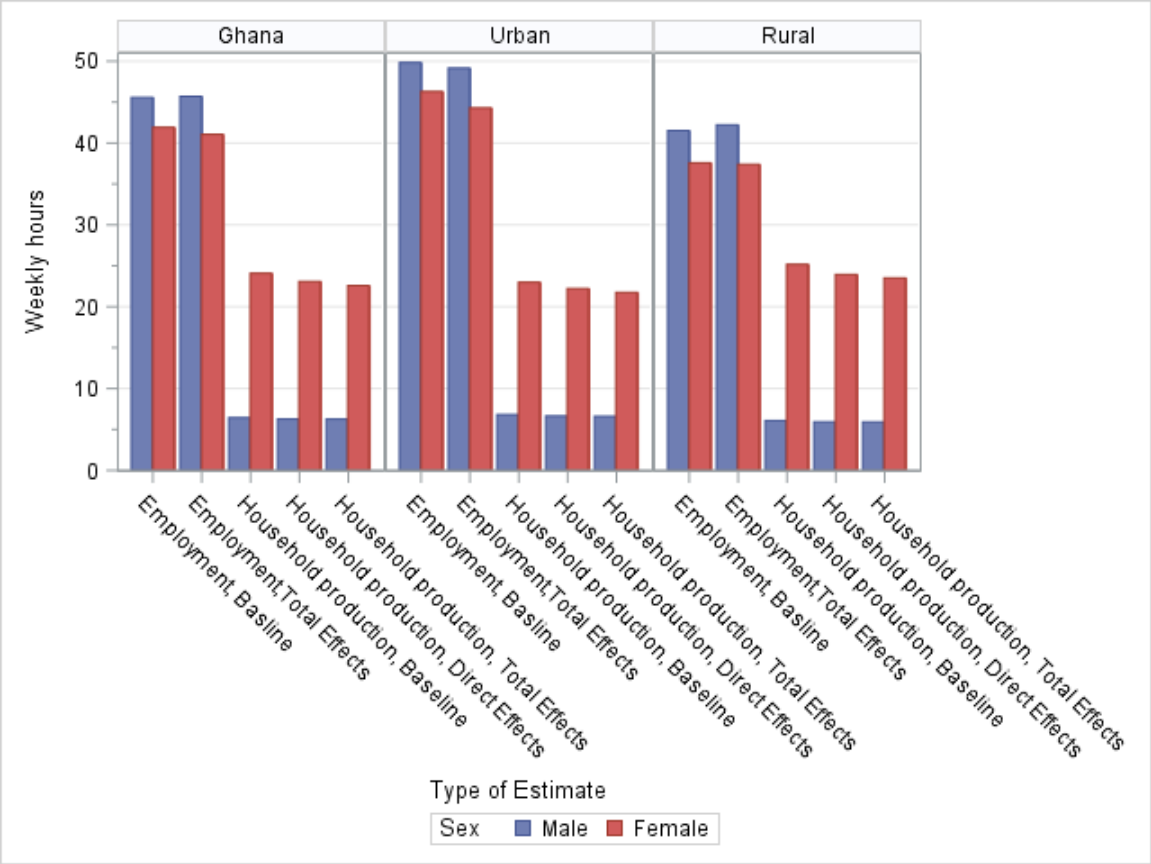
Figure 4-25 Employment Rate by Sex and Location of Persons 15–70 Years of Age (percent), Actual (baseline) and Simulated, Ghana



Note: "Total effect" in this figure refers to the simulated scenario that accounts for the job-creation impact of the policy interventions.

How did the increase in the employment rate affect time allocation between required household production and employment? We found that the average hours of employment and household production did not change much for men (figure 4-26). However, for women in both urban and rural areas, average hours of required household production decline as a result of job creation. Compared to the baseline, their averages are already about an hour lower per week after accounting for the direct effects associated with expanding ECE (section 4.3.1). Once the indirect effects of job creation are also incorporated into our estimates (labeled "total effects"), the average hours are even lower for women—by roughly 90 minutes per week. For urban women, unlike other groups that we have shown in the figure, there is also a decline in average hours of employment (approximately 120 minutes per week) because the new entrants into the ranks of the urban working women seem to have fewer hours per week at the job, unlike their rural counterparts.

Figure 4-26 Average Weekly Hours of Employment and Required Household Production of Employed Persons (15–70 years of age) by Sex, Actual and With Policy Interventions, Ghana

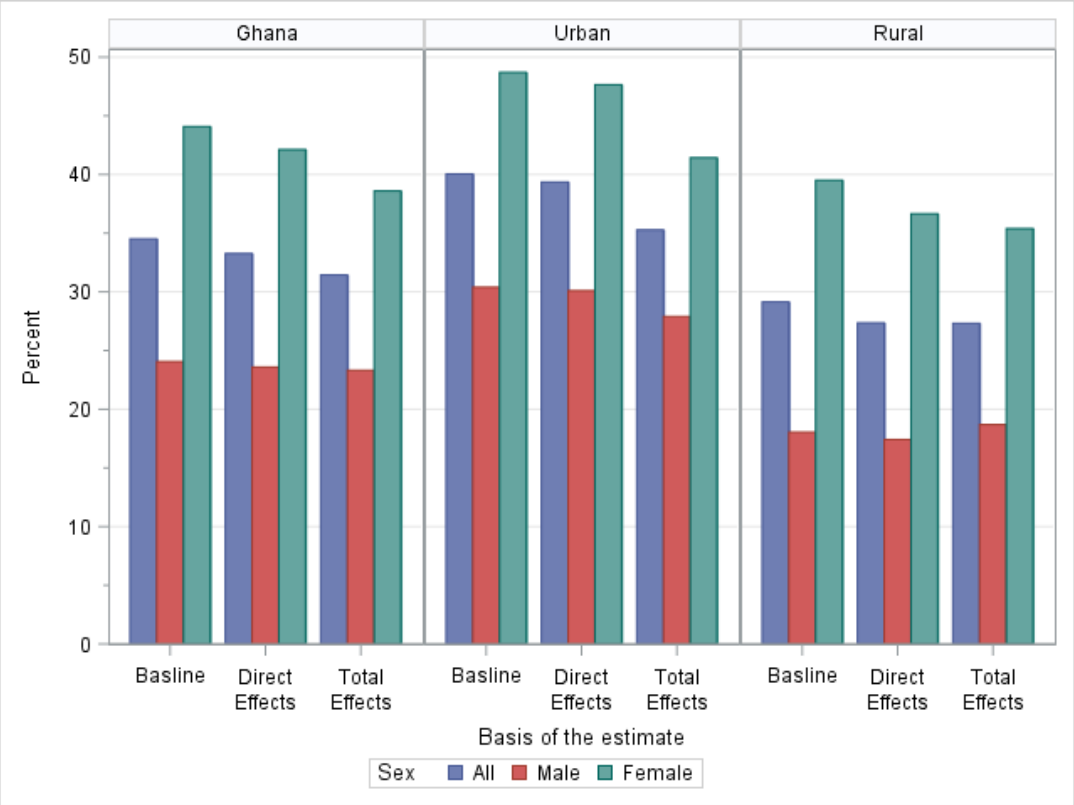


Note: "Baseline" refers to the actual situation or the situation without the policy interventions. Total effects for employment are the hours of employment after accounting for the job-creation impact of road improvements and expanding ECE. Total effects for household production are the hours of household production after accounting for the direct impact of expanding ECE and the job-creation impact of road improvements and expanding ECE. Direct effects for household production are the hours of household production after accounting for the direct impact of expanding ECE.

The total effects of the policy intervention thus lowered women's average hours of employment and required household production nationally. For men, on the other hand, there were no notable changes. The outcomes would lead us to expect a decline in the incidence of time poverty among women and no change for men. Our estimates bear out this intuition and show an overall reduction of 5 percentage points (44 percent to 39 percent) in the time poverty rate of women as a result of total effects (figure 4-27). The decline is found to be more substantial among urban than rural women, in line with our findings described above regarding the changes in their average hours of employment and required household production. In spite of the decline in the rate of time poverty, compared to the baseline, the number of time-poor women

actually increased by about 47,000 due to total effects, a reflection of the growth in women's employment. It is useful to note here that the number of time-poor women had fallen by about 125,000 as a result of the direct effects of roads improvement and expanding ECE. Thus, although the newly employed women appear to be less prone to time deficits than the already employed, the incidence among them is high enough to increase the number of time-poor women. All of the increase took place in urban areas, which is where most of the female employment growth occurred.[23]

Figure 4-27 Time Poverty Rates of Employed Persons (15–70 years of age) by Sex and Location, Actual and With Policy Interventions, Ghana



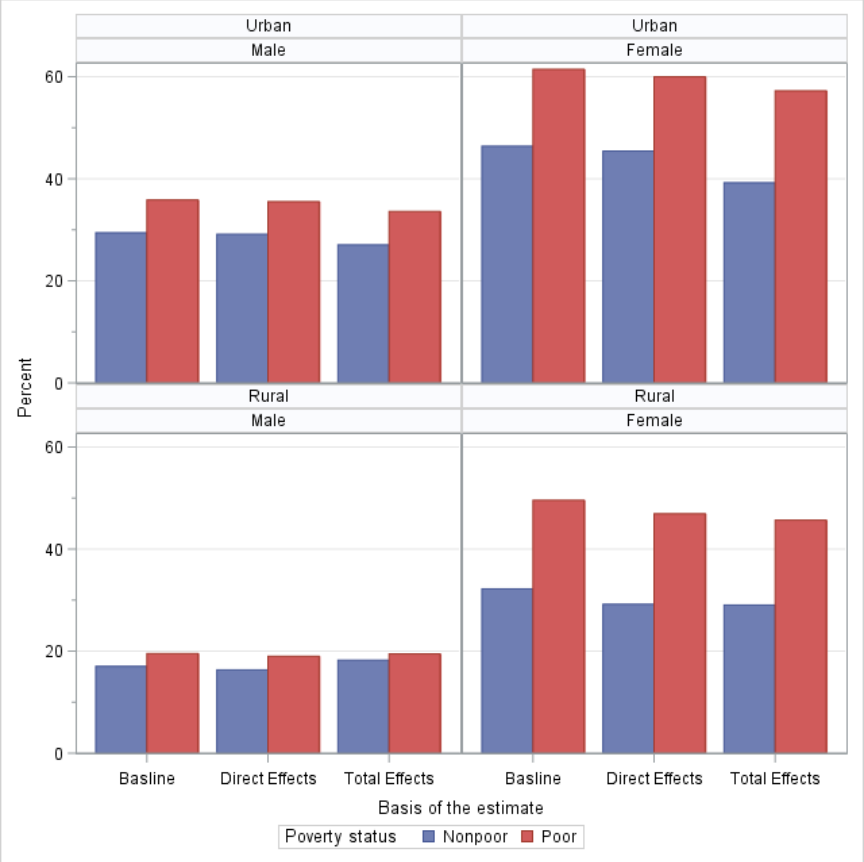
We now turn to examining whether the changes in the time poverty rate were differentiated across the LIMTCP poverty line. Actual (baseline) time poverty rates are higher for poor than nonpoor men; that ranking continues to hold after accounting for the total effects of the policy interventions, at roughly similar levels as in the baseline (figure 4-28). Poor women

[23] In the rural areas, even the absolute number of time-poor women declined by 3 percent, or about 32,000 persons. This is in contrast to an increase of 163,000 in the total number of time-poor in the country as a whole.

encountered a higher rate of time poverty than nonpoor women in the baseline and after accounting for the effects of the policy interventions. However, the interventions reduced the incidence of time poverty more among nonpoor urban women than poor urban women (7 percentage points versus 3 percentage points, respectively) and about equally among nonpoor rural women and poor rural women (roughly 3 percentage points each). Among poor women, the decline in the rate of time poverty was also accompanied by reductions in the absolute number of time-poor persons, while among nonpoor women, it occurred alongside an increase in the number of time-poor women. Thus, the increase in the size of the time-poor female population that we noted in the previous paragraph occurred among nonpoor women, primarily in the urban areas. We can infer from this outcome that the job creation among women due to the policy interventions was predominantly concentrated among nonpoor households—a point that we discuss further below. The estimates also show that the newly employed among the urban women encountered a lower rate of time poverty than their already-employed counterparts: the decline in the incidence of time poverty for urban women can mostly be attributed to the job-creation effects. In contrast, for rural women, almost all of the decline in the rate of time poverty can be attributed to the direct effects of road improvements and expanding ECE.[24]

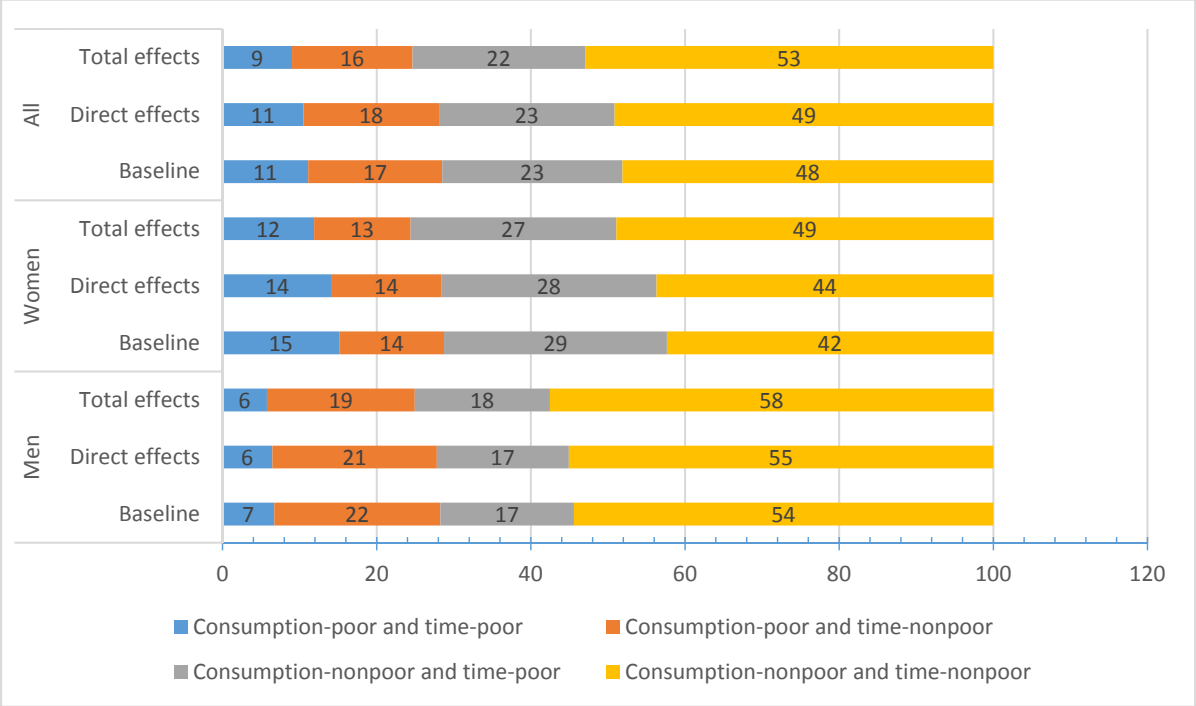
[24] In addition to its incidence, it is also important, just as with any form of deprivation, to examine the extent of the deprivation among those who are deprived. Our estimates showed that the average value of time deficits remained roughly unchanged, at about 19 hours per week, for all employed time-poor persons. This near-constancy holds for the subgroups differentiated by sex and consumption poverty status.

Figure 4-28 Time Poverty Rates of Employed Persons (15–70 years of age) by Sex and Consumption Poverty Status, Actual and With Policy Interventions, Ghana



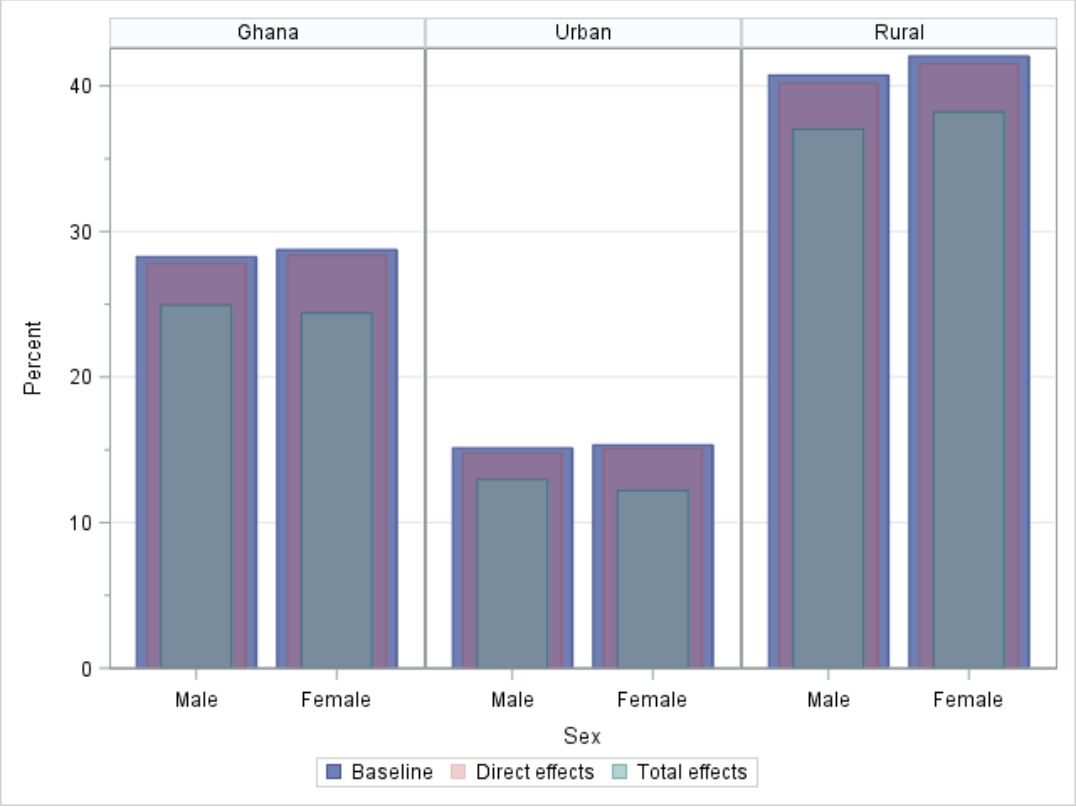
The decline in the incidence of time poverty among poor women implies that the percentage of women bearing the double burden of time and consumption poverty has declined as a result of the policy interventions. We estimate that employed women encountering the double bind fell by as much as 3 percentage points, to 12 percent (figure 4-29). The change amounts to an absolute reduction of about 80,000 persons. The percentage of women with neither consumption nor time deficits increases by 7 percentage points, as implied by the fall in the rate of time poverty among nonpoor women. On the other hand, the "time-nonpoor and consumption-poor" category and the "time-poor and consumption-nonpoor" category shrink in terms of their shares of the total employed women. These changes are mainly driven by the indirect effects of job creation rather than the direct effects of the ECE expansion and road improvements.

Figure 4-29 LIMTCP Distribution of Employed Persons (15–70 years of age) by Sex (percent), Actual and With Policy Interventions, Ghana



Turning now to the changes in the incidence of consumption poverty among the employed that is associated with the changes in the LIMTCP distribution described above, we find that the decline is slightly higher among women than men (4 percentage points versus 3 percentage points, respectively). We find that one out of every four employed persons continues to be consumption-poor after accounting for the effects of the policy interventions (figure 4-30). Poverty rates fell the most in rural areas, where male and female poverty both declined by about 4 percentage points. The declines in the incidence of poverty were sufficient to reduce the number of the employed poor among all of the subgroups shown in the figure. For Ghana as a whole, the number of employed poor fell by 1 percent, or about 38,000 persons, to reach a level of 3.29 million persons.

Figure 4-30 Rate of Consumption Poverty among Employed Persons (15–70 years of age) by Location and Sex (percent), Actual and With Policy Interventions, Ghana

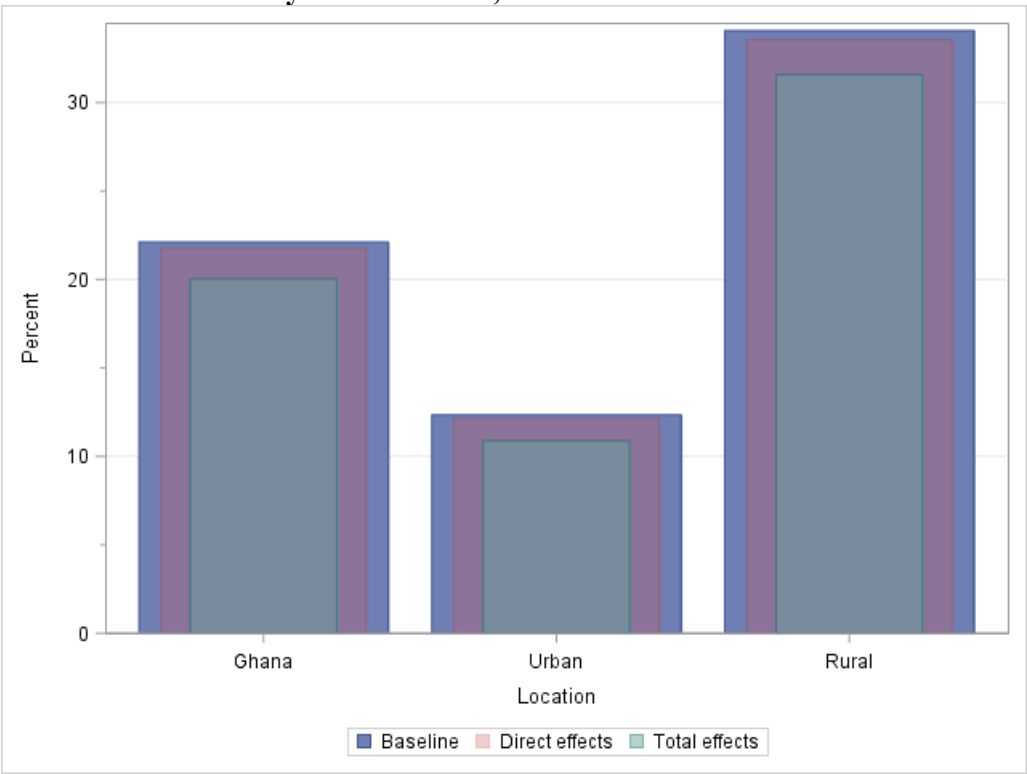


Mirroring the decline in the incidence of poverty among employed persons, the rate of consumption poverty of employed households also declined (from 22.1 to 20.0 percent) as a result of the policy interventions (figure 4-31). The number of consumption-poor employed households also fell by about 62,000 households as a result of the policy interventions.[25] We found that the decline in the poverty rate was somewhat higher in rural areas than urban areas (2.5 percentage points and 1.5 percentage points, respectively). Accordingly, rural areas accounted for 60 percent of the fall in the total number of poor households. In spite of the fall in the poverty rate and number of poor people, there was almost no change in the average amount of unmet consumption expenditures (the gap between the LIMTCP poverty line and household consumption expenditures) among the consumption-poor households. The average deficit was

[25] While it may seem counterintuitive that the fall in the number of employed consumption-poor households exceeds the fall in the number of employed consumption-poor persons, it is a plausible outcome that reflects an increase in the average number of employed persons in consumption-poor households. Suppose that there were ten poor households in the baseline with each of them having a single employed person as a member. If job creation were to halve the number of consumption-poor households and yet increase the average number of employed persons per poor household to, say, two, there will be no change in the number of employed consumption-poor persons.

GH₵1,874 and GH₵2,443, respectively, in the rural and urban areas after accounting for the effects of the policy interventions. As a percentage of the preintervention levels, they both constitute about 96 percent.

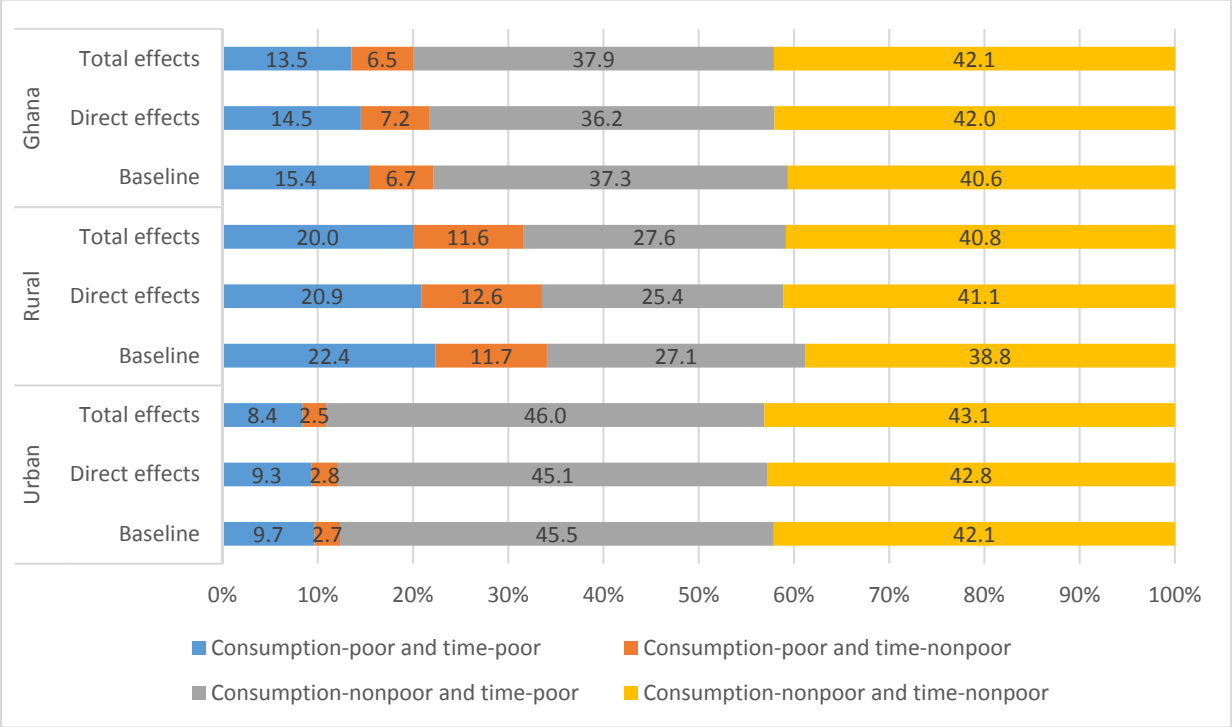
Figure 4-31 Rate of Consumption Poverty among Employed Households by Location (percent), Actual and With Policy Interventions, Ghana



We estimated that the decline in consumption poverty due to total effects in Ghana was split between the time-poor and time-nonpoor segments of the consumption-poor households because the share of each group in the population fell (figure 4-33). Interestingly, in the rural areas, the decline in the share of the time-poor segment does not change much between the direct and total effects simulations, suggesting that the decrease in time poverty among the consumption-poor households was mainly due to the expansion of ECE and improvements in roads. In contrast, we find that in the urban areas, the reduction in the time-poor segment due to direct effects is much smaller compared to that due to job creation. It is notable in both urban and rural areas, direct effects by themselves mostly reshuffle households between the time-poor and time-nonpoor segments on both sides of the consumption poverty line, while job-creation effects are the main factor behind the reduction in the rate of consumption poverty. But job creation

often carries with it the penalty of time deficits, which is reflected in the accompanying increase in the share of the time-poor segment of the consumption-nonpoor group due to total effects. This is reflected in our finding that the overall time poverty rate among households was not altered substantially from the baseline level by the total effects of the policy interventions.

Figure 4-32 LIMTCP Distribution of Employed Households by Location (percent), Actual and With Policy Interventions, Ghana



We now summarize the changes in the number of consumption-poor households from the baseline to the simulated scenario with policy interventions. The direct effects of road improvements and ECE expansion lowers the time deficits of consumption-poor households in the baseline. For some households, this reduction leads to their LIMTCP poverty line falling below their consumption expenditures and, therefore, facilitates a transition out of poverty. Our estimate of the decrease in the number of consumption-poor households via this mechanism is shown in table 4-4, line 3. For some households, the reallocation of the threshold hours of production among their members that is generated by the ECE expansion can lead to

impoverishing time deficits. We found that the instance of such households was practically negligible in Ghana (table 4-4, line 4). [26]

Policy interventions create jobs that have opposite effects on poverty reduction. Some households that were consumption-poor in the baseline will be able to increase their consumption expenditure beyond their LIMTCP poverty line as a result of their additional earnings. In the table, our estimate of the reduction in the number of consumption-poor households due to this process is displayed on line 6. On the other hand, some households that were consumption-nonpoor after accounting for the direct effects may become consumption-poor because job creation results in impoverishing time deficits for them. The increase in the monetized value of their time deficits (due to changes in time allocation between required household production and employment of household members) raises their LIMTP poverty line to a level that is above their augmented (due to additional earnings) household expenditures. We found that this group (line 7) has a dampening effect on the poverty-reducing impact of job creation. For approximately every eleven consumption-poor households for which job creation facilitates an escape out of consumption poverty, it drags one household into poverty.[27] However, the employment effects on poverty reduction far outstrip those of the direct effects operating via the decrease in the monetized value of time deficits.

[26] There was a single observation with a weighted value of 120 that fitted into this group.
[27] Our estimate of the poverty-reducing impact of job creation is about 93,000 households (line 5), while the poverty-creating impact (line 8) amounts to 9,000 households, a ratio of approximately 11:1.

Table 4-4 Decomposition of the Change in the Number of Consumption-Poor Households (in thousands) Due to Policy Interventions, Ghana

Line		Number (in thousands)			Percentage of baseline		
		Urban	Rural	Ghana	Urban	Rural	Ghana
1	Number in the baseline	424	972	1,396	100.0	100.0	100.0
2	Direct effects						
3	Reduction	-8	-14	-22	-1.8	-1.4	-1.6
4	Addition	0	0	0	0.0	0.0	0.0
5	Employment effects						
6	Reduction	-34	-59	-93	-8.0	-6.1	-6.7
7	Addition	5	3	9	1.2	0.4	0.6
8	Total effects						
9	Total reduction: Lines 3 + 6	-42	-74	-115	-9.8	-7.6	-8.2
10	Total addition: Line 4 + 7	5	3	9	1.2	0.4	0.6
11	Net reduction: Lines 9 + 10	-36	-70	-106	-8.6	-7.2	-7.6
12	Number after interventions: Lines 1 + 11	388	902	1,290	91.4	92.8	92.4

Notes: All households with at least one person between the ages of 15–70 are included in the calculations.
Line 3: Number of households that were nonpoor after accounting for direct effects but were poor in the baseline.
Line 4: Number of households that were poor after accounting for direct effects but were nonpoor in the baseline.
Line 6: Number of households that were nonpoor after accounting for employment effects but were poor after accounting for direct effects.
Line 7: Number of households that were poor after accounting for employment effects but were nonpoor after accounting for direct effects.

A fundamental factor that has limited the scope of employment to reduce poverty in the current context is the nature of the job creation triggered by the policy interventions. The job creation is not targeted to recruit individuals from consumption-poor households. As described in appendix C, those who gain employment or switch to better jobs are individuals that best match the characteristics of individuals who currently hold such jobs. Consumption poverty is not a directly relevant characteristic in determining this outcome, though it exerts an indirect influence in so far as the nonemployed status of the potential job recipient is correlated with their consumption poverty status. In fact, the share of consumption-poor individuals in the actually employed population exceeds their share in the total number of those who gain employment by a considerable margin (29 percent versus 16 percent).

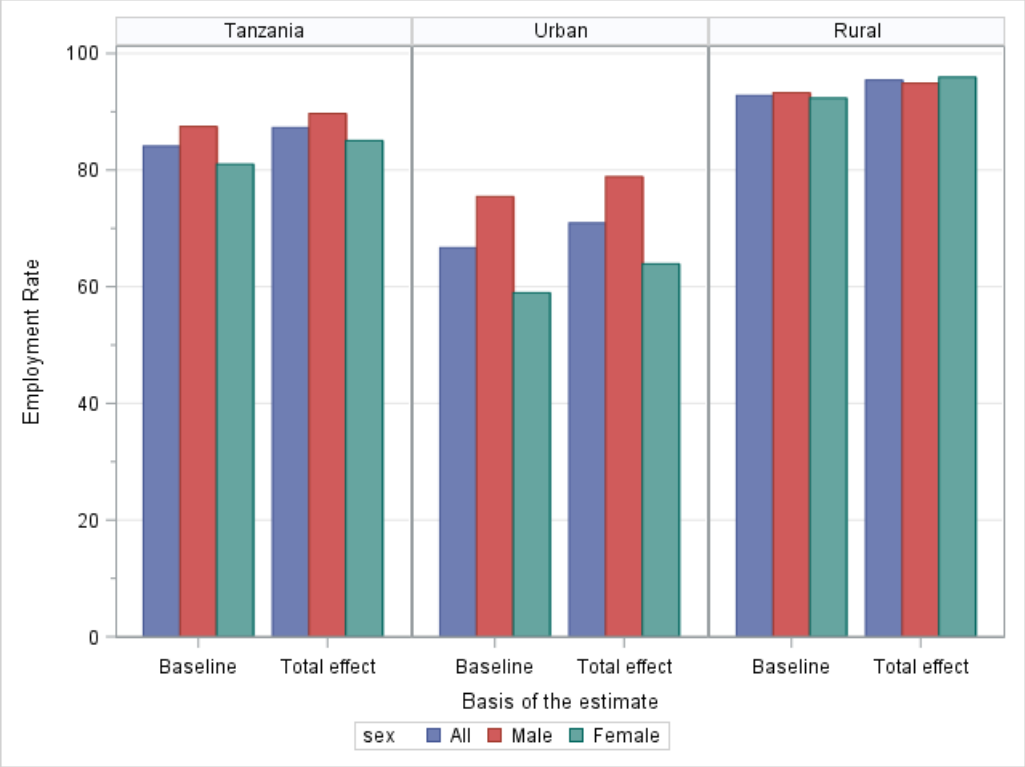
4.4.2 Tanzania

Our estimates showed that the proposed road improvements and ECE expansion would result in an addition of about 722,000 persons (15–70 years old) in employment, representing an increase of 3 percentage points in the employment rate (figure 4-33).[28] The relative increase is highest among urban females and lowest among rural males. The other two groups, i.e. urban males and rural females, saw relative increases that were in tandem with their shares in actual (baseline) total employment. Thus, the new jobs created seem to favor urban females at the expense of rural males. As shown in the figure, the employment rate among urban females is relatively low (59 percent, as compared to a national average of 84 percent). Further, the ECE sector that grows dramatically under our proposed policy intervention is relatively intensive in female labor. Both these factors—availability of large pools of nonemployed females and a policy intervention that creates employment in a sector with relatively high levels of female employment—contributed to the faster growth in the employment of urban women.[29]

[28] Additionally, about 80,000 persons that were self-employed or unpaid family workers switched employment to become wage/salary workers.

[29] Just as in Ghana, there was virtually no change in the distribution of employed persons across different intervals of hours of employment. This is important to note because the incidence of time poverty is higher in intervals with higher hours of employment.

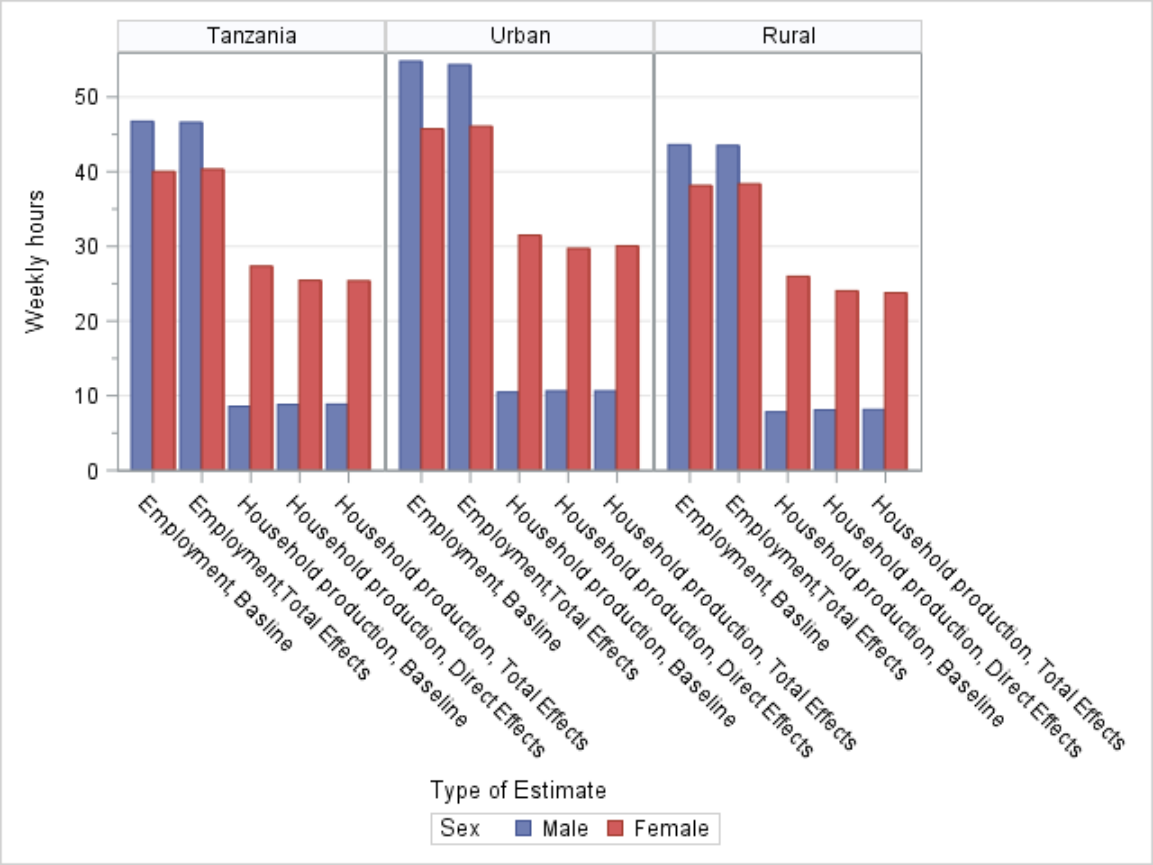
Figure 4-33 Employment Rate by Sex and Location of Persons Ages 15–70 Years (percent), Actual (Baseline) and Simulated, Tanzania



Hours of employment and required household production are the crucial determinants of time poverty. We now turn to examine how these have changed (or not) as a result of job creation. There was practically no change in the average hours of employment for either men or women, indicating that the newly employed workers are not different from those who are already employed in terms of their hours at the job (figure 4-34). The average hours of household production for men remains practically unchanged from the effects of the policy interventions. We had reported earlier that the expansion of ECE had brought about a decline in the average value for employed women in households with young children (figure 4-18). We can observe that decline reflected in the average for employed women in all households in figure 4-34 in the bar labeled "direct effects." When we combine these effects with the effects of job creation, we obtain the item labeled "total effects." The reduction from the baseline appears to be less (about 45 minutes per week) under total effects than direct effects for urban women. In other words, the newly employed urban women had, on average, a greater number of hours of household production than their already-employed counterparts. In contrast, for rural women, both effects indicate the same average hours. Thus, compared to the baseline, the average number of hours of

household production for urban and rural women were lower by 1 hour and 2 hours, respectively, per week.

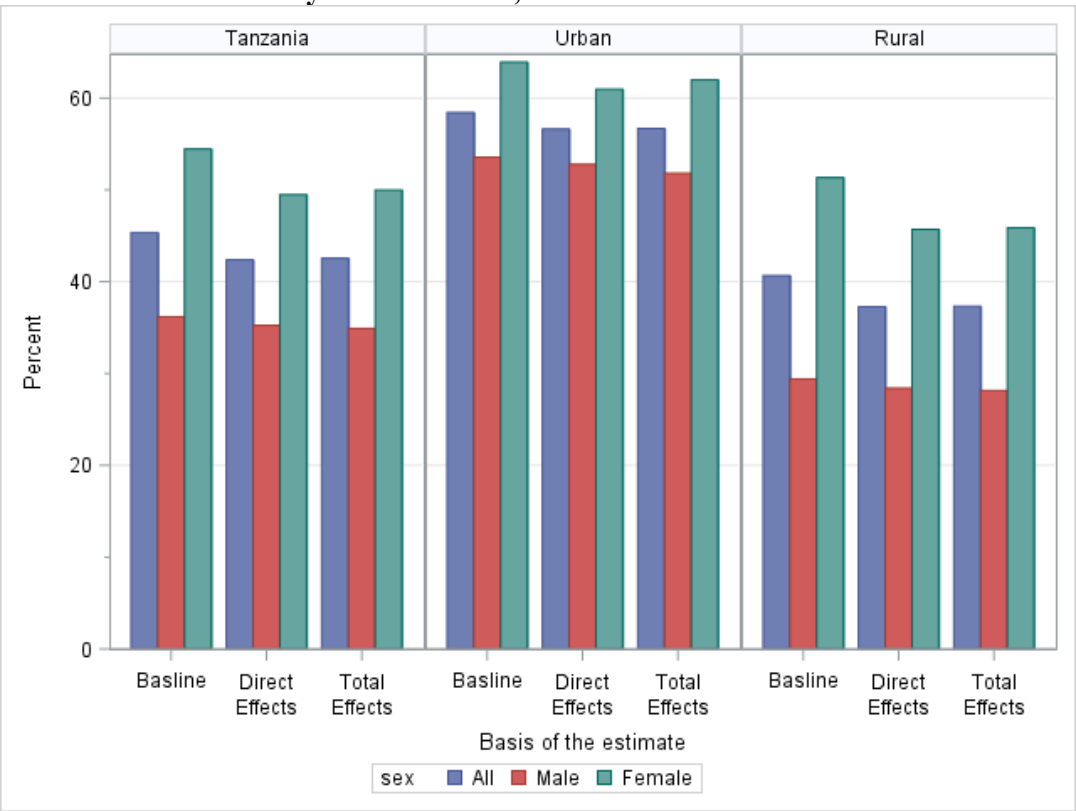
Figure 4-34 Average Weekly Hours of Employment and Required Household Production of Employed Persons (15–70 years of age) by Location and Sex, Actual and With Policy Interventions, Tanzania



Since the average hours of household production declined and hours of employment remained unchanged among women, we would expect a decline in the rate of time poverty among women. Our estimates confirm this intuition (figure 4-35). The decrease was most substantial for rural women and amounted to 5 percentage points, leaving them with a time poverty rate of 46 percent after accounting for the total effects of the policy interventions. Some of the reduction in time poverty due to direct effects is offset by increases due to the total effects for urban women, the group that has the highest time poverty rate (61 percent after accounting for the total effects of the policy interventions). Consistent with the evidence that we presented above regarding the absence of a change in hours of household production and employment, men's rates of time poverty underwent little change as a result of the policy interventions. The

proportionate decline in the time poverty rate was also accompanied by an absolute reduction in the number of time-poor persons, unlike in Ghana. For Tanzania as a whole, the fall was about 226,000 persons, out of which 189,000 were women. However, in urban Tanzania, the number of time-poor persons actually rose by about 94,000 persons, out of which 78,000 were women.

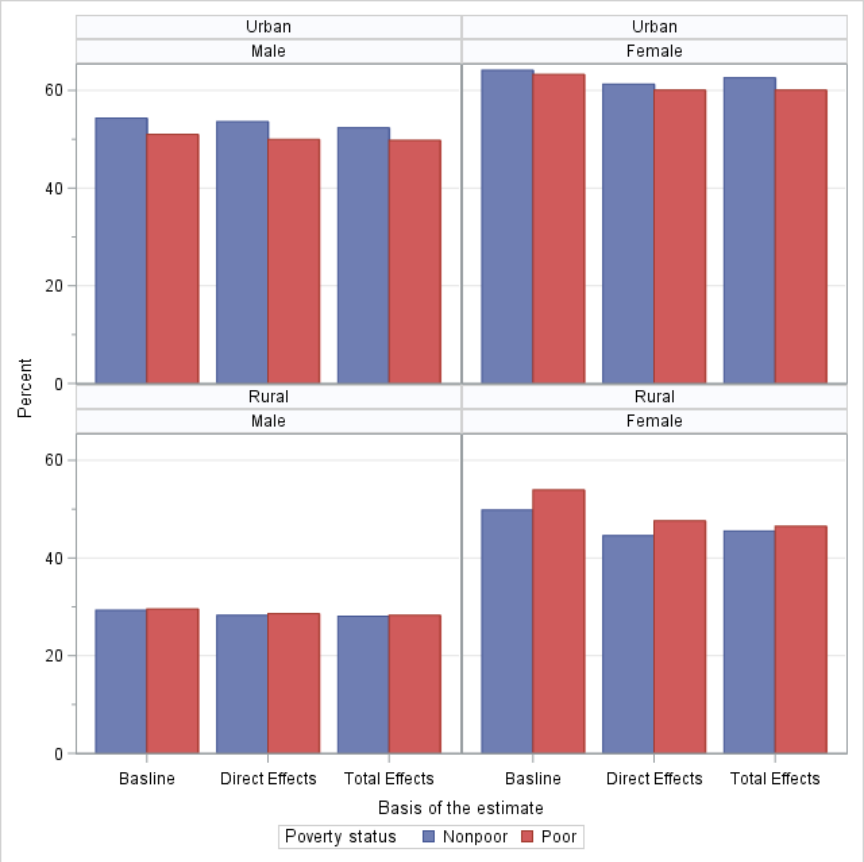
Figure 4-35 Time Poverty Rates of Employed Persons (15–70 years of age) by Sex and Location, Actual and With Policy Interventions, Tanzania



Was there a difference between nonpoor and poor groups in terms of the effects of the policy interventions on time poverty rates? In fact, we found that the most marked decline occurs for rural poor women (figure 4-36). Their rate of time poverty falls from 54 percent in the baseline to 47 percent after the total effects. Nonpoor rural women also experience a decline, but one that is smaller in terms of percentage points (4 percentage points). For both groups, most of the decline occurs as a result of the direct effects of road improvements and ECE expansion. Indeed, policy interventions seem to equalize the time poverty rate between poor and nonpoor rural women. There was also an absolute decline in the total number of time-poor rural women: those in the consumption-nonpoor and consumption-poor segments fell by, respectively, 40,000

and 227,000. For urban women, too, the direct effects lower the incidence of time poverty both among poor and nonpoor women. However, the job-creation effects increase time poverty among nonpoor women while leaving it unchanged among poor women. In fact, the absolute increase in the number of urban time-poor persons that we described in the previous paragraph occurs solely among the consumption-nonpoor (especially women), while the consumption-poor experienced a decline.[30]

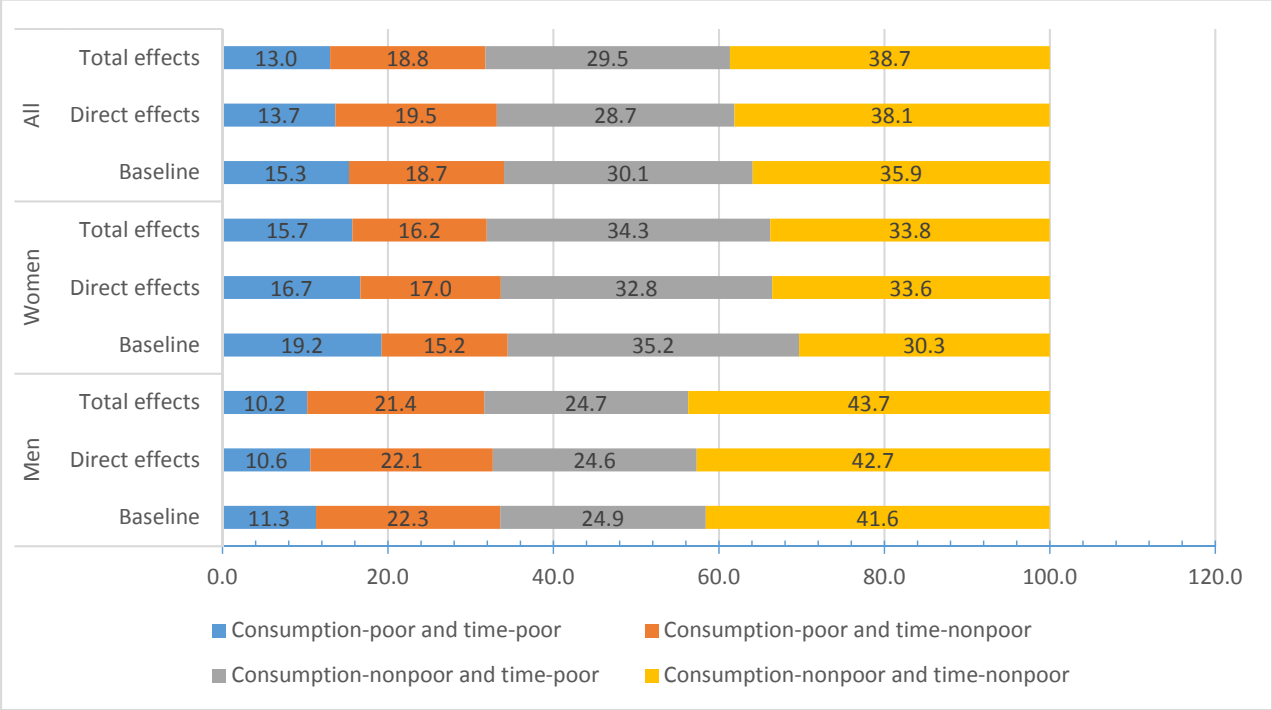
Figure 4-36 Time Poverty Rates of Employed Persons (15–70 years of age) by Location, Sex, and Consumption Poverty Status, Actual and With Policy Interventions, Tanzania



[30] Average time deficits for time-poor persons in the subgroups shown in figure 4-37 did not display much change as a result of the policy interventions, which is analogous to our finding for Ghana. The largest decline occurred for consumption-poor women in the rural areas (95 minutes per week, or about 7 percent), followed by consumption-nonpoor women in the urban areas (66 minutes per week, or about 4 percent). For all the other subgroups, the decline in the average value was less than an hour.

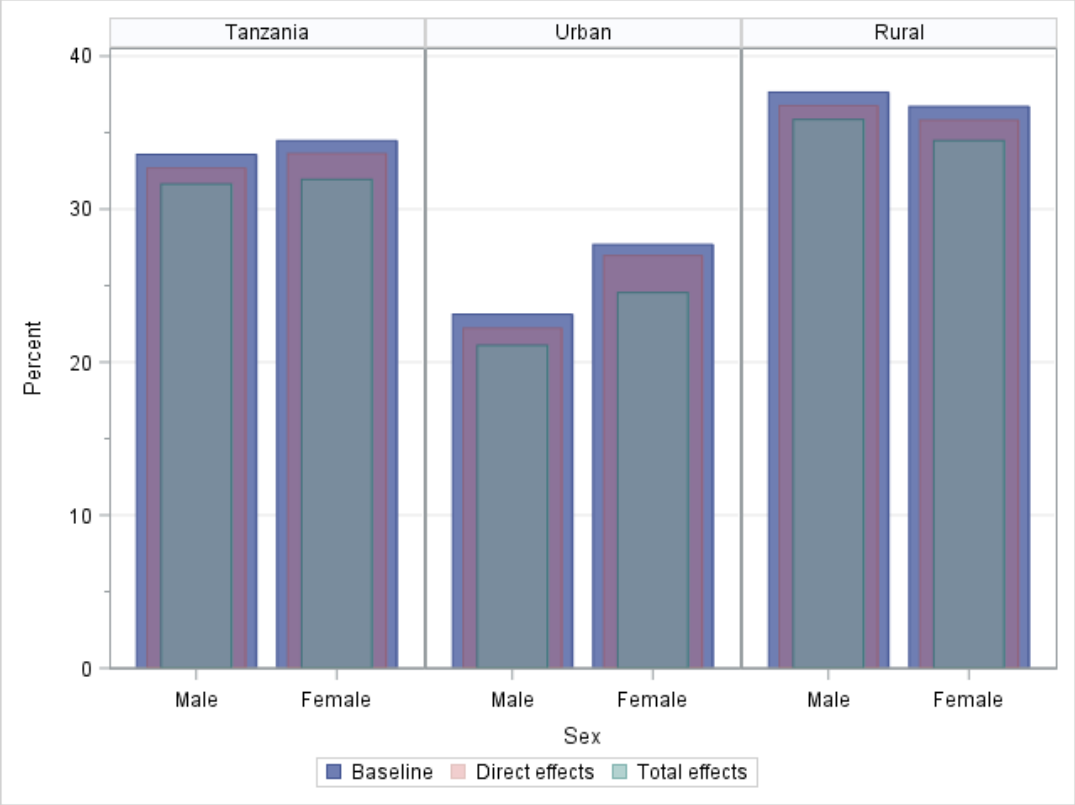
Just as in the case of Ghana, we found that the proportion of women with both time and consumption deficits declined as a result of the policy interventions in Tanzania (figure 4-37). The decline was about 3 percentage points (to 16 percent), which represents approximately 264,000 women. We also found that the percentage of women with neither deficits increased by 4 percentage points to reach a level of 34 percent. Both these outcomes were primarily the result of the direct effects of the policy interventions. Job creation lowers consumption poverty, therefore, we saw a decline (relative to the situation with direct effects) in the percentage of women in both the time-poor and time-nonpoor segments of the consumption-poor group. Job creation also creates time poverty, especially for women, and hence the slight increase (relative once again to the situation with direct effects) in the share of women who are consumption-nonpoor but time-poor. As for men, the direct effects seem to have less notable effects than for women, in accordance with the small changes in their time poverty rates generated by such effects that we observed above. Effects stemming from job creation, on the other hand, lower the proportion of men in the consumption-poor category and increase the percentage of men with neither consumption nor time deficits, relative to the situation with direct effects. Thus, while we observe an increase in the proportion of those with neither deficits for both men and women, the reason behind the growth is different along gender lines. For women, it is the direct effects of road improvements and expanding ECE on lowering time poverty; for men, the decisive factor is the effects of job creation.

Figure 4-37 LIMTCP Distribution of Employed Persons (15–70 Years of Age) by Sex (percent), Actual and With Policy Interventions, Tanzania



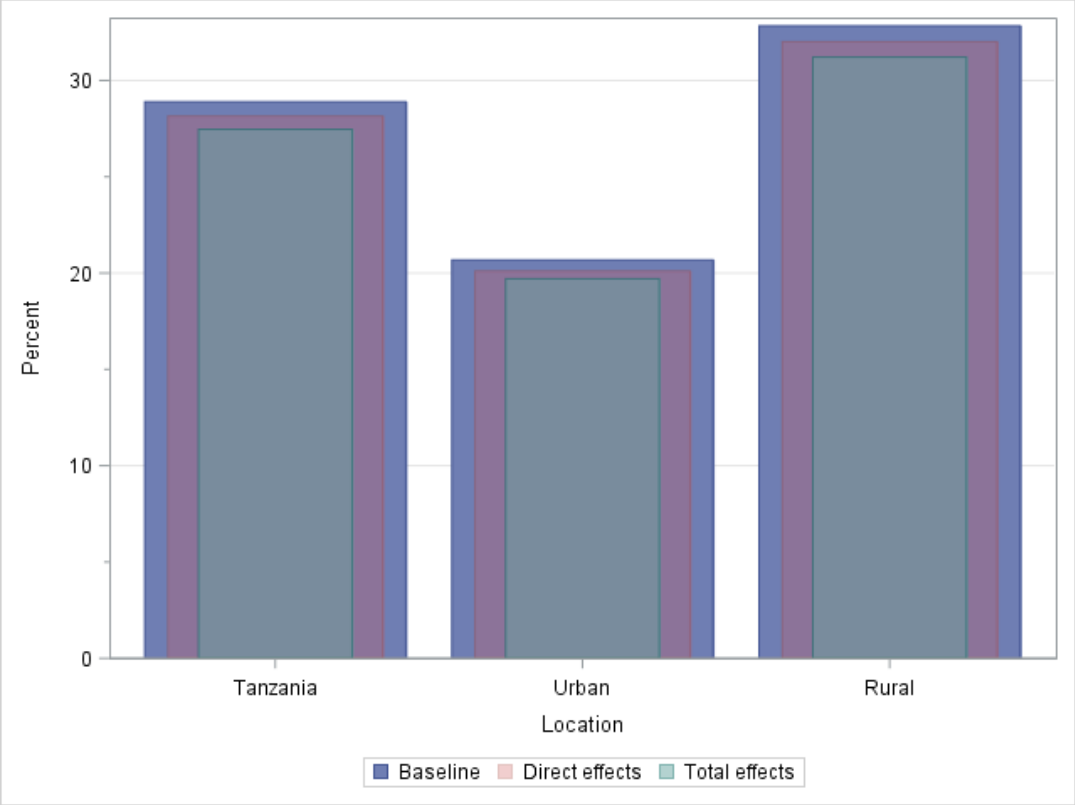
For Tanzania as a whole, the rate of consumption poverty falls by about 3 percentage points each for men and women due to the policy interventions (figure 4-38), amounting to a decline of about 197,000 persons from the ranks of the employed consumption-poor. Still, about 32 percent of all employed people (6.31 million) are consumption-poor. Women face a higher rate of poverty in urban than rural areas (28 percent versus 23 percent). This pattern of gender disparity prevails after the policy interventions, too, though both urban and rural woman experience declines in their rates. Rural women make up about 32 percent of the decrease in the total number of poor—a proportion that is lower than their share of the total number of the baseline poor population (41 percent). Rural males account for the same percentage in both the decline in and the actual number of the poor (40 percent), thus indicating that urban men and women were overrepresented in the decrease in the number of poor. This is mainly a reflection of the higher average earnings in urban areas. Other things being equal, a poor household has a better chance of escaping poverty via the employment of an additional member of the family in urban areas than in rural areas.

Figure 4-38 Rate of Consumption Poverty among Employed Persons (15–70 Years of Age) by Location and Sex (percent), Actual and With Policy Interventions, Tanzania



As we would expect from the above, the incidence of consumption poverty among employed households fell from 28.9 percent to 27.5 percent (figure 4-39). The fall in the incidence also represents a decline of about 94,000 households. The percentage-point reduction in the poverty rate was slightly higher in rural than urban areas (1.6 percentage points versus 1 percentage point, respectively), but the poverty rate itself is markedly higher in the rural areas to begin with. Similar to our findings for Ghana, the average gap between the consumption-poor households' poverty line and its consumption expenditures remained mostly unchanged in spite of the decline in the incidence of poverty. The average deficit was approximately TZS57,400 and TZS52,900 in the urban and rural areas, respectively, after accounting for the effects of the policy interventions. Compared to their preintervention values, they are approximately 4 percent and 3 percent lower, respectively.

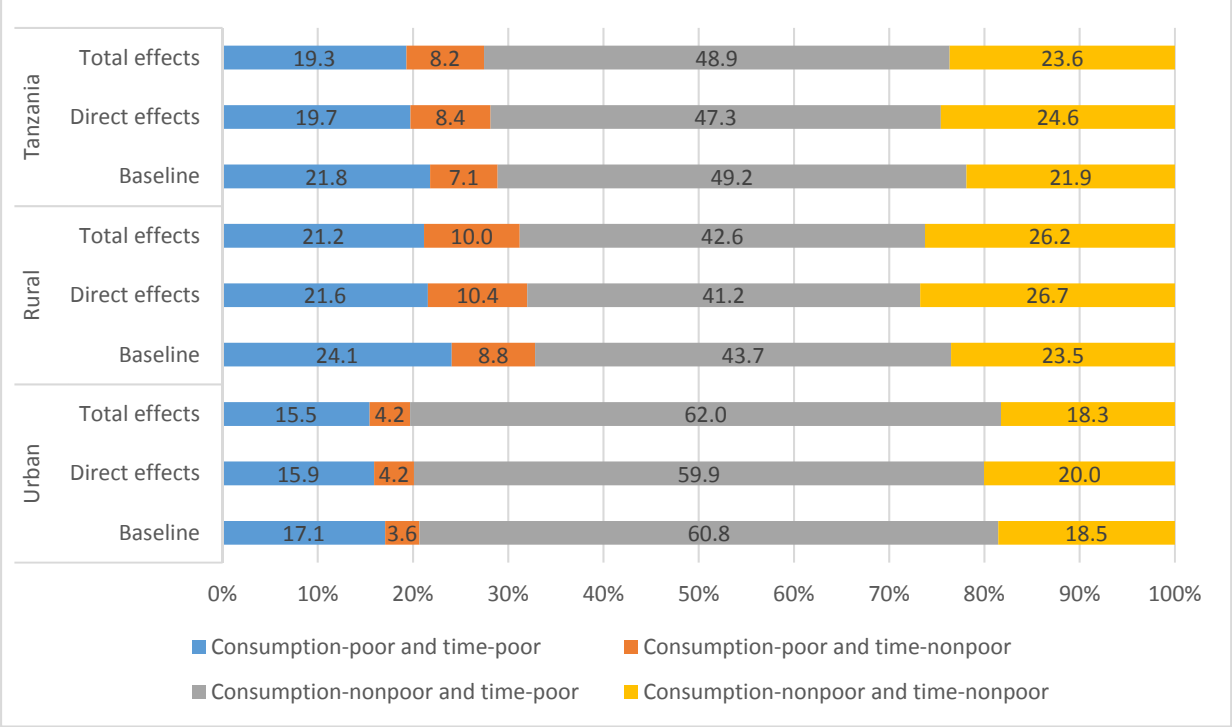
Figure 4-39 Rate of Consumption Poverty among Employed Households by Location (percent), Actual and With Policy Interventions, Tanzania



The policy interventions succeeded in reducing the incidence of the double bind of consumption and time deficits among Tanzanian households. We estimated that the share of households in the double bind fell by 2.5 percentage points (representing 182,000 households) to 19.3 percent (figure 4-40). Most of this decline is due to direct effects. As shown in the figure, the percentage of those in the double bind changes only a little between the bars labeled "direct effects" and "total effects." However, the decline in the share of those in the double bind is accompanied by an increase in the percentage of time-nonpoor and consumption-poor households, thus indicating a reshuffling of households between the time-poor and time-nonpoor segments of those who are consumption-poor. We also estimated that the percentage of households with neither time nor consumption deficits increased by 1.8 percentage points as a result of the total effects. But, we may recall that the change in this percentage due to the direct effects was more substantial. Therefore, we can conclude that the employment effects reversed some of the gains made against time deficits by the direct effects. This reversal is mirrored in the higher percentage of consumption-nonpoor households that are time-poor after accounting for

total effects than when we only take direct effects into account. However, the percentage associated with total effects is still slightly lower than in the national baseline, indicating that in conjunction with the decline in time poverty among the consumption-poor, the net effect of the policy interventions was to decrease time poverty among all households. We estimate that the fall was about 3 percentage points. However, time poverty is rampant across employed households, with 68.2 percent in its grip. Urban areas differed from the rural areas in this respect: the decline in the time poverty rate of the consumption-nonpoor that was generated by direct effects was completely reversed by the employment effects to leave the final time poverty rate at the same level as the baseline: 77 percent.

Figure 4-40 LIMTCP Distribution of Employed Households by Location (percent), Actual and With Policy Interventions, Tanzania



Let us now turn to an overview of the mechanisms that transmit the effects of the policy interventions to changes in the number of consumption-poor households (table 4-5). We start with the actual number of consumption-poor households (line 1), examine the extent to which reductions (lines 3 and 6) and additions (lines 4 and 7) are made as a result of the interventions, and arrive at the postintervention number of consumption-poor households (line 12). The

estimated reductions due to the direct and employment effects are quite close, after taking into account the addition made to poverty by the employment effects. This is in striking contrast to Ghana, where the employment effects far outweighed the direct effects in terms of their impact on poverty reduction. Urban Tanzania is similar to Ghana in this respect, though the relative importance of job creation in reducing poverty is lower here than in Ghana. In rural Tanzania, however, the job-creation effects seem to be slightly less important in poverty reduction than the direct effects of road improvements and ECE expansion. The greater importance of the direct effects in Tanzania stems predominantly from the more considerable impact that the policy interventions have on reducing time requirements for commuting and household production in Tanzania than Ghana (see section 2).

As we discussed before, employment of additional household members may come at the expense of increasing the monetized value of the household to such an extent that it offsets the extra consumption expenditures financed by additional earnings and pushes the household below the LIMTCP poverty line. We found that in Ghana, for every eleven consumption-poor households that transition out of consumption poverty as a result of the job creation, one household is dragged into poverty. In Tanzania, our estimate is that the ratio stands at 10:1 nationally, but 7:1 in urban areas and 13:1 in rural areas.

Table 4-5 Decomposition of the Change in the Number of Consumption-Poor Households (in thousands) Due to Policy Interventions, Tanzania

Line		Number (in thousands)			Percentage of baseline		
		Urban	Rural	Tanzania	Urban	Rural	Tanzania
1	Number in the baseline	573	1,816	2,388	100.0	100.0	100.0
2	Direct effects						
3	Reduction	-15	-44	-59	-2.7	-2.4	-2.5
4	Addition	0	0	0	0.0	0.0	0.0
5	Employment effects						
6	Reduction	-26	-43	-69	-4.6	-2.4	-2.9
7	Addition	4	3	7	0.7	0.2	0.3
8	Total effects						
9	Total reduction: Lines 3 + 6	-42	-87	-128	-7.3	-4.8	-5.4
10	Total addition: Line 4 + 7	4	3	7	0.7	0.2	0.3
11	Net reduction: Lines 9 + 10	-38	-83	-121	-6.7	-4.6	-5.1
12	Number after interventions: Lines 1 + 11	534	1,733	2,267	93.3	95.4	94.9

Notes: All households with at least one person between the ages of 15–70 are included in the calculations.
Line 3: Number of households that were nonpoor after accounting for direct effects but were poor in the baseline.
Line 4: Number of households that were poor after accounting for direct effects but were nonpoor in the baseline.
Line 6: Number of households that were nonpoor after accounting for employment effects but were poor after accounting for direct effects.
Line 7: Number of households that were poor after accounting for employment effects but were nonpoor after accounting for direct effects.

The considerations that we raised in connection with the effectiveness of the job creation elicited by the policy interventions to reduce poverty in the context of Ghana also applies to Tanzania. Just as in Ghana, consumption-poor individuals are underrepresented among those who gain employment (i.e., nonemployed individuals that get jobs and employed individuals that switch to a better job) as a result of the policy interventions. The shares of consumption-poor individuals among those who gain jobs and those who are already employed in the baseline are, respectively, 25 percent and 34 percent. Given the considerable overlap between residing in rural areas and being consumption-poor, it is not surprising that rural residents are also underrepresented among those who gain employment. Rural areas are home to 74 percent of the employed population, but only 58 percent of those who gain employment live in rural areas.

5 CONCLUSION

The scope of the benefits of the proposed policy interventions far exceeds the reduction of time deficits and indirect effects on job creation. Improvements to road conditions have positive effects on access to markets, technology (e.g., fertilizers), health providers, and educational institutions, to name a few obvious and well-recognized benefits. Similarly, expanding access to ECE is widely recognized as having intrinsic benefits for the children who attend the programs in terms of their physical, cognitive, and cultural development. The importance of these benefits for social and economic development cannot be overemphasized. From this broad perspective, it is fair to view the effects on time and consumption poverty as spillover benefits from the policy interventions to a considerable extent. This makes the effects we discussed in this report very different in nature from the impact of a conditional cash transfer program or a job guarantee program based on self-selection.

The impact of physical and social infrastructure expenditures on time and consumption poverty is clear for both Ghana and Tanzania. Road improvements and ECE expansion lead directly to the reduction of employed women's time deficits by lowering the thresholds of commuting and household production. Consequently, fewer women are left in a situation in which they and their households fail to meet the minimum required amount of household production to subsist with consumption expenditures around the official poverty line. In our framework, this has the effect of lowering the adjusted poverty line (official poverty line plus the monetized value of time deficits) and, as a result, some households manage to escape consumption poverty. Moreover, investments in the physical and social infrastructure generate employment opportunities that lead to an increase in household income and consumption expenditures. This does result in impoverishing time deficits for some in the sense that the rise in the monetized value of their time deficits (i.e., the increase in their poverty line) outstrips the additional household consumption expenditures financed out of their additional earnings. However, the net effect of higher employment is to reduce consumption poverty in both countries. Further, the proportion of women with neither time nor consumption deficits increases, and the percentage of women facing the double bind of consumption and time deficits declines, as well. We now summarize the principal findings for each country separately in the next two subsections.

5.1 Ghana

Our proposed policy intervention in physical infrastructure is to rehabilitate all roads in poor condition. Clearly, rehabilitation of poor roads can only be one ingredient in a comprehensive program for improving road conditions. However, it is an essential ingredient. For social infrastructure, we propose to raise the enrollment rate for 0–3 year olds to 31 percent and to have childcare centers staffed by at least one teacher with university education. Our benchmark is South Africa, in which the pre-primary enrollment rate for children 0–4 years old was 31 percent in 2015. In Ghana, the current enrollment level is 334,400 children, and the target enrollment level is 947,443 children. The combined public expenditures to implement the policy interventions amount to 1.74 percent of the baseline GDP. However, the stimulus imparted by additional expenditure also boosts tax revenues by 0.54 percent of baseline GDP, so that the net expenditure is 1.20 percent of baseline GDP. In comparison, the debt service paid by Ghana on the public external debt rose from 0.77 to 4.27 percent of GDP between 2011 and 2017.[31]

Our estimates indicate that the number of consumption-poor households in Ghana would fall by 106,000, or 7.6 percent, to 1.29 million. We found that the majority (80 percent) of this decline was due to the indirect or job-creation effects of the policy interventions. Direct effects that reduce the monetized value of time deficits through reductions in the thresholds of commuting and household production accounted for the remainder. While the net result of job creation was poverty reducing, it is crucial to recognize that job creation can also push some low-income households into consumption poverty because the increase in the monetized value of their time deficits is more than large enough to offset the additional earnings. We estimate that for every eleven consumption-poor household that became consumption-nonpoor due to job creation, one consumption-nonpoor household became consumption-poor. In urban Ghana, the ratio is lower, at 6:1.

We estimated that the number of working poor (i.e., the number of employed, consumption-poor individuals) fell by 1 percent (or roughly 38,000) to 3.3 million. It is noteworthy that the decline in the working-poor population that was generated by the direct effects was actually higher by about 10,000. Thus, it turns out that the employment effects actually added people to the ranks of the working poor while simultaneously lowering the rate of

[31] Interest payments alone on external debt rose from 0.25 percent of GDP to 1.61 percent of GDP over the same period.

consumption poverty among the employed. The number of the employed poor increased for rural workers and urban male workers; the only exception was urban females, for whom employment resulted in a fall in their number among the consumption-poor. But, since the level of employment increased at a faster rate, we observed a decline in the incidence of consumption poverty for all employed persons. The incidence of consumption poverty among employed persons falls from 28.3 percent to 27.8 percent with the direct effects, and then to 25 percent with the total effects.

The effect of the interventions on reducing the burden of the double bind of consumption and time poverty showed a gendered pattern. While the percentage of women in the double bind declined from 15 percent to 12 percent, the percentage of men declined only by 1 percentage point (to 6 percent). We found that the bulk of this decline (78 percent) took place due to direct effects for women and all of it could be attributed to direct effects for men. The number of women and men that escaped the double bind was 75,000 and 10,000, respectively.

Transition out of consumption poverty was facilitated by a fall in the rate of time poverty of the rural poor females, who make up roughly 50 percent of those in the double bind. Compared to the baseline, their rate of time poverty fell by 3 percentage points with the direct effects and then by another 1 percentage point (to 46 percent) after accounting for the total effects of the policy interventions. The time poverty rate among urban poor females also declined from 61 percent to 58 percent, with indirect effects accounting for most of the decline among them, indicating that the newly employed in this group are less prone to time poverty than the already employed. Compared to the reductions in time poverty in the ranks of consumption-poor women, the decline among consumption-poor men was substantially less.

5.2 Tanzania

The intervention in physical infrastructure that we model for Tanzania involves the rehabilitation of all poor feeder roads in the country. While this is not all that is needed for a better road network, we believe that this goal should be an integral part of a comprehensive program for improving road conditions. Our proposed intervention in the domain of social infrastructure entails raising the net enrollment rate in pre-primary education for 5–6 year olds to 100 percent. This would mean making pre-primary education available to an additional 1,705,168 children. We estimate that the required public expenditures would be around 1.04 percent of GDP. Once

we take into account the increase in tax revenues that result from the higher level of economic activity generated by the boost to public expenditures, the net expenditure amounts to 0.74 percent of GDP. This is not a trivial amount. One way to put the demand that it places on the public exchequer in perspective is to note that Tanzania's debt service on the public external debt rose from 0.21 percent of GDP to 0.95 percent of GDP between 2011 and 2017.

We estimate that the policy interventions would reduce the number of consumption-poor households by 121,000, or 5.1 percent, to 2.27 million. Almost half of this decline (46 percent) can be attributed to the direct effects of the policy interventions. We can account for the rest of the fall created by the job creation from the fiscal stimulus imparted by the additional public expenditures. Our framework allows us to identify the impoverishing effect of employment that operates via time deficits, i.e., estimate the number of nonpoor households that become poor households when additional members of their household gain employment. In Tanzania as a whole, for every ten households that escaped consumption poverty via additional employment, one nonpoor household became consumption-poor. The ratio is lower in the urban than rural areas (7:1 versus 13:1, respectively).

The number of employed consumption-poor individuals also declines by roughly 197,000, or by 3 percent, to 6.31 million. We estimate that the direct effects of the policy interventions facilitated the transition for the majority (84 percent) of those who made the transition out of consumption poverty. Among employed rural females, this was true of virtually everyone who made the transition. The gendered effect of the interventions can be seen most clearly in the changes in the proportions of employed men and women who are prone to the double bind of consumption and time deficits. We estimated that the percentage of such men and women declined by, respectively, 1.1 percentage points and 3.5 percentage points to 10.2 percent and 15.7 percent. The number of women and men that escaped the double bind stood at 264,000 and 77,000, respectively. Almost all of this reduction (94 percent) could be attributed to the direct effects for women, while for men the direct effects played a slightly less critical role (84 percent).

Underpinning both these findings, i.e., transition out of consumption poverty and decline in the double bind, is the changes in the time poverty rates triggered by the policy interventions. Employed rural females, who constitute about 50 percent of all employed persons in the double bind, experienced a sharp decline in their time poverty rate, mostly as a result of the direct

effects of the interventions. Their actual time poverty rate was 54 percent, which fell by 7 percentage points, or 227,000 persons. While the percentage-point decline was lower, time poverty rates also fell among both poor and nonpoor males in urban and rural areas, as well as among rural nonpoor women. However, the decline in the rate of time poverty was not sufficient for preventing an increase in the number of consumption-nonpoor but time-poor urban men and women. For these groups, the employment effects offset the decline brought about by the direct effects in the number of time-poor persons.

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APPENDIX A: ESTIMATING THE IMPACT OF ROAD IMPROVEMENTS AND EXPANSION OF EARLY CHILDHOOD EDUCATION (ECE) ON TIME ALLOCATION

We examined the direct impact of our proposed policy interventions on how individuals spend their time in section 2. The purpose of this appendix is to present the econometric models used in deriving the estimates described in section 2. We also discuss the results from some alternative specifications that we explored to highlight the complexity of the issues.

A.1 Data

We obtained the elasticities of time allocation with respect to the infrastructure improvements from models estimated based on the time use surveys for Ghana and Tanzania. As described in section 2, we use different definitions for the policy interventions in the two countries. We were guided in our choices by the availability of data and needs for policy interventions specific to each nation. In terms of ECE, we define the relevant measure for Ghana as the share of children (0–3 years of age) currently enrolled at a crèche center. The proposed intervention is to increase the enrollment rate to 31 percent. For Tanzania, the measure is the net enrollment rate in pre-primary education for children 5–6 years of age. The policy goal is to raise the enrollment rate to 90 percent. As for road improvements, we use the percentage of households in a region that have access to an all-season passable road within a distance of 2 km from the residence for the case of Ghana. Here the policy intervention is to achieve universal access to a passable road close to the residence. For Tanzania, the relevant measure is the percentage of roads in good condition in a region and the policy intervention is to increase the share of roads in good condition from their current levels to 100 percent. Region-specific data on actual regional enrollment rates and road conditions are merged into the time use data for each country.

A.2 Models

The goals of the estimation are to ascertain the impact of road improvements on the time spent on travel to employment, (i.e., commuting) and the effect of expanding ECE on time spent on household production. We define a subsample of the sample collected in the time use survey as the group of persons that have the potential to be directly affected ("beneficiaries") in terms of their time use. Models aiming to analyze the impact of expanding ECE are estimated using

households with at least one child that could benefit from ECE expansion. The beneficiaries of road improvements consist of working men and women between the ages of 15–70 years.

To identify the impact of the policy interventions on individuals' time use decisions, we use a Tobit model under the assumption that the number of hours people engage in a specific activity is censored at zero (see, for example, Wooldridge [2002, 525]). This model also assumes that the same process that determines the decisions to engage in a specific activity also determines the number of hours dedicated to that activity. This relationship can be written as follows:

$$t_j^* = x\beta + \delta z + u$$
$$t_j = \max(0, t_j^*)$$

In the equations above, t_j^* is the latent number of hours a person would like to spend on activity j, t_j is the observed number of hours that a person is currently engaged in activity j, x is a set of controls variables, z is a variable capturing the policy intervention, and u is a normally distributed error with mean zero and standard deviation σ, with all controls assumed to be uncorrelated to this error.

As discussed in section 2, the Tobit model is estimated separately for subgroups of beneficiaries. For the commuting model, we estimate separate models for those who are employed part time and those who are employed full time (40 hours or more per week). To ascertain the impact of the ECE expansion on time spent on household production, we ran separate models for girls, boys, women, and men.

A.3 Model Specifications

In order to obtain reasonable and consistent estimates for the effect of the policy interventions on time use allocations for Ghana and Tanzania, we select a minimum set of controls to estimate the effect of the policy intervention that is as close to a causal effect as possible. We also used different model specifications for the two policy interventions.

For the model of commuting time, we use a parsimonious model that controls only for basic demographic characteristics (age and education) and household structure (household type, size, and composition). We do not include a gender control because of the role played by

commuting time in our framework of measuring time deficits. As discussed in section 4, we use the geographically differentiated average commuting time spent by part-time and full-time workers in the form of a threshold that is common to both men and women. Since all of the variations of the policy intervention variable come from the regional differences, we do not control for whether or not an individual lives in an urban or rural area.

For the analysis of time spent on household production, given that we aim to obtain estimates of the impact of the policy intervention that can vary by the type of household and individuals, a richer set of controls was included compared to the commuting model. In addition to the standard age and education characteristics, we also include controls for job characteristics, marital status, household bargaining structure (proxies include relative age between husband and wife, and relative education), household size and household composition, overall household consumption/income, and access to public utilities (electricity). For Ghana, we also control for the average distance to public services (including health facilities, and primary and secondary school units) and the nearest market.

A.4 Results

The results of the Tobit regressions for Ghana are reported in tables A1 and A2. Results for Tanzania are in tables A3 and A4. Paying attention to the policy intervention variables, we observe that the results are fairly consistent with the expectations of the direction of the impact of the proposed policy implementations.

In Ghana, the enrollment rate in ECE is negatively related to an individual's hours of household production, with the exception of boys. The precision of the estimates is low, and none of the coefficients are statistically significant, despite the large magnitude of the coefficient. In Tanzania, the results indicate that the enrollment rate has a negative and statistically significant effect on total household production time for women of all ages, but has a positive, albeit nonsignificant, effect on men's and boys' hours of household production.

Turning to road improvements, we find that for both countries, improvements would reduce the time spent on commuting. The estimates are statistically significant for most specifications with the exception of full-time workers in Ghana. We should also note that the effects appear to be larger in Tanzania than in Ghana.

Table A-1 Impact of ECE Enrollment on Weekly Hours of Household Production, Ghana

	(1) Girls	(2) Boys	(3) Women	(4) Men
Age group				
5–14	-0.272	1.351		
	(2.417)	(1.761)		
21–30			1.013	-8.747**
			(2.553)	(3.599)
31–40			1.814	-8.908**
			(2.936)	(3.902)
41–50			-5.847*	-7.661*
			(3.031)	(4.130)
51–60			-16.10***	-10.14**
			(3.675)	(4.523)
61+			-24.58***	-16.82***
			(4.692)	(5.791)
Unpaid family worker	5.254	1.458	2.209	-9.411**
	(8.613)	(5.679)	(1.795)	(3.757)
Base group (full time)				
Part-time employed	8.896	8.288**	12.88***	6.855***
	(5.521)	(3.391)	(1.297)	(1.940)
Nonemployed	6.138	5.991	15.71***	-2.383
	(8.495)	(5.813)	(2.963)	(5.158)
Goes to school=1	-12.35***	2.297	-7.833**	-0.752
	(4.366)	(2.619)	(3.807)	(4.415)
Education				
(Base primary education)				
Never attended	3.978	-5.284	-0.0459	-3.870
	(10.35)	(4.000)	(1.839)	(2.810)
Middle education	2.295	2.868*	3.976**	-3.377
	(2.577)	(1.668)	(2.013)	(2.724)
Secondary education or more	-6.704	2.024	5.083	-0.268
	(5.790)	(4.890)	(3.096)	(2.864)
Relative age (wife to husband)	20.07**	3.117	2.532	-6.615
	(8.085)	(6.723)	(4.043)	(5.599)
Relative age x (nonhead or spouse)			-12.35	12.62
			(14.21)	(18.65)
Relative education				
(Base husband more educated)				
Equally educated	-0.845	0.614	-3.833**	1.371
	(2.623)	(1.718)	(1.936)	(1.750)
Wife more educated	5.113	4.259*	-5.247*	3.185
	(3.841)	(2.442)	(2.728)	(2.466)
Single household	-11.30***	4.165	-0.297	-13.14**
	(4.330)	(3.271)	(3.504)	(6.169)
Equally educated x (nonhead or spouse)			2.611	-8.338*
			(4.284)	(4.255)
Wife more educated x (nonhead or spouse)			-10.39	-17.02**
			(8.576)	(7.433)
Single x (nonhead or spouse)			1.150	7.871
			(5.122)	(10.72)

	(1) Girls	(2) Boys	(3) Women	(4) Men
Language spoken (base Akan)				
English	-1.627	-4.724**	1.446	-0.320
	(3.689)	(1.982)	(2.064)	(1.814)
Other	-1.171	-1.882	3.199**	-0.422
	(3.132)	(2.003)	(1.628)	(1.850)
Religion: =1 is Christian	5.739***	2.890*	-0.199	5.468***
	(2.051)	(1.528)	(1.497)	(1.648)
Log household size	-4.447	-27.53*	16.00**	17.19
	(16.62)	(15.19)	(6.768)	(14.24)
(0-1) Share of children 0–5	20.61	96.04**	-9.013	-15.51
	(47.29)	(38.28)	(15.40)	(32.09)
(0-1) Share of children 6–9 not in school	1.094	79.10**	-22.57	-29.94
	(47.06)	(38.78)	(15.36)	(30.80)
(0-1) Share of children 10–17 not in school	3.470	79.57**	-27.26*	-27.96
	(47.73)	(39.14)	(16.13)	(31.72)
(0-1) Share of adults 61 or older	10.19	26.12*	24.97**	21.11
	(14.26)	(14.27)	(10.25)	(15.01)
=1 if there is an extended family adult in HH	2.135	2.684	-0.238	2.705
	(2.891)	(2.599)	(2.157)	(2.463)
Log (#adults +1)	-8.640	40.14**	-15.14	-17.95
	(24.30)	(20.28)	(9.942)	(19.67)
Share of employed adults	-2.509	-0.546	-0.0288	-12.16
	(5.142)	(3.003)	(4.682)	(8.941)
Share of male adults	-1.247	7.988	4.322	35.03*
	(6.838)	(5.333)	(6.003)	(19.85)
Log consumption	-0.515	0.256	-1.243	0.669
	(1.882)	(1.182)	(1.101)	(1.185)
Distance to primary school	-1.525	-2.270	-1.293	1.005
	(3.828)	(1.784)	(1.263)	(1.287)
Distance to secondary school	0.403***	-0.0441	0.112	-0.125*
	(0.133)	(0.107)	(0.0704)	(0.0730)
Distance to health facility	-0.656*	0.198	0.403**	0.0257
	(0.397)	(0.321)	(0.191)	(0.213)
Distance to nearest market	0.335	-0.211	-0.651***	0.249
	(0.343)	(0.291)	(0.149)	(0.196)
Uses electricity	-1.521	-2.487	-0.912	0.0470
	(2.212)	(1.569)	(1.328)	(1.798)
Is a not head-spouse member			-8.705*	8.403
			(5.000)	(8.978)
Is a wage worker			5.011	-0.443
			(3.452)	(1.913)
Works as agriculture worker			-0.332	2.583
			(1.424)	(2.140)
Marital status				
=1 married			10.78***	4.394
			(3.093)	(5.104)
=3 other marital status			11.14***	4.905
			(2.969)	(5.200)
Regional enrollment rate in ECE	-0.384	0.0572	-0.193	-0.179
	(0.356)	(0.210)	(0.192)	(0.229)
Constant	47.35	-57.87**	28.08*	-10.54

	(1) Girls	(2) Boys	(3) Women	(4) Men
	(32.74)	(22.68)	(14.42)	(25.27)
Model variance SE^2	230.3***	115.5***	324.9***	219.8***
	(24.51)	(15.09)	(17.18)	(32.08)
Observations	386	399	1591	1074

Note: *: significant at 10 percent level; **: significant at 5 percent level; ***: significant at 1 percent level

Table A-2 Impact of Access to Roads on Weekly Hours of Commuting, Ghana

	Full-time worker		Part-time worker	
Age group	Coefficient	Std. Err.	Coefficient	Std. Err.
21–30	0.140	(0.986)	0.583	(1.592)
31–40	0.0945	(1.080)	0.124	(1.740)
41–50	1.713	(1.189)	0.691	(1.914)
51–60	1.591	(1.252)	-1.037	(2.057)
61+	3.662*	(2.223)	-2.961	(2.931)
Education (never attended)				
Primary	0.0586	(0.710)	-1.663	(1.188)
Middle	-0.832	(0.631)	-4.101***	(1.043)
Secondary or above	0.253	(0.677)	-3.148**	(1.431)
=1 nonhead or spouse	-0.835	(0.987)	-2.866*	(1.737)
Log household size	-1.326	(0.846)	1.029	(1.459)
Single household	-3.171***	(0.751)	-2.250*	(1.305)
Share of children 0–5	2.171	(2.013)	-7.549**	(3.713)
Share of children 6–17	0.265	(1.881)	-4.427	(3.370)
Share of adults 61+	-5.085**	(2.347)	-1.857	(3.996)
Share of extended family members	-6.170**	(2.466)	-3.295	(4.721)
Share of HHs in the region with access to all-season road	-0.0137	(0.0151)	-0.0913***	(0.0335)
Constant	7.142***	(1.628)	11.43***	(3.018)
var(e.thp)	124.5***	(12.85)	179.2***	(19.86)
N	4010		1869	

Note: *: significant at 10 percent level; **: significant at 5 percent level; ***: significant at 1 percent level

Table A-3 Impact of ECE Enrollment on Weekly Hours of Household Production, Tanzania

	Girls	Boys	Women	Men
Age group				
13–17	6.588***	3.117***		
	(1.077)	(0.790)		
21–30			-0.101	0.0953
			(1.748)	(1.462)
31–40			-2.999	0.480
			(1.936)	(1.711)
41–50			-5.674***	-0.154
			(2.075)	(1.783)
51–60			-9.348***	1.786
			(2.483)	(1.927)
61+			-18.08***	2.128
			(3.057)	(2.402)
Employment status (full time)				
Part time	-5.378**	4.044***	4.259***	1.586**
	(2.279)	(1.277)	(0.876)	(0.716)
Not employed	-10.46***	2.507**	-2.278	-1.491
	(2.272)	(1.221)	(2.392)	(2.314)
=1 goes to school	-3.467	3.081	-17.94***	-3.668
	(2.986)	(3.136)	(3.520)	(5.793)
Education level				
(Base: primary incomplete)				
Never attended	-7.500**	0.0470	1.211	0.512
	(3.054)	(3.201)	(1.380)	(1.148)
Primary complete	-3.474	7.473**	1.141	-0.0819
	(4.132)	(3.692)	(1.367)	(1.080)
Secondary or above	3.663	-4.207**	-3.746*	0.952
	(2.729)	(1.655)	(2.252)	(1.557)
Relative age head to spouse	-1.760	-4.300**	0.508	-1.526
	(4.417)	(2.023)	(3.794)	(2.353)
Relative age x (nonhead or spouse)			-17.97**	10.72**
			(9.145)	(4.797)
Single household	-1.514	-3.208	-2.331	5.835
	(4.015)	(2.110)	(4.363)	(3.755)
Single x (nonhead or spouse)			-18.59**	2.144
			(8.711)	(5.757)
Relative education				
(Base: husband more educated)				
Equal education	0.719	0.686	-0.621	-0.690
	(1.039)	(0.768)	(1.389)	(1.007)
Wife more educated	0.990	1.139	2.194	0.352
	(1.376)	(1.077)	(1.855)	(1.310)
=1 nonhead or spouse			-0.508	6.629***
			(3.067)	(2.426)
Equally educated x (nonhead or spouse)			-4.090	-3.472*
			(2.952)	(2.044)
Wife more educated x (nonhead or spouse)			-6.015	-2.548
			(4.212)	(2.337)
Log household size	-3.845	-0.393	2.057	0.870

	Girls	Boys	Women	Men
	(6.134)	(5.120)	(6.207)	(5.390)
(0-1) Share of children 0–5	29.26*	2.097	15.94	-3.309
	(16.65)	(13.74)	(13.69)	(11.68)
(0-1) Share of children 6–9	22.54	-1.743	4.599	0.897
	(16.76)	(13.51)	(14.20)	(11.78)
(0-1) Share of children 10–17	20.00	-5.772	-7.122	-0.672
	(17.01)	(13.97)	(14.41)	(11.99)
(0-1) Share of adults 61 or older	6.834	-6.460	10.38	-12.65**
	(7.018)	(5.135)	(6.740)	(5.292)
Extended family member present	2.615***	0.368	0.0682	0.404
	(1.001)	(0.791)	(1.187)	(0.918)
Log (#adults +1)	3.761	-1.572	-9.370	-2.002
	(8.486)	(6.918)	(8.187)	(6.743)
Share of employed adults	2.665	2.348	-2.783	-0.636
	(2.218)	(1.891)	(3.068)	(2.957)
Share of male adults	0.703	-0.674	-2.441	7.735
	(2.273)	(2.024)	(4.394)	(5.214)
Total household income				
(Base: under 50,000)				
50,000–99,000	-0.0745	0.781	1.669*	-1.024
	(0.863)	(0.737)	(0.956)	(0.788)
100,000–199,000	1.326	-1.943**	1.318	0.762
	(1.447)	(0.940)	(1.418)	(1.201)
200,000–499,000	-1.016	-0.243	1.369	1.951
	(1.972)	(1.472)	(2.205)	(1.595)
500,000–999,000	-2.406	-1.188	8.221	-4.681**
	(3.646)	(4.925)	(5.709)	(2.182)
1,000,000 +	-18.00***	-13.94***	-17.29***	-9.597***
	(6.608)	(3.266)	(4.304)	(3.540)
Uses electricity	-3.270**	-2.266*	-1.636	-2.604**
	(1.537)	(1.288)	(1.689)	(1.249)
Marital status (single)				
Married			6.720***	1.525
			(1.727)	(1.532)
Other			0.201	-2.153
			(1.848)	(2.370)
=1 is wage worker			-6.357**	-3.002**
			(2.984)	(1.205)
=1 is agriculture worker			-2.834**	0.212
			(1.311)	(1.066)
Regional net enrollment rate in ECE	-0.0978***	0.0183	-0.146***	0.0244
	(0.0365)	(0.0275)	(0.0377)	(0.0315)
Constant	13.54	2.709	45.34***	3.183
	(10.65)	(8.804)	(8.319)	(7.132)
var(e.thp)	152.7***	93.65***	243.0***	121.7***
	(8.392)	(6.985)	(9.651)	(10.07)
Observations	**1141**	**1100**	**1519**	**1260**

Note: *: significant at 10 percent level; **: significant at 5 percent level; ***: significant at 1 percent level

Table A-4 Impact of Access to Roads on Weekly Hours of Commuting, Tanzania

	Full-time workers		Part-time workers	
Age group				
18–20	-0.918	(0.685)	1.336***	(0.499)
21–30	-1.412**	(0.653)	0.913*	(0.493)
31–40	-1.245*	(0.671)	1.064*	(0.547)
41–50	-0.997	(0.696)	0.762	(0.580)
51–60	-1.675**	(0.722)	0.383	(0.619)
61+	-1.685*	(0.933)	-2.413***	(0.785)
Education (never attended)				
Primary not complete	-0.846***	(0.328)	-1.187***	(0.319)
Primary complete	-0.858***	(0.252)	-1.345***	(0.281)
Secondary or above	-2.007***	(0.369)	-3.679***	(0.504)
Nonhead nor spouse	0.256	(0.395)	-0.0398	(0.420)
Log household size	-0.453	(0.369)	-0.151	(0.383)
Single household	-0.322	(0.307)	0.0256	(0.313)
Share of children 0–5	1.248	(0.866)	1.403	(0.926)
Share of children 6–17	-0.219	(0.786)	0.583	(0.842)
Share of adults 61+	-0.931	(0.948)	2.480***	(0.940)
Share of extended family members	-0.423	(0.953)	-1.319	(1.164)
Share of roads in good condition in the region	-0.0291***	(0.00595)	-0.0313***	(0.00718)
Constant	13.15***	(0.750)	8.991***	(0.669)
var(e.commute)	32.40***	(1.255)	27.26***	(1.009)
Observations	3662		2562	

Note: *: significant at 10 percent level; **: significant at 5 percent level; ***: significant at 1 percent level.

A.5 Alternative Models

A.5.1 Impact of ECE

In addition to the models presented above, other model specifications were estimated in an attempt to disentangle the mechanism through which the ECE expansion and road improvements affect time spent on household production. In principle, if the processes that determine the number of hours an individual spends on each type of household production activity is independent of other activities, one should expect that the impact of the policy interventions on each individual component would provide a better understanding of the transmission mechanisms of the policy intervention. One caveat of this strategy, however, is that it would ignore any interrelations that are not accounted for when individuals choose between different types of household production activities.

Using the same specification as used for analyzing the impact of ECE intervention on total household production hours, we estimate additional models in an attempt to identify the adjustment mechanism in individual behavior. In contrast with the main model, the alternative specifications use specific components of total household production (rather than the aggregate) as dependent variables. We identified four separate components of the total time spent on household production: time spent on core activities (cooking, cleaning, and other household chores) and procurement (mainly shopping); time spent on care (caring for children and adults); travel time related to core, procurement, and care activities; and time spent on collecting firewood and water.

The marginal effects concerning the ECE interventions (measured as the change in the numbers of hours spent per week generated by a 1 percentage point increase in enrollment) for the alternative models for both Ghana and Tanzania are reported in table A-5. The results are somewhat puzzling. The ECE intervention in Ghana has a small and statistically insignificant impact on aggregate hours of household production. However, when looking at specific categories of household production, we find that the most substantial impact seems to be on time spent on collecting water and firewood by women, girls, and boys. There is also a reduction in the time spent on care activities for men. Furthermore, concerning other categories of household production, the group that is most affected by the policy intervention would be boys, for whom there is an *increase* in the time spent on procurement and core activities, as well as a decline in travel time related to household production activities.

For Tanzania, the effects are somewhat more consistent. For girls, the negative impact on total hours of household production seems to be explained by a decline in the time that they spend on care activities and travel related to household production. The fall in the time spent by women on household production seems to be mainly explained by a drop in the time spent on procurement and core activities, as well as a decline in the time spent on collecting water and firewood. We find that the impact on total household production hours of boys and men is positive but small. The transmission channel appears to be via the time spent on care activities (less time for boys and more for men).

Table A-5 Marginal Effects of the Expansion of ECE on Weekly Total Hours of Household Production and its Major Components

	Ghana			
	Girls	**Boys**	**Women**	**Men**
Total household production	-0.343	0.0395	-0.183	-0.0867
	(0.317)	(0.145)	(0.182)	(0.110)
Procurement + core	0.235	0.212*	-0.0125	-0.00622
	(0.210)	(0.122)	(0.131)	(0.069)
Care	-0.234	-0.0194	-0.06	-0.121**
	(0.161)	(0.045)	(0.117)	(0.056)
Travel time for core, care and procurement	0.0207	-0.0857*	0.00203	-0.0269
	(0.045)	(0.048)	(0.026)	(0.018)
Water and firewood collection	-0.380***	-0.125***	-0.255***	0.00289
	(0.053)	(0.039)	(0.038)	(0.029)
N	386	399	1591	1074
	Tanzania			
	Girls	**Boys**	**Women**	**Men**
Total household production	-0.0859***	0.0146	-0.142***	0.0181
	(0.032)	(0.022)	(0.037)	(0.023)
Procurement + core	-0.034	0.0133	-0.0726***	0.00266
	(0.022)	(0.014)	(0.027)	(0.016)
Care	-0.0324***	-0.0159*	-0.0107	0.0142**
	(0.012)	(0.009)	(0.015)	(0.007)
Travel time on for core, care and procurement	-0.00795**	-0.00414	-0.00741	0.0099
	(0.003)	(0.003)	(0.005)	(0.006)
Water and firewood collection	-0.00488	0.00739	-0.0394***	-0.00666
	(0.009)	(0.007)	(0.008)	(0.007)
N	1141	1100	1519	1260

Note: *: significant at 10 percent level; **: significant at 5 percent level; ***: significant at 1 percent level. Robust standard errors in parenthesis.

A.5.2 Impact of Road Improvements

We also investigated the impact of road improvements on the main categories of household production. The estimated marginal effects (measured as the change in the numbers of hours spent per week generated by a 1 percentage point increase in access to good roads) are shown in table A6. For Ghana, the results suggest that road improvements will reduce the time spent on water and firewood collection for all except girls. This is somewhat surprising given that girls spent disproportionately more time on firewood and water collection. Other results are also counterintuitive. It seems that road improvements would actually increase the time spent on

travel related to household production by girls and increase the time women spent on care activities.

The results for Tanzania are somewhat more consistent. Improvements in road conditions seem to be related to a reduction in total numbers of hours of household production, particularly for men and women. In all cases, a sizeable component of the decrease in hours of household production seems to be driven by the lower amount of time spent on care and, to a lesser extent, by travel time related to household production. We obtain an unexpected result that suggests that improvement in roads may increase the time boys spent on the collection of water and firewood.

Table A-6 Marginal Effects of Road Improvements on Weekly Total Hours of Household Production and its Major Components

	Ghana			
	Girls	**Boys**	**Women**	**Men**
Total household production	-0.017	-0.00411	0.0412*	-0.00105
	(0.036)	(0.019)	(0.025)	(0.013)
Procurement + core	-0.0229	0.018	0.00547	0.00888
	(0.032)	(0.018)	(0.020)	(0.009)
Care	0.00223	-0.00845*	0.0362***	0.00216
	(0.011)	(0.005)	(0.011)	(0.005)
Time on core, care, and procurement	0.0122**	-0.00364	0.00555	0.000392
	(0.006)	(0.005)	(0.004)	(0.002)
Water and firewood collection	-0.0076	-0.0136***	-0.0102***	-0.0123**
	(0.006)	(0.004)	(0.004)	(0.005)
N	1090	1075	3885	3152
	Tanzania			
	Girls	**Boys**	**Women**	**Men**
Total household production	-0.0128	-0.0105	-0.0486***	-0.0408***
	(0.019)	(0.013)	(0.018)	(0.010)
Procurement + core	-0.00869	-0.00344	-0.0175	-0.0186***
	(0.014)	(0.009)	(0.014)	(0.007)
Care	-0.0113*	-0.0142***	-0.0327***	-0.0130***
	(0.006)	(0.005)	(0.006)	(0.003)
Time on core, care, and procurement	-0.000916	-0.0112***	-0.00122	-0.0146***
	(0.002)	(0.002)	(0.002)	(0.003)
Water and firewood collection	0.0026	0.0112**	-0.00292	0.000343
	(0.005)	(0.005)	(0.003)	(0.003)
N	1908	1908	3600	3137

Note: *: significant at 10 percent level; **: significant at 5 percent level; ***: significant at 1 percent level. Robust standard errors in parenthesis.

APPENDIX B: ESTIMATING THRESHOLDS OF HOUSEHOLD PRODUCTION

A crucial step in operationalizing our measure of time and consumption poverty is an estimation of appropriate thresholds of household production (section 4.1). The method that we follow is similar to the construction of thresholds for consumption or income poverty: we construct a reference group, differentiate that group into subgroups based on characteristics that are assumed to cause variations in thresholds, estimate the hours of household production for an average household of each of the subgroups, and then assign those averages as thresholds for the households with identical characteristics in the population. Since the thresholds are meant to capture the requirements that are implicit in the official poverty line, it seems appropriate to select households with consumption expenditures "around" the poverty line to form the reference group. We would also want to avoid understating the thresholds; therefore, it seems reasonable to select households with at least one nonemployed adult so that we can assume with greater certainty than otherwise that the minimal needs of household production are being met. This is an additional requirement for a household to be included in the reference group. Once the reference group is identified, a decision has to be made regarding the characteristics along which the thresholds are going to be differentiated. In effect, this is equivalent to choosing the number of thresholds.

In our previous research, in line with much of the existing literature on the subject, we decided that the relevant axes of differentiation are the number of adults and children. The strategy for the estimation of the thresholds (THR) was to use a simple *cell* average of total hours of household production (THP), based on the reference group, where a *cell* is defined by the number of adults (A) and number of children (C) living in the household:

$$THR_{\#a,\#c} = E(THP|A = a, C = c) = \frac{1}{N_{a,c}} \sum (THP_{\#a,\#c})$$

Since households with a large number of adults and a large number of children are rare, especially after taking into account other sample restrictions, the above conditional mean was typically estimated after top-coding the number of children at three and number of adults at three in order to have a sufficient number of observations per cell to estimate the conditional mean.

The reference group was defined as households that live with incomes or consumption expenditures within 75 percent to 150 percent of the official poverty line and have at least one nonworking adult.

While the previous strategy had the advantage of being a simple and transparent methodology for the estimation of household production thresholds, it had two major disadvantages. On the one hand, it would provide biased estimates of thresholds for households of a larger size, since large households were treated as if there were at most three adults and/or three children in that particular household. On the other hand, while in principle additional characteristics could be used to estimate the thresholds, including allowing for differences for larger households, the number of available observations for each subgroup would rapidly decline in most actually existing samples, thereby increasing the size of the sampling errors in the estimation of the thresholds.

In order to address the two problems described above, we developed an alternative strategy that allows for the estimation of thresholds using a larger set of household characteristics to allow for the differentiation of larger households while maintaining some of the desired properties of the thresholds. Similar to the literature on the construction of equivalence scales (see, e.g., Yacthew, Sun, and Deri [2003]), for households in the reference group we estimate a nonlinear model that has the functional form:

$$THP = a_0\left(A_{18-59} + a_1 C_{0-6} + a_2 C_{7-17} + a_3 E_{60p}\right)^b + e$$

In the equation above, A_{18-59} is the number of adults between 18–59 years of age, C_{0-6} and C_{7-17} are the number of children between 0–6 and 7–17 years of age, respectively, and E_{60p} is the number of people 60 years or older living in the household. In this framework, a_0 is the scale shift parameter that will indicate the number of hours required by a household with only one adult; $a_1, a_2,$ and a_3 represent the relative additional hours of household production with respect to an adult; and b is the parameter for the economies of scale. The estimated equation serves the same role as the simple cell average did before in that the parameters of the equation are used to ascertain the threshold for every household in the population.

The estimation results of the above model specification for Ghana and Tanzania are shown in tables B1 and B2. To allow for greater flexibility, models were estimated separately for

people living in rural and urban areas. In addition, models were estimated using the baseline hours of household production described in section 4.2 (shown under the column "baseline"), as well as the hours of household production that prevailed after the simulated impact of the ECE expansion in each country (shown under the column "direct effects"). It should be noted that the modified equation for the threshold was applied only to households with young children that would benefit directly from the expansion ("beneficiary households") and not to all households.

Contrary to our expectations, the estimates suggest that there are no economies of scale in regards to thresholds in rural areas. The estimates of the parameter representing economies of scale (b) for both rural Ghana and Tanzania fall within the range of 0.97 to 1.07. In contrast, there is some evidence of economies of scale for urban areas, particularly in Tanzania.

Focusing on the relative time requirement coefficients, our estimations suggest that young children require, on average, fewer hours of household production compared to adults, although the coefficients are larger for urban Ghana compared to rural Ghana. In urban Ghana, the presence of children of ages 7–17 years has about the same impact on thresholds as an adult. However, in rural areas, children of that age have more than twice the impact on thresholds as compared to adults. In Tanzania, children ages 7–17 years have an effect on thresholds that is smaller than that of adults, although the effect is somewhat more substantial in urban areas. In Ghana, the number of elderly has a bigger effect on thresholds compared to adults, especially in urban areas, whereas in Tanzania, their impact on thresholds is almost the same as for adults in urban areas.

Comparing the models of thresholds after the ECE expansion to the baseline model, we find that in both countries the coefficients associated with the number of children become smaller, with very little change in the coefficients for other household characteristics, as we would expect given the nature of the policy intervention.

Table B-1 Estimated Equation for the Thresholds of Weekly Hours of Household Production, Ghana

	Baseline		With direct effects	
	Rural	Urban	Rural	Urban
Scale shift	10.69***	10.71***	11.04***	11.00***
	[1.505]	[1.880]	[1.569]	[1.984]
Number of children 0–6 years of age	0.372***	0.883**	0.163	0.559*
	[0.141]	[0.353]	[0.129]	[0.300]
Number of children 7–17 years of age	1.086***	2.299***	1.093***	2.240***
	[0.167]	[0.637]	[0.165]	[0.621]
Number of persons over 60 years of age	1.179***	1.585***	1.172***	1.585***
	[0.180]	[0.420]	[0.180]	[0.412]
Economies of scale	1.067***	0.877***	1.042***	0.864***
	[0.0781]	[0.102]	[0.0796]	[0.107]
N	853	596	853	596

Note: *: significant at 10 percent level; **: significant at 5 percent level; ***: significant at 1 percent level

Table B-2 Estimated Equation for the Thresholds of Weekly Hours of Household Production, Tanzania

	Baseline		With direct effect	
	Rural	Urban	Rural	Urban
Scale shift	14.44***	28.28***	17.14***	31.73***
	[2.405]	[3.484]	[2.746]	[3.819]
Number of children 0–6 years of age	0.329***	0.296**	0.112	-0.0427
	[0.127]	[0.149]	[0.124]	[0.135]
Number of children 7–17 years of age	0.638***	0.821***	0.654***	0.785***
	[0.228]	[0.158]	[0.222]	[0.156]
Number of persons over 60 years of age	1.351***	1.005***	1.310***	0.941***
	[0.224]	[0.248]	[0.216]	[0.241]
Economies of scale	1.063***	0.766***	0.966***	0.700***
	[0.113]	[0.0716]	[0.109]	[0.0724]
N	275	643	275	643

Note: *: significant at 10 percent level; **: significant at 5 percent level; ***: significant at 1 percent level

APPENDIX C: MICROSIMULATION OF THE EFFECTS OF SECTORAL CHANGES IN EMPLOYMENT

In order to attempt to fully capture the impact of changes in sectoral employment simulated in the CGE models for Ghana and Tanzania, we employ a methodology similar to that used in the estimation of the impact of the American Recovery and Reinvestment Act and of spending on ECE in the United States (Zacharias, Masterson, and Kim 2009; Antonopoulos et al. 2010). The CGE model provides an estimate of the change in total employment of each sector in response to the shift in spending on road improvements and ECE expansion. Our task is to determine the individuals that are likely to get the new jobs and the attendant changes in the earnings and time allocation of the individuals that get the jobs. In addition, we also need to determine the changes in the time allocation of other members of the job recipients' households and their household consumption expenditures. We simulate this change by finding the likeliest individuals for each new job created. We then simulate the reshuffling of household production responsibilities within job recipients' households. Here we document the method used for this project and the measures of quality we use to assess the simulated distributions of employment and household production.

As always with these types of simulations, it is not possible to assess how well the assignment is done. Since we are creating a counterfactual distribution of earnings and time allocation, we have nothing against which to compare the results, other than the baseline actual scenario. Given that fact, we do check that the results are not implausible given the characteristics of the recipients and donors and the actual distribution of time and income. These checks are presented in the third section, below. We conclude with an overall assessment of the exercise.

C.1 Data and Methodology

The base datasets for each of the microsimulations presented in this appendix are the synthetic datasets created for the estimation of the LIMTCP for Ghana and Tanzania (Rios Avila 2016; Zacharias et al. 2018), modified as described in appendix A in order to capture the direct effects of the ECE expansion on the hours spent each week on household production by individuals in the two countries. For Ghana, the synthetic dataset is based on the 2012 GLSS, augmented with

time use information from the 2009 Ghana Time Use Survey (GTUS). It contains a total of 72,373 individual records from 16,772 households. For Tanzania, the synthetic dataset is based on the 2012 THBS, augmented with time use information from the 2006 Tanzanian Integrated Labor Force Survey (TILFS). This dataset comprises 46,593 individual records from 10,186 households.

We begin with the output of the CGE models produced for the two countries, which break down employment changes into nine different sectors, as well as three scenarios for each country. We apply the percentage change in employment to the actual level of employment in primary activities by the nine sectors and by the categories of labor in the SAM for each country. The latter are divided among individuals in urban and rural areas and by the educational attainment of each individual. This yields a matrix of new jobs by nine sectors and eight labor types.

To assign the jobs we use a hot-decking statistical matching procedure that we will describe below, but first we will outline the preparation for this matching procedure. We first identify potential job recipients. These potential recipients are those that are not currently working for pay in Ghana and those not working at all in Tanzania. Next, we identify donor records within the same dataset, because we will be assigning sets of job characteristics (industry, occupation, job status, earnings, and hours) that actually exist to new job recipients. For all recipients and donors, we rank the nine sectors by likelihood of being employed within them by running a multinomial probit model on all of the employed individuals and then using the results to predict the likeliest sectors. We repeat this procedure for job status, industry, and occupation. Finally, we predict the likelihood of being employed using a simple probit model. Many of the employed are unpaid, as workers on a family farm or nonfarm enterprise. As such we also need to capture the impact of shifts in these types of employment on household consumption expenditures.

In order to estimate individuals' contributions to these farms and enterprises, we estimate log-linear production functions separately for each household's farm and nonfarm gross output. Our model specification is:

$$\ln Y = \alpha + \boldsymbol{\beta} \ln \boldsymbol{L_F} + \gamma_1 \ln L_H + \gamma_2 \ln H + \gamma_3 \ln K + \gamma_4 \ln X + \boldsymbol{\varphi Z} + \mu$$

where ln Y is the natural log of the value of output, $\boldsymbol{lnL_F}$ is a vector of the log of the amount of family labor by age categories[32] and sex, L_H is the amount of hired labor, H is the amount of land operated (in the case of farm businesses), K is the amount of capital employed, X is the amount of other inputs into production, and $\boldsymbol{Z}$ is a vector of household characteristics, including dummies for agroclimatic zone (in the case of farms), region, rural/urban status, and age, sex, and education level of the household head. We use the results to predict the output for each individual without their labor. These individual predicted contributions are then scaled to add up to each household's net farm and nonfarm income, respectively.

We next use a three-stage Heckit procedure to impute wages and hours for each individual. The imputations for the earnings and usual weekly hours of paid work are performed using a three-stage Heckit procedure (Berndt 1996, 627) separately for each combination of four age categories[33] and sex. The first stage is a probit estimation of labor force participation:

$$lf_i = \alpha_1 + \beta X + \varepsilon_i$$

The vector of explanatory variables, X, comprises the number of children under the age of 5 and the number of children ages 6–17 in the household; the individual's education; and the individual's spouse's age, education, and labor force status. The regression is run on the universe of all eligible adults. The Mills ratio is calculated for all individuals using the results of the first stage regression:

$$\lambda = f\left(\frac{-\hat{lf}}{\sigma_{\hat{lf}}}\right) \Bigg/ \left(1 - F\left(\frac{-\hat{lf}}{\sigma_{\hat{lf}}}\right)\right)$$

where f is the normal density function, F is the normal distribution function, $\hat{lf}$ is the estimated probability of labor force participation, and $\sigma_{\hat{lf}}$ is the standard deviation of $\hat{lf}$.

The second stage is an OLS estimate of the log of hourly wage:

[32] The six categories are: under 18 years old, 18–24 years old, 25–44 years old, 45–64 years old, and 65 or older.
[33] Under 25 years old, 25–34 years old, 35–54 years old, and 55 and older.

$$\ln w_i = \alpha_2 + \gamma_2 Z + \theta_2 \lambda + \mu_i$$

This regression is run only on those that are actually employed for pay. The vector of explanatory variables, *Z*, in this stage includes the individual's education, age, industry, occupation, geographic region, rural/urban location, spouse's labor force status, and, λ, the Mills Ratio calculated in the first stage. The inclusion of the Mills ratio corrects for the selection bias induced by limiting the regression to those in paid employment. The imputed log of wage is predicted for donors and recipients from the results of the regression, with industry and occupation replaced for the latter by the industries and occupations assigned in the previous step.

The third stage is a regression of usual hours of paid work per week:

$$h_i = \alpha_3 + \gamma_3 Z + \omega \ln \hat{w}_i + \theta_3 \lambda + \eta_i$$

The regression is once again run only on those in paid employment. The vector of explanatory variables, *Z*, in this stage is the same as the previous stage, with the addition of the number of children under 5 years of age and the number of children ages 6–17 in the household. Finally, the imputed wage predicted in the second stage and the Mills ratio calculated in the first stage are included. Imputed hours per week are predicted for donors and recipients using the results of the regression, replacing the industry and occupation of the latter with their assigned values.

With the variables generated in the previous steps, as well as other characteristics, we then proceed through the job assignment procedure. For each combination of the nine sectors and eight rural/urban education categories for those recipients for whom the sector was the likeliest sector, we identify a pool of individuals actually employed in that sector that most resemble the recipient. We randomly draw from this group of donors and assign the job to the recipient. We next check that the sum of the weights of the recipients does not exceed the number of new jobs available. If there are more recipients than jobs, we make the assignment only to those that are the likeliest to be employed, using up all of the available jobs. If there are more jobs than recipients, they are all assigned jobs. The total jobs assigned are then subtracted from the total

remaining to be assigned in that cell of the sector and rural/urban education matrix. Those assigned jobs are removed from the remaining recipient pool and the process continues. If, after going through all the possible assignments for recipients' first most-likely sector there are still jobs remaining, we move on to the second most-likely sectors and so on. If, after having gone through all nine of the ranked sectors for each recipient, jobs remain to be assigned, we compress the matrix by combining all of the remaining jobs in the rural and urban areas for each sector and repeat the process.

Once the jobs assignment is complete, we address the likelihood of a reshuffling of household production responsibilities in recipient households. We thus go through the second round of statistical matching. In this round, the recipient pool consists of all those for whom time use information is available in a household that contains at least one job recipient. The donor pool consists of everyone in the survey. The change in the allocation of time use hinges on the change in the number of workers in the household, so for this round of hot-deck matching, we weight the number of male and female workers as heavily as the number of adults and the number of children in the household. In this case, we match within groups of individuals with the same sex, age category, and educational attainment.

Finally, we check the results to the best of our ability. This is largely a judgment call, since there is no counterfactual distribution with which to compare our estimates. We do check that the implied consumption expenditures match the changes in consumption expenditures predicted by the CGE model. We adjust the consumption expenditures as necessary. We now move on to document both microsimulations individually and to detail the checks we do to ensure the quality of the microsimulation.

C.2 Ghanaian Microsimulation

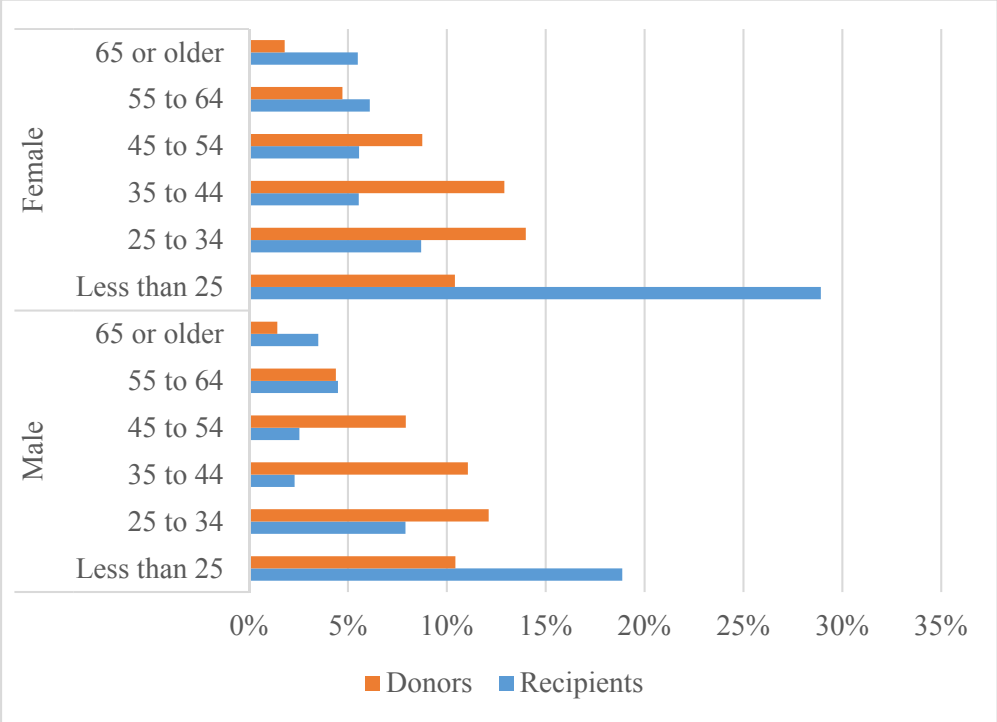
The employment changes produced by the CGE model are presented in table C-1. The single largest change is in the care scenario and in the care services sector, reflecting the large investment in ECE being modeled here. Employment increases are less than 1 percent in the other eight sectors in the care scenario. Employment in the capitalist construction sector grows the most under the construction scenario (9.2 percent), and other than public services, employment increases between 2.8 percent and 3.8 percent in each of the other sectors. Here we report the results of the microsimulation that includes both policy interventions.

Table C-1 Employment Changes by Scenario and Sector, Ghana (percent change)

Sector	Scenario		
	Construction	Care	Both
Own-account agriculture	2.9	0.8	3.7
Capitalist mining	3.2	0.7	3.9
Capitalist manufacturing	3.3	0.8	4.1
Own-account manufacturing	3.1	0.8	3.9
Capitalist construction	9.2	0.2	9.4
Capitalist services	3.1	0.9	4.0
Own-account services	2.8	0.8	3.5
Public services	0.8	0.3	1.1
Care services	3.8	135.0	138.8

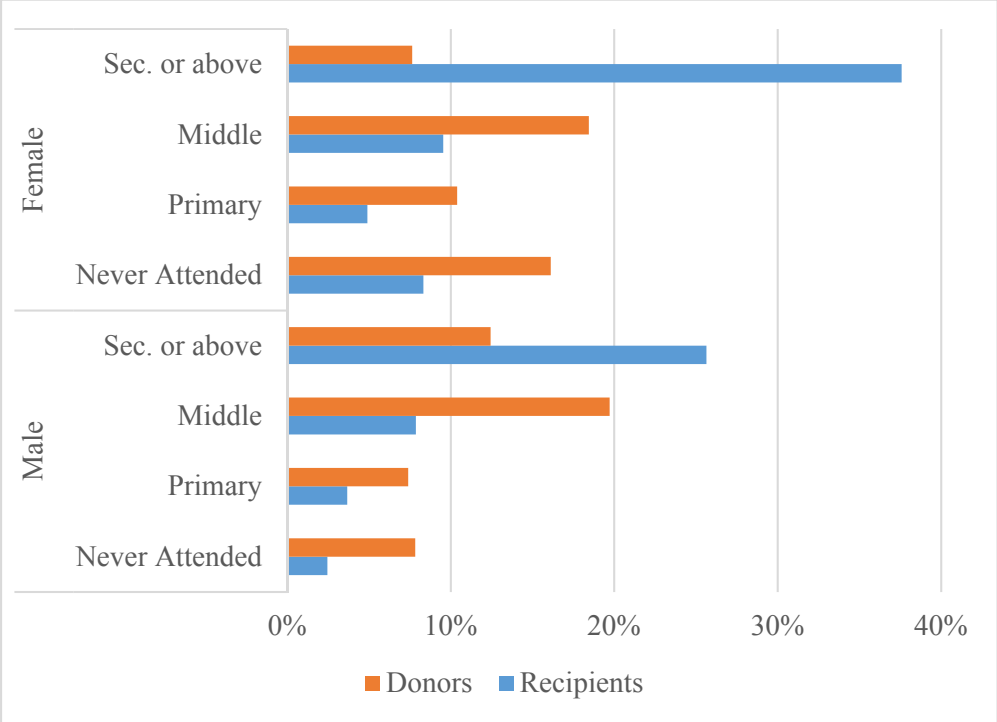
The first step is to reproduce the sectoral breakdown using the industry variables provided in the employment section of the GLSS. We then proceed to form the recipient and donor pools for the job assignment matching procedure. The recipient pool for the job assignment was defined to comprise all eligible adults that were not already working in paid employment. As is to be expected, the recipient and donor pools are quite different. The recipient pool is mostly female (60 percent), while the donor pool is more evenly split between male (47 percent) and female (53 percent). Nearly one-third of potential recipients are females under 25 years of age and another 19 percent are young males, meaning almost one-half of the recipient pool is under the age of 25 (figure C-1). The donor pool is more evenly distributed, with those under the age of 45 accounting for 71 percent of the donor pool.

Figure C-1 Shares of the Job Assignment Donor and Recipient Pools, by Age and Sex, Ghana (percent)



In terms of educational attainment, the donors and recipients are also quite different (figure C-2). For both men and women, the recipient pool tends to be more highly educated. Of the donors, 20 percent have secondary or higher education, while 63 percent of the recipients do. Although males that never attended school are twice as large a share of the recipient and donor pools as females that never attended school, females in both the recipient and donor pools were twice as likely as males to never have attended school.

Figure C-2 Shares of the Job Assignment Donor and Recipient Pools, by Age and Education, Ghana (percent)



The assignment itself uses the likeliest sector for each individual in the recipient pool, matching them with donors working in that sector wherever possible. Because the composition of the jobs created leans heavily toward the care services sector, which is a small sector in the actual distribution of jobs by industry, the assignment of jobs is skewed toward that sector (table C-2). Because of this skewed distribution of new jobs, only 34 percent of individuals in the recipient pool received jobs in their likeliest predicted sector, and two-thirds of the assignments were to the care services sector (the likeliest sector for fewer than 5 percent of recipients). While almost all of those for whom the care services sector was the likeliest sector were assigned to that sector, they make up the second-smallest share of individuals assigned to that sector, with those for whom own-account services was the likeliest sector making up the bulk of the individuals assigned to care services. In all three of the other likeliest predicted sectors, a greater share of individuals in the recipient pool was assigned to care services than their likeliest predicted sector. Given the distribution of jobs created, this pattern of assignments is inevitable and likely to be the best that can be done.

Table C-2 Assigned Sectors by Likeliest Sector, Ghana (percent)

Assigned Sector	Likeliest Sector: Own-account agriculture	Capitalist services	Own-account services	Care services	Total
Own-account agriculture	**14.4**	0.0	0.1	0.0	14.5
Capitalist mining	0.0	0.0	0.0	0.0	0.0
Capitalist manufacturing	0.4	0.0	0.9	0.0	1.2
Own-account manufacturing	0.2	0.0	2.7	0.0	2.9
Capitalist construction	0.5	0.4	1.6	0.0	2.4
Capitalist services	0.1	**1.4**	0.0	0.0	1.4
Own-account services	1.2	0.0	**18.1**	0.1	19.4
Public services	0.0	0.0	0.1	0.0	0.1
Care services	15.1	2.0	36.4	**4.5**	58.0
Total	31.8	3.7	59.7	4.7	

To assess the quality of the matching procedure, we compare the earnings and weekly working hours of the recipients to that of the donor pool. While we do not expect these distributions to be necessarily alike, given the nature of the differences between the recipient and donor pools, we still expect there to be some correspondence between them. Figure C-3 shows the ratios of mean and median earnings and weekly hours of recipients to donors, by sex and age category. It is notable that for the most part, earnings are lower for those receiving jobs in the simulation because the jobs that they are likeliest to receive are lower paying. This tendency is due to their own characteristics (relatively youthful and uneducated), but clearly younger job recipients do well in comparison to their counterparts in the donor pool, especially young men (although female job recipients between the ages of 25–34 had median earnings more than double that of their counterparts in the donor pool).

Figure C-4 shows the same ratios for male and female recipients living in rural and urban areas. Mean and median earnings are lower for the simulation recipients than for those in the donor pool. Median earnings are very low for rural women and urban men compared to their counterparts in the donor pool. Hours of work are more similar, as is to be expected since there is much less variation in hours of work than in earnings among employed people. The ratio of mean earnings between recipients and donors is highest for urban males, then for rural males, with urban females having the smallest ratio.

Figure C-3 Ratio of Simulated to Actual Mean and Median Earnings and Weekly Hours by Sex and Age, Ghana

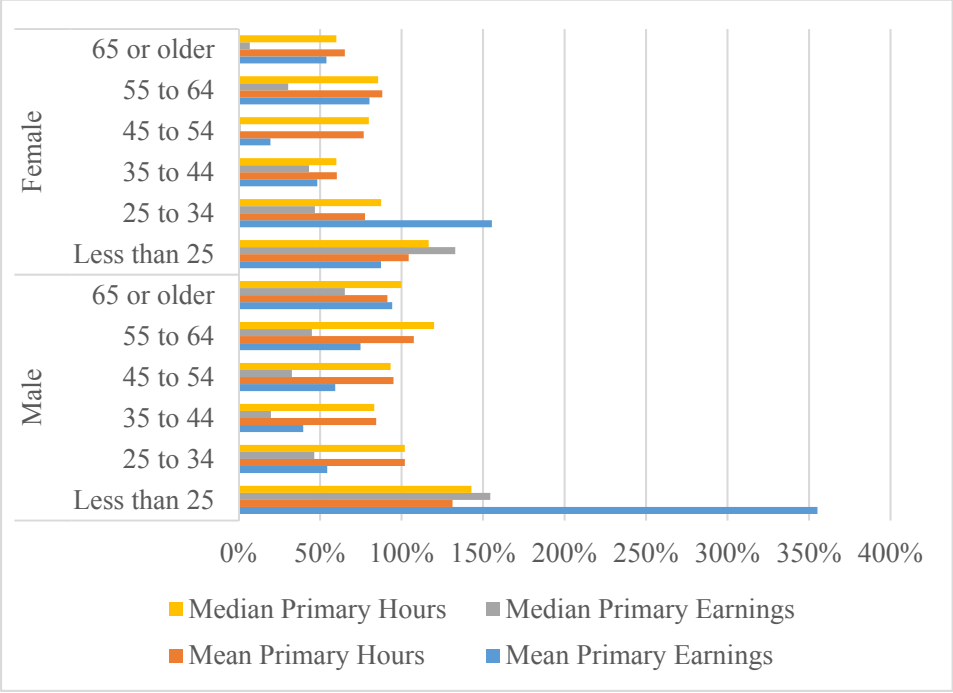
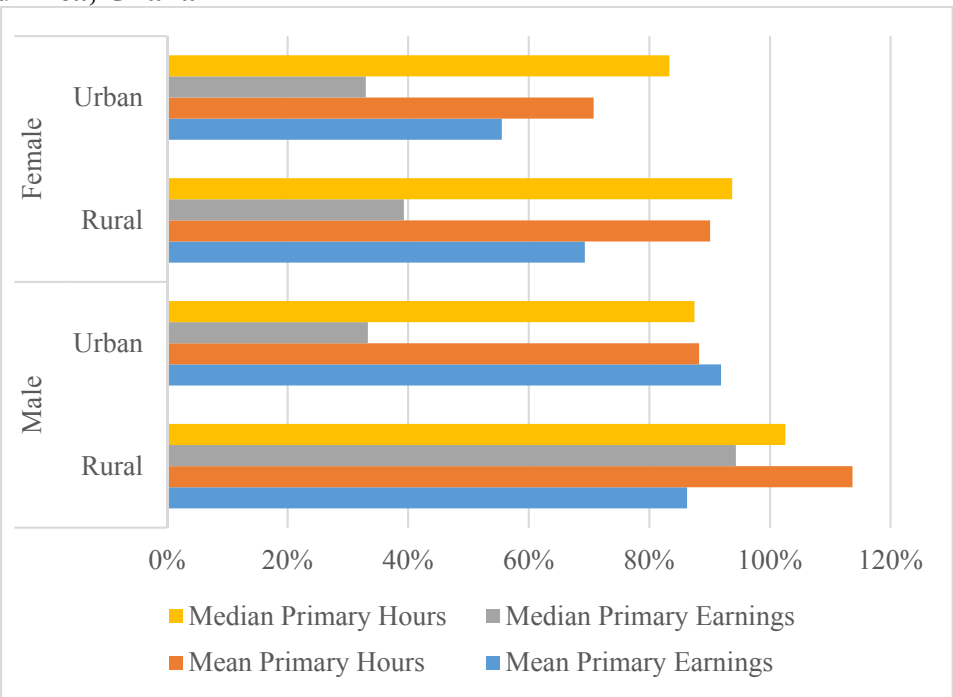
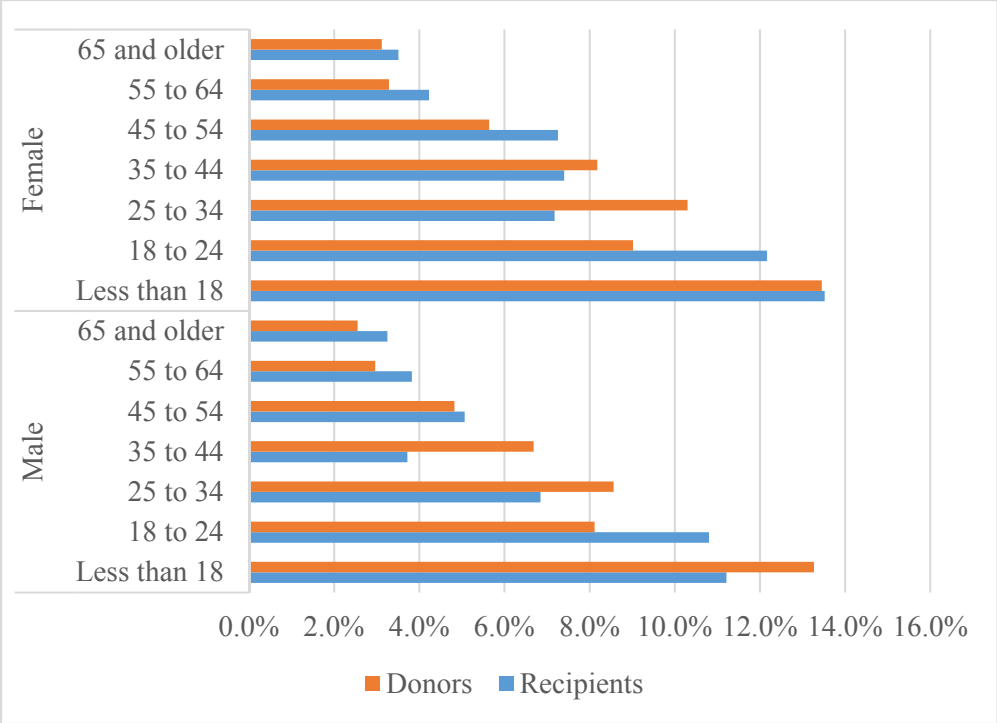


Figure C-4 Ratio of Simulated to Actual Mean and Median Earnings and Weekly Hours by Sex and Area, Ghana



Once the jobs have been assigned, we move on to reassigning household production hours. Since the GTUS collects data for everyone in the household ages 10 and up, the recipient pool is every individual age 10 and older in a household in which there is a job recipient in the microsimulation. The donor pool is all individuals for whom time use data is collected. We expect the two pools to be similar, with the qualification that the recipient pool will be different to the degree that the households from which job recipients are drawn are different from those in the population as a whole. The biggest divergence between recipient and donor pools by sex and age is among those ages 18–24 years, who are a significantly larger share (23 percent) of the recipient than the donor pool (17 percent). This indicates that recipient households in the job assignment tend to be composed of younger individuals than the general population of households.

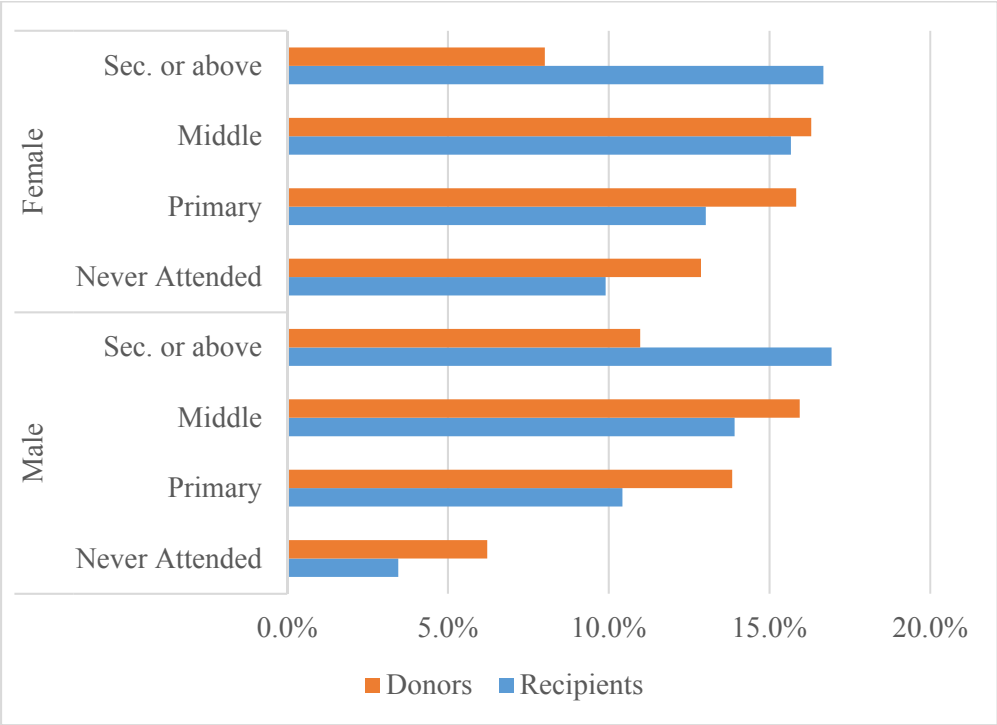
Figure C-5 Time Use Donor and Recipient Pools by Sex and Age, Ghana



We next compare the distribution of the donor and recipient pools by sex and educational attainment (figure C-6). The interesting characteristic here is the greater share of those that have completed secondary or more education in the recipient pool relative to the donor pool. This reflects a similar pattern in the recipient pool for the jobs assignment (figure C-2). While these

differences are interesting, they are not worrying for the reassignment of time use, since that happens within matching cells comprised of individuals with the same age, sex, and educational characteristics. We now look at the results of this step of matching for Ghana.

Figure C-6 Time Use Donor and Recipient Pools by Sex and Educational Attainment, Ghana



To assess the plausibility of the distribution of weekly household production hours in the reassigned households, we first compare the mean and median weekly hours of household production by sex and age (figure C-7). The distribution of hours is quite similar. The largest divergence (18 percent) is in the median weekly hours of household production for males ages 18–24 in the recipient pool, but the absolute difference is 0.8 hours per week. The median hours of household production for men over 24 years old was zero in both the recipient and donor pools. It appears that by age and sex, the recipient distribution is quite like that of the donor pool.

We see a similar story when we compare the same ratios by sex and educational attainment (figure C-8). In every subgroup, the ratio of recipient to donor is nearly unity. Here, the most substantial deviation is 31 percent, among males with primary education only. However, male donors with primary education have median weekly hours of household

production of just 2.9 hours per week. Those in the recipient pool have just 0.9 hours less. The last step in the preparation of the synthetic file for the simulation is the estimation of household consumption expenditures in response to the changes in income generation within recipient households.

Figure C-7 Ratio of Mean and Median Weekly Hours of Household Production between Recipients and Donors by Sex and Age, Ghana

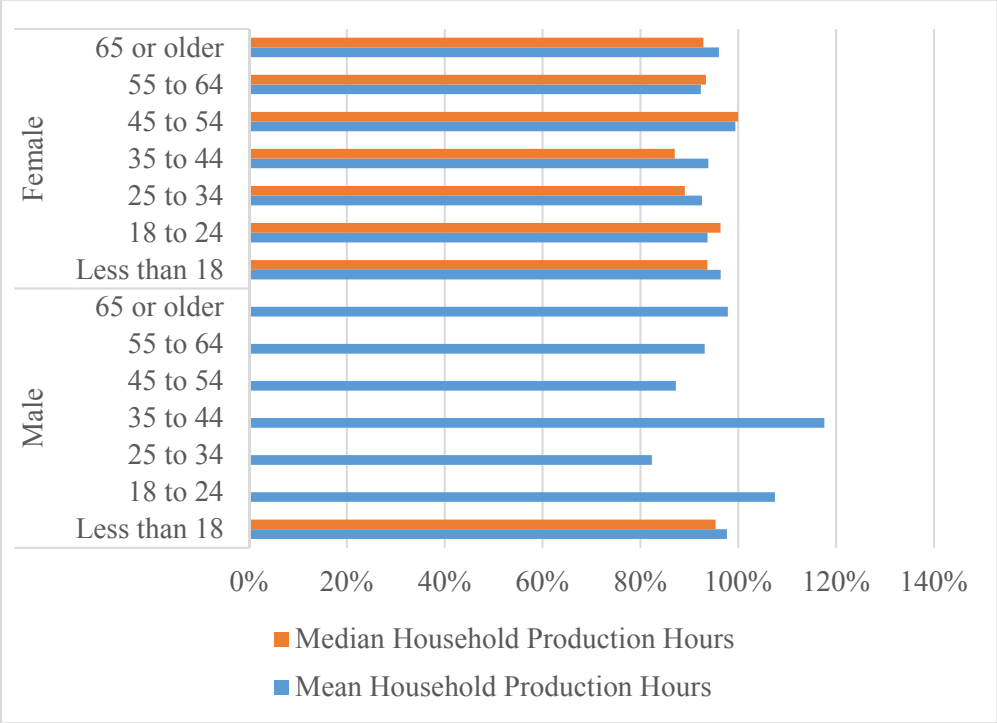
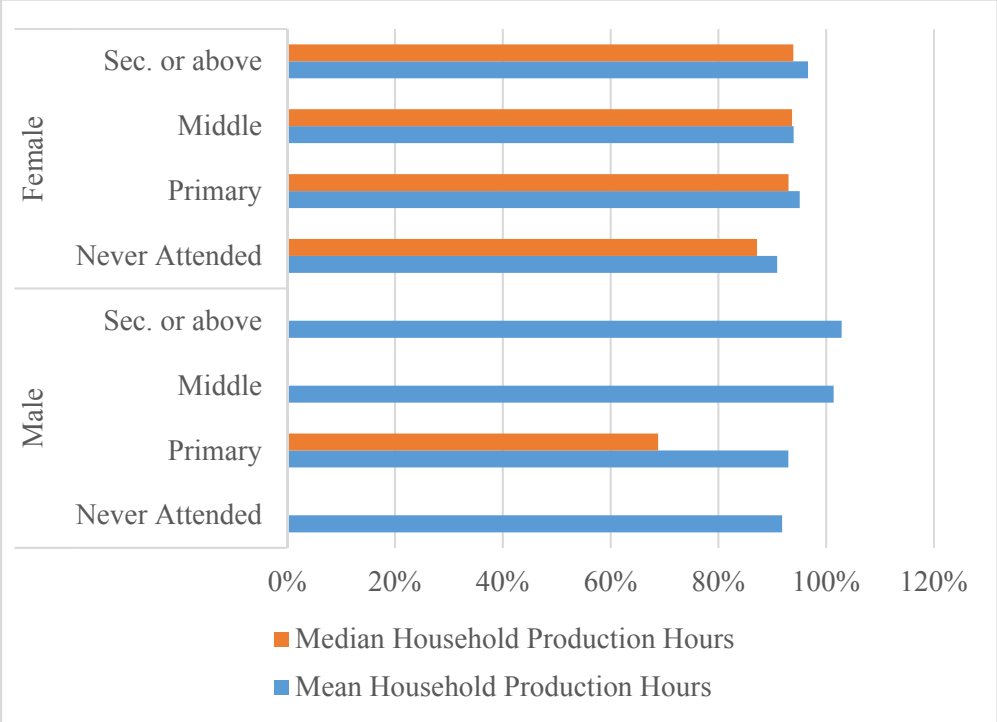


Figure C-8 Ratio of Mean and Median Weekly Hours of Household Production between Recipients and Donors by Sex and Educational Attainment, Ghana



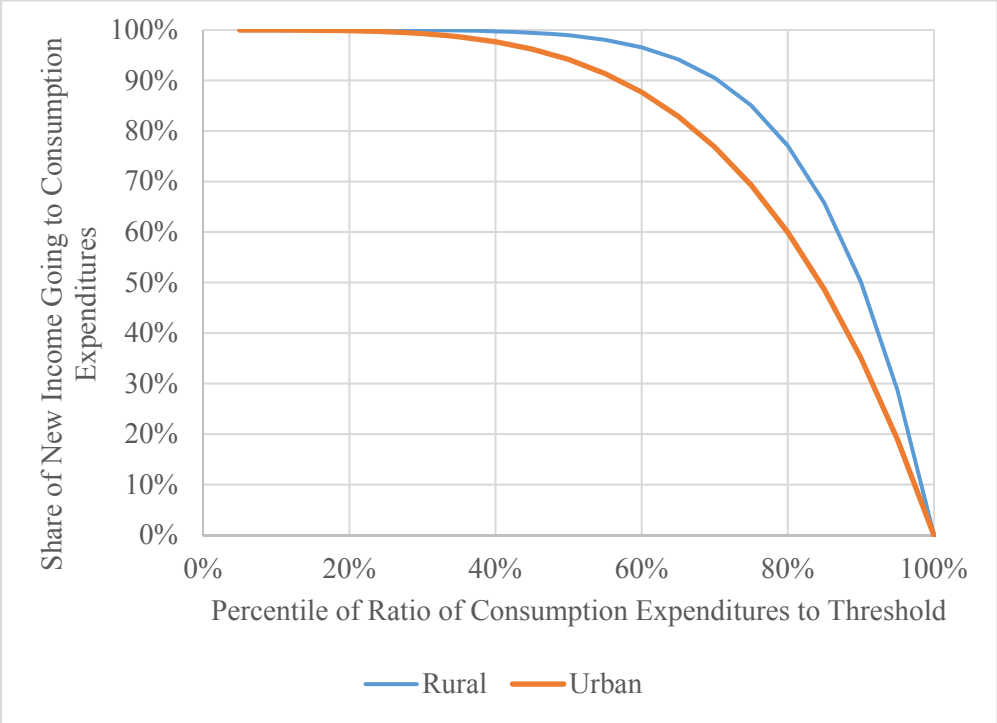
We first add up the changes in the income generated by recipients of jobs in the simulation and subtract any contribution to household income associated with their previous occupation for each household. We then convert changes in income into changes in consumption expenditure by applying a decreasing marginal propensity to consume to households as their ratio of actual consumption expenditure to the official poverty threshold increases, as in the following equation.

$$\Delta x_i = \Delta y_i \left(1 - F\left(\frac{x_i}{z}\right)^{\alpha}\right)$$

where x_i is household consumption expenditures, y_i is household income, $F()$ is the cumulative distribution function, z is the poverty threshold, and α is a parameter chosen to produce the increase in expenditures generated by the CGE model (3.9 percent in rural areas and 4.4 percent in urban areas). If we assumed a marginal propensity to consume of unity for all households in the simulation, we would estimate increases in consumption expenditures of 11.2 percent and 16.7 percent in rural and urban areas, respectively. Applying the above formula and values of α

of 4.7 and 2.65 for rural and urban areas, respectively, yields estimates of consumption expenditures that are consistent with the macroeconomic aggregates predicted by the CGE model. The resulting marginal propensity to consume profile is shown in figure C-9. We next move on to assess the results of the simulation for Tanzania.

Figure C-9 Consumption Expenditure Adjustment Profile for Rural and Urban Households According to Their Rank in the Distribution of the Ratio of Actual Expenditures to the Poverty Threshold, Ghana



C.3 Tanzanian Microsimulation

The employment changes from the CGE model for Tanzania are presented in table C-4. Again, the single biggest change is in the care scenario and in the care services sector. The capitalist construction sector also grows a fair amount under the construction scenario. Here we report the results of the scenario that includes both policy interventions. In this scenario, the existing distribution of employment by sector yields an overall employment growth of 4.5 percent.

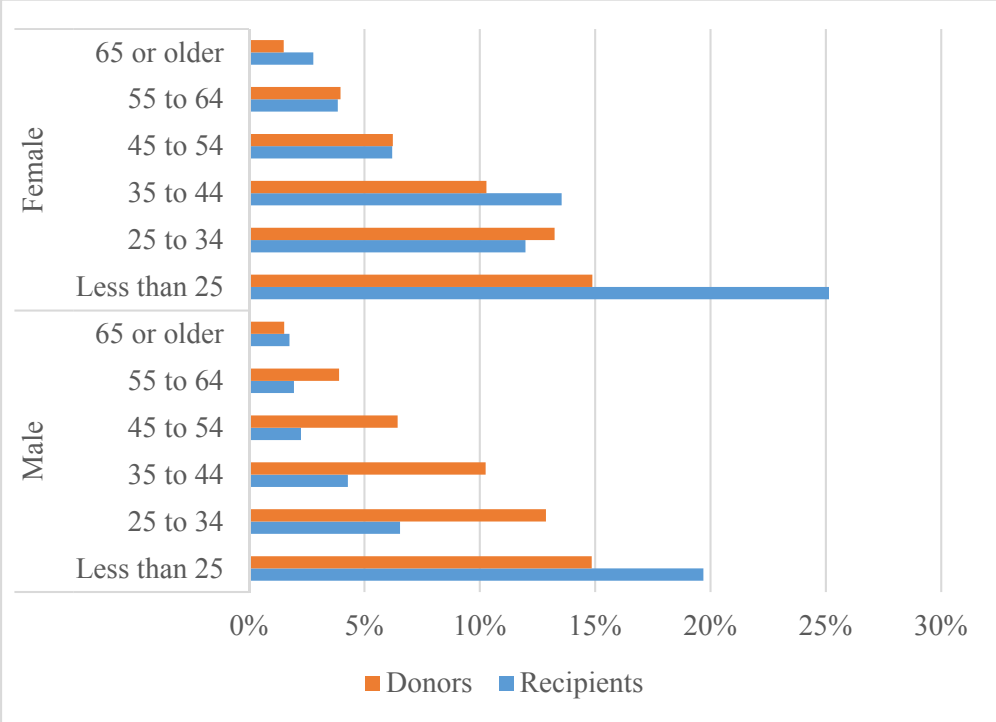
Table C-3 Employment Changes by Scenario and Sector, Tanzania (percent change)

Sector	Scenario		
	Construction	Care	Both
Own-account agriculture	0.5	1.3	1.8
Capitalist mining	1.1	0.9	1.9
Capitalist manufacturing	1.0	1.5	2.5
Own-account manufacturing	0.6	1.8	2.5
Capitalist construction	1.2	0.2	1.4
Capitalist services	0.8	1.8	2.5
Own-account services	0.8	2.3	3.2
Public services	0.2	0.6	0.7
Care services	0.3	150.8	151.0

Again, the first step is to reproduce the sectoral breakdown using the industry variables provided in the employment section of the THBS.[34] We then proceed to form the recipient and donor pools for the job assignment matching procedure. The recipient pool for the job assignment was defined to comprise all eligible adults that were not already working in paid employment. As is to be expected, the recipient and donor pools are quite different. The recipient pool is mostly female (64 percent), while the donor pool is evenly split between male and female. One-quarter of recipients are females under 25 years of age and another 20 percent are young males, so nearly one-half of the recipient pool is under the age of 25 (figure C-10). The donor pool is more evenly distributed, with 30 percent of donors under the age of 25 and those under 45 accounting for 76 percent of the donor pool.

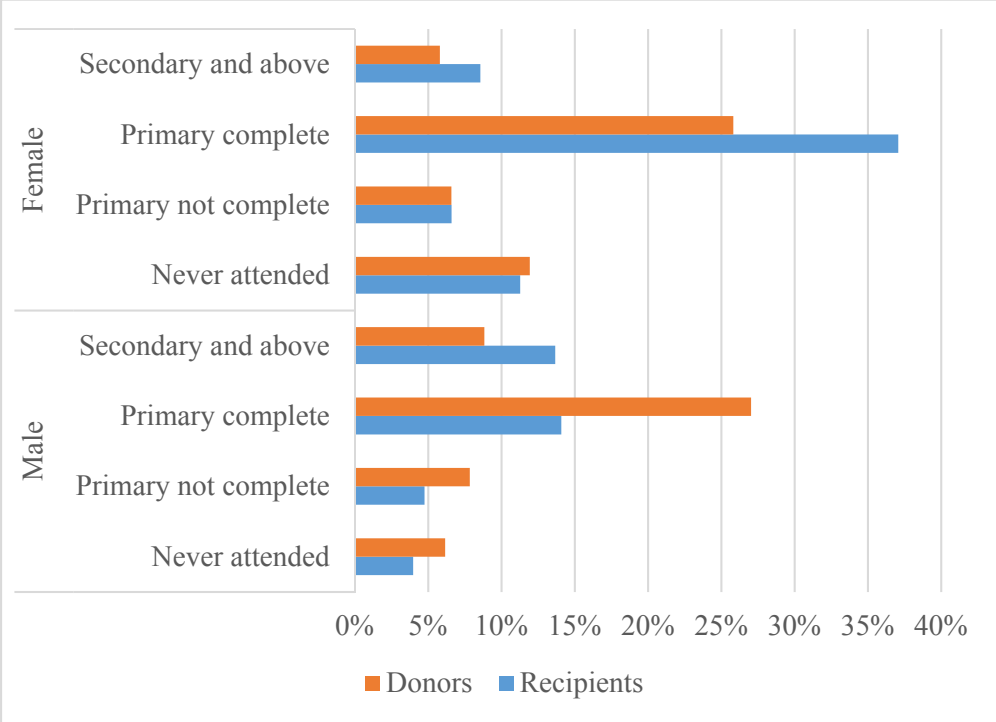
[34] A detailed mapping of the industries in the SAM for Tanzania, the CGE model, and the THBS is provided in an auxiliary spreadsheet.

Figure C-10 Shares of the Job Assignment Donor and Recipient Pools, by Age and Sex, Tanzania (percent)



The level of education of the population in Tanzania is generally lower than that of Ghana, and this is reflected in the breakdown of the recipient and donor pools by sex and educational attainment in figure C-11. The largest share of males and females in both the recipient and donor pools (51 percent and 53 percent, respectively) are those that have finished primary education only. For both males and females, those with secondary education and above are larger shares of the recipient pools than the donor pools.

Figure C-11 Shares of the Job Assignment Donor and Recipient Pools, by Education and Sex, Tanzania (percent)



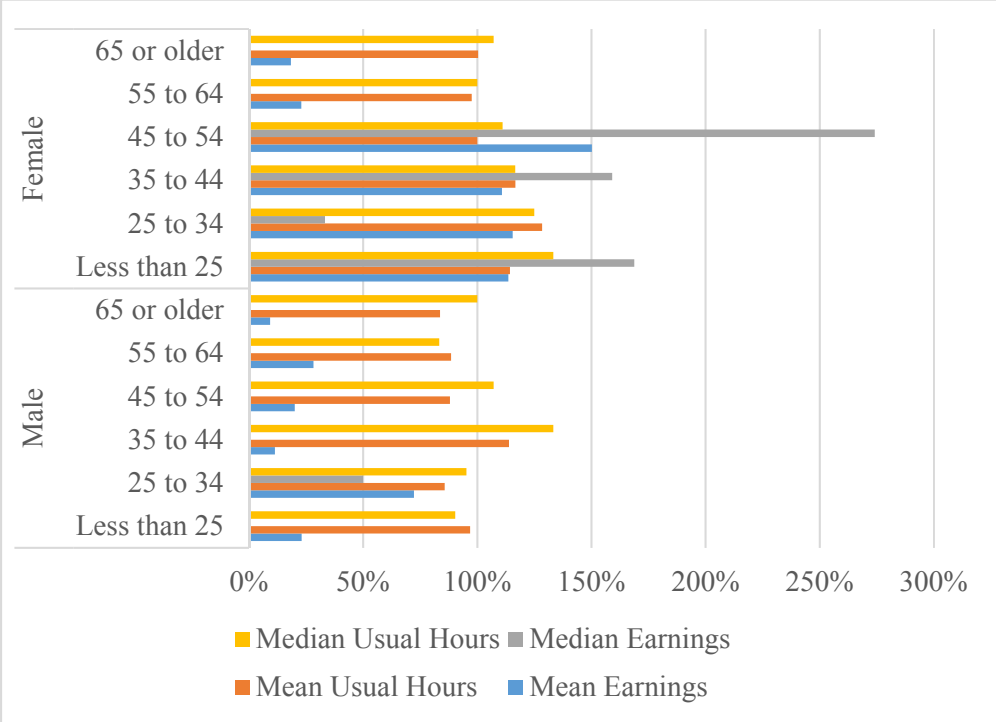
Moving on to the assignment of jobs, we see that because the majority of jobs were in the care sector, most individuals assigned jobs were not assigned work in their first most-likely sector (table C-5). The largest exception to this trend was among those whose likeliest sector was own-account agriculture, of whom over one-half received job assignments in that sector. Of course, all of those whose likeliest sector was care services were indeed assigned to that sector, but they make up less than 2 percent of all job recipients.

Table C-4 Assigned Sectors by Likeliest Sector, Tanzania (percent)

Assigned Sector	Likeliest Sector					
	Own-account agriculture	**Own-account manufacturing**	**Capitalist services**	**Own-account services**	**Care services**	**Total**
Own-account agriculture	**40.7**	0.0	0.0	0.0	0.0	40.7
Capitalist manufacturing	0.4	0.0	0.0	0.0	0.0	0.4
Own-account manufacturing	5.6	**0.0**	0.0	0.6	0.0	6.2
Capitalist services	0.8	0.3	**0.0**	0.1	0.0	1.2
Own-account services	4.2	1.7	0.0	**0.0**	0.0	5.9
Care services	24.0	15.9	0.2	3.9	**1.6**	45.6
Total	75.7	17.9	0.2	4.6	1.6	

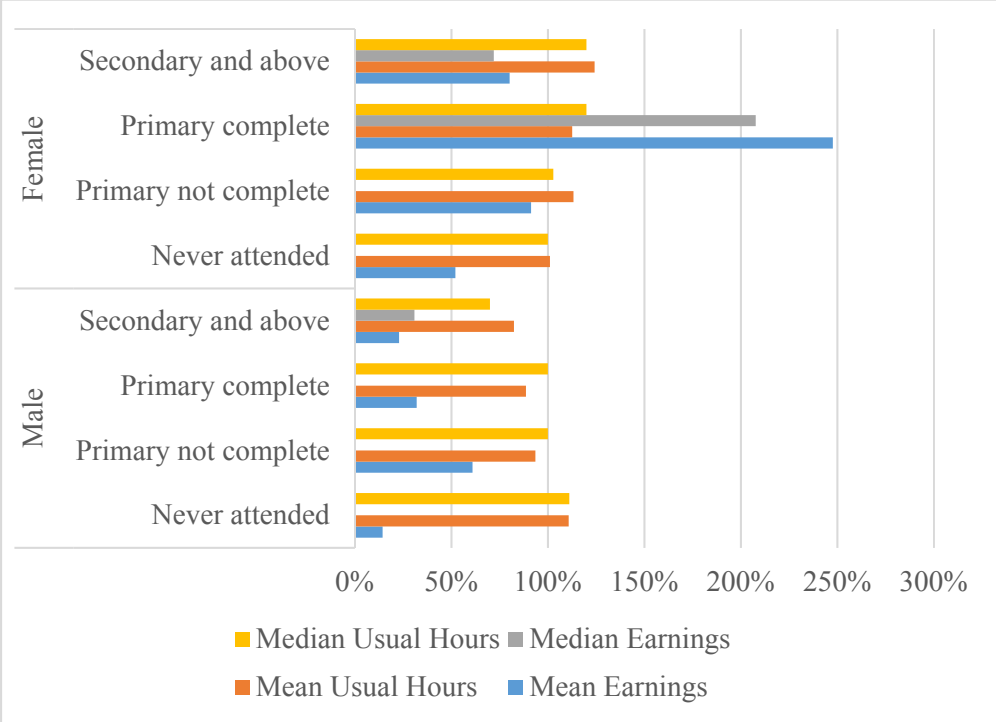
Comparing the distribution of earnings and hours between the recipients and the donor pool for Tanzania by sex and age, we see in figure C-12 that, for the most part, usual weekly hours of work among the recipients are very similarly distributed to the donor pool. Earnings are a different story, with the earnings of female recipients under the age of 55 generally higher than those of their counterparts in the donor pool. For male recipients, the opposite is true, with their earnings being lower. The highest ratio among males is 72 percent for the mean earnings of those ages 25–34.

Figure C-12 Ratio of Simulated to Actual Mean and Median Earnings and Weekly Hours by Sex and Age, Tanzania



Looking at the comparison by sex and education in figure C-13, we can see that hours of work are again similarly distributed among job recipients and the donor pool. The pattern in earnings seen above is present especially among females with primary education, who receive considerably higher earnings than usual among females in Tanzania. Because we are assigning jobs that the recipients are most likely to receive (within the constraints imposed by the sectoral composition of the jobs created in the CGE model of the spending associated with the policy interventions), these divergences between earnings between the recipients and the donor pool are more evidence of the differences between the two groups than of problems with the simulation.

Figure C-13 Ratio of Simulated to Actual Mean and Median Earnings and Weekly Hours by Sex and Educational Attainment, Tanzania



As with the Ghanaian simulation, we expect that the time use reassignment pools will be more alike than the earnings pools, since the recipients, in this case, are all those individuals with time use information in the households that contain at least one job recipient in the simulation and the donors are all the individuals with time use information. As we see in figures C-14 and C-15, these pools are very similarly distributed by sex, age, and education. The one significant difference in terms of age is among younger males and females: those under 18 make up a larger share of the donor than the recipient pool. The opposite is true among those ages 18–24, and combining the two youngest groups yields similar shares for both female and male recipients and donors. The comparison by education shows more significant differences: the recipient pool tends to be more highly educated than the donor pool. These differences are not of great concern, since the statistical match for the time use reassignment is done within cells constructed from sex, age, and education.

Figure C-14 Time Use Donor and Recipient Pools by Sex and Age, Tanzania

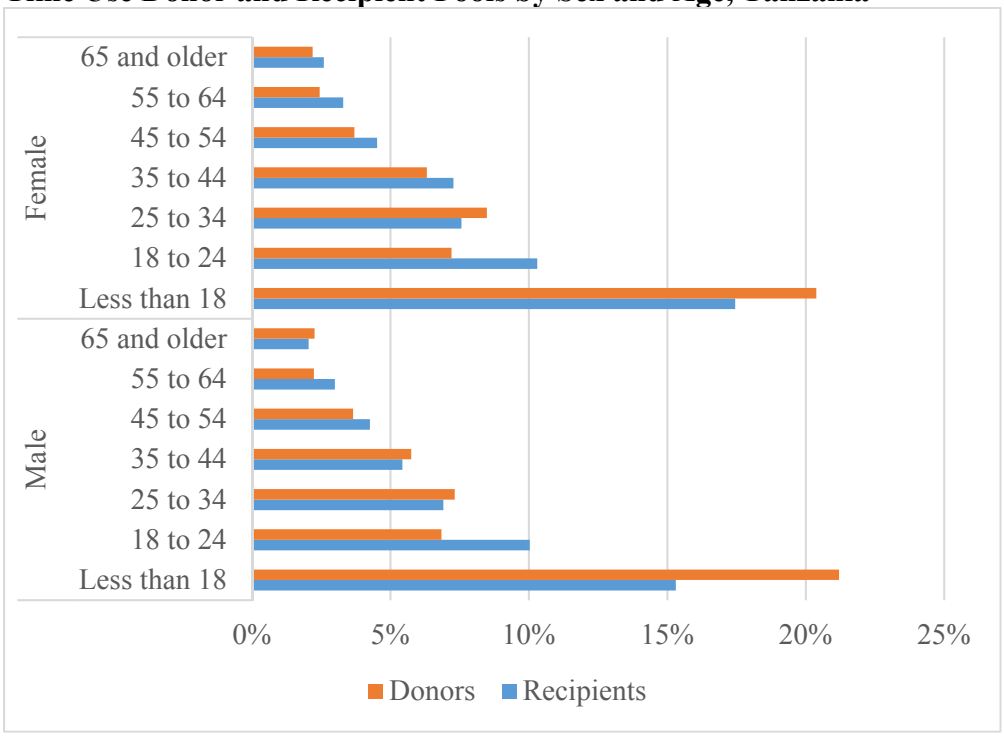
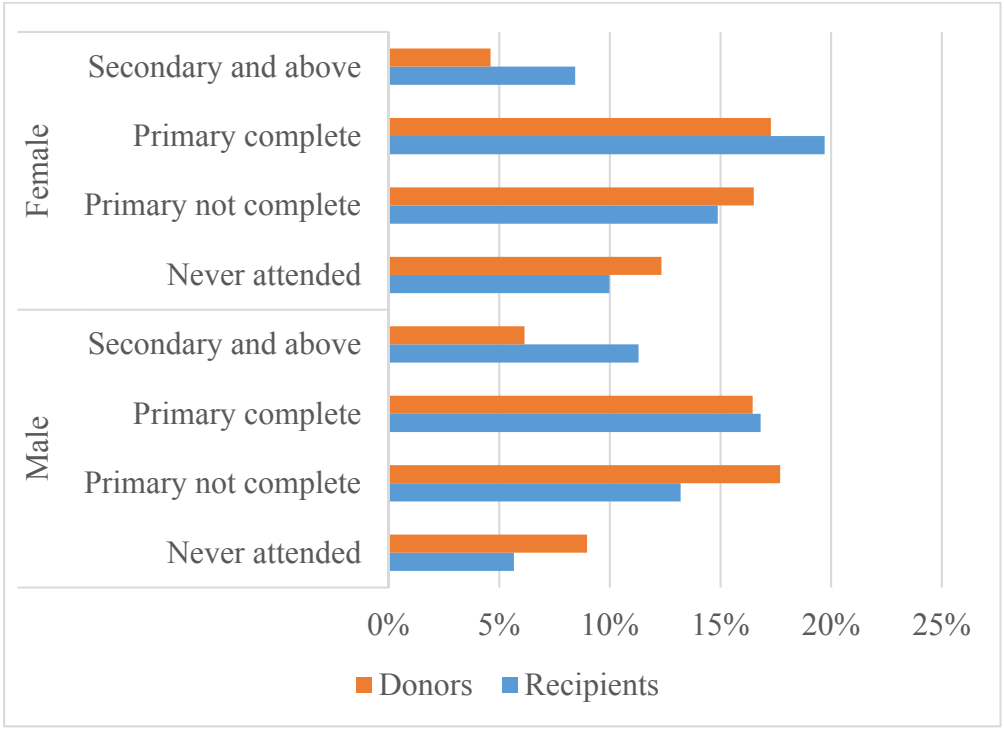
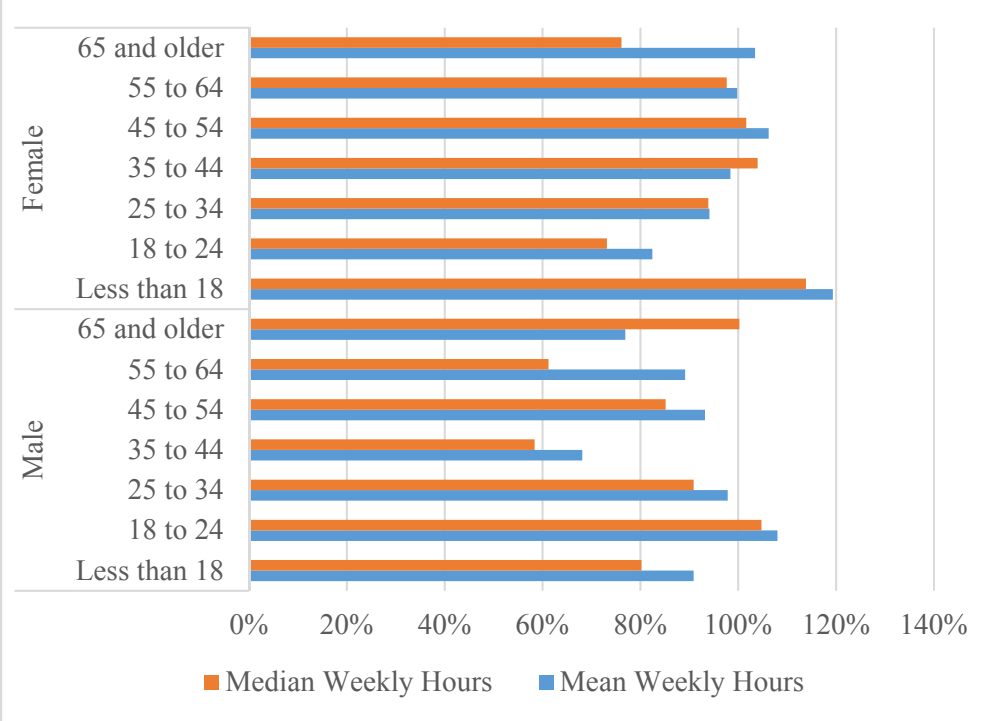


Figure C-15 Time Use Donor and Recipient Pools by Sex and Educational Attainment, Tanzania



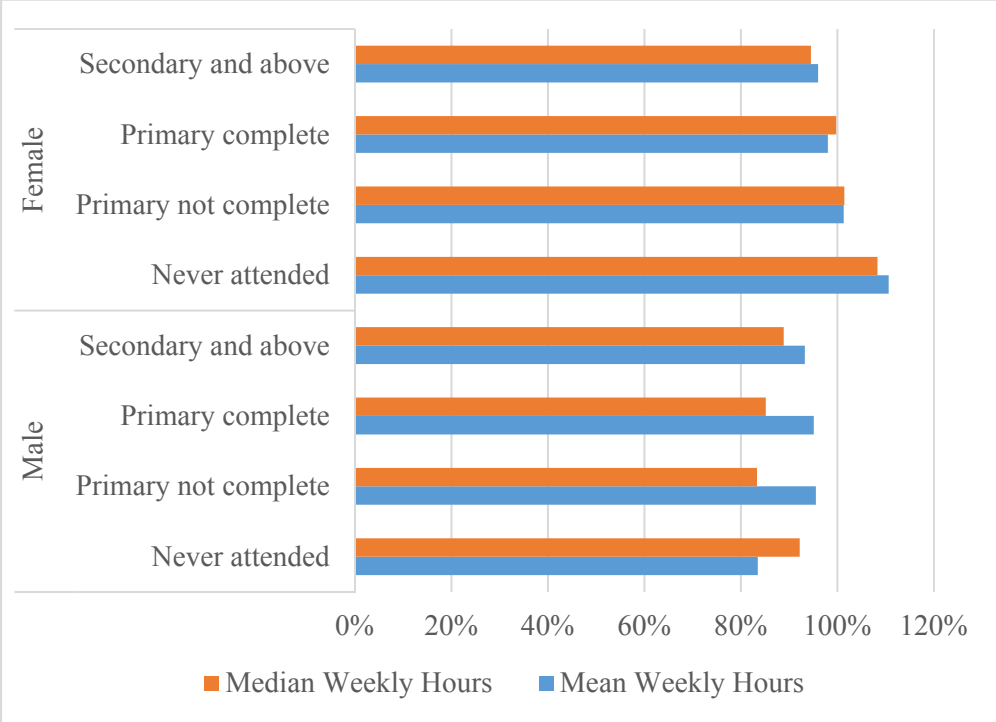
The results of the reassignment are presented in figures C-16 and C-17. The distribution of weekly hours of household production among recipients and donors is very similar by sex and age. In most categories, the ratios of mean and median hours are near unity. Although the division of unpaid household work by sex is unequal in Tanzania, no subcategory of males had zero median hours of household work, as in Ghana. Nonetheless, the largest relative differences, such as the 58 percent ratio between males ages 35–44 in the recipient and donor pools, translate to an absolute difference of just two hours per week at the median (three hours for those in the recipient pool, compared to five hours for those in the donor pool).

Figure C-16 Ratio of Mean and Median Weekly Hours of Household Production between Recipients and Donors by Sex and Age, Tanzania



In terms of the comparison by education (figure C-17), the differences are even smaller, with most ratios being near unity. The largest relative difference is in the mean weekly hours of work for males who never attended school. The recipients averaged 7.5 hours per week, compared to the 9 hours per week of the donors, for a ratio of 84 percent. None of these differences are a source of concern in an exercise of this nature.

Figure C-17 Ratio of Mean and Median Weekly Hours of Household Production between Recipients and Donors by Sex and Educational Attainment, Tanzania



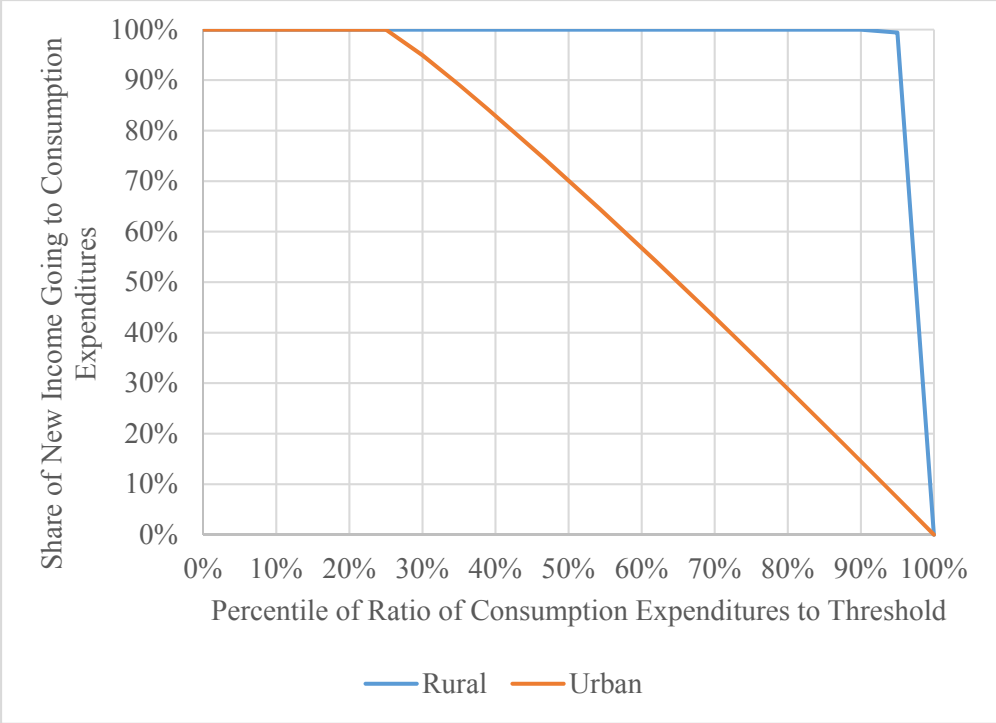
The final step in the simulation was to adjust consumption expenditures. The formula used for the adjustment was slightly different for Tanzania:

$$\Delta x_i = \Delta y_i \left(1 - \left(\frac{F\left(\frac{x_i}{z}\right) - 0.25}{0.75}\right)^{\alpha}\right) \forall F\left(\frac{x_i}{z}\right) > 0.25$$

In this case, we assumed the marginal propensity to consume was one up to the 25th percentile and decreasing afterward. The decrease was again determined by the parameter α, which in this case was 75 for rural areas and 1.1 in urban areas. Rural incomes in the Tanzanian simulation were not greatly increased beyond the predicted increase in consumption expenditures (4.3 percent versus 2.4 percent, respectively), so the adjustment was relatively small except at the very top of the distribution of the ratio of consumption expenditures to the poverty threshold. For urban areas, the imputed increase in incomes was 11.7 percent, compared to the projected rise in consumption expenditures of 2.2 percent in the CGE model. Thus, the adjustment was more

drastic (nearly linear) in the urban areas. The adjustment profiles are presented in figure C-18, below.

Figure C-18 Consumption Expenditure Adjustment Profile for Rural and Urban Households According to Their Rank in the Distribution of the Ratio of Actual Expenditures to the Poverty Threshold, Tanzania



In conclusion, the simulation appears to be as good a reflection of the macroeconomic changes predicted by the CGE model as is possible given the data sources and methods we have. No subset of job or time use recipients appears to be drastically out of line with the existing distribution of employment hours and earnings or household production hours.