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Comparing the poverty-reduction efficiency of targeted versus universal benefits amid crises

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Abstract: This study evaluates which type of benefit—a universal benefit, a proxy mean-tested benefit, or a categorical benefit— better cushions the poverty effects of income shocks in a developing economy. We compare the effectiveness of the three benefit schemes on poverty first conceptually and then by considering two different crisis scenarios, the COVID-19 pandemic and a hypothetical agricultural shock, in a tax-benefit microsimulation model for Ethiopia. The results suggest that while the proxy-means-tested benefits are the most effective in reducing the poverty gap index, a simple categorical benefit is equally good in lowering the headcount poverty. Universal benefits may lead to lower poverty increases when crises hit. This suggests that there could be a trade-off between minimizing poverty during normal times and offering protection against shocks when the poverty incidence changes.

Key words: social protection, income distribution, poverty, microsimulation, COVID-19, Ethiopia

JEL classification: C81, D31, H55, I32

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1 Introduction

Tax-benefit systems should, in addition to reducing poverty and inequality in normal times, provide support for households when crises hit. This social insurance function is prominent in the welfare states in developed countries. The results in Dolls et al. (2012) suggest that European welfare states, and to a lower extent the US tax-benefit system, provide considerable automatic stabilization against shocks.

This is understandable because of the means-tested feature of taxes and benefits. When the government can observe income levels, it can design policies that are directly a function of incomes. Hence, when incomes decline, and most income earners pay taxes out of their income, their tax liability drops. In a progressive income tax system, they then face a lower average tax rate. Similarly, if workers become unemployed, they become eligible for unemployment benefits. In addition, many benefits are linked not only to discrete changes in the labour market status but also to smaller changes in incomes. Unemployment benefits or other benefits, such as housing allowances, are adjusted upwards if the benefit recipients' incomes decline.

In low- and lower-middle-income developing countries, most workers typically work in the informal sector. Hence, many are outside of the tax net and if their incomes drop, this decline is not cushioned by a reduction in tax liability. Most workers are also outside of social insurance policies, and they are not sheltered by unemployment benefits in case of job loss. The results in Adu-Ababio (2022) confirm that the extent of automatic stabilization in selected developing countries falls short of that of developed economies.

In these countries, social protection policies are typically geared towards poverty reduction, not primarily to providing insurance against shocks. Benefits are often given in a proxy-means-tested (PMT) fashion, where the authorities gather information about household composition and living standards (e.g. about type of dwelling and asset ownership) and calculate a score based on these characteristics. If the overall score is below a threshold value, the household is deemed eligible for a transfer, whereas households with scores above the threshold receive no benefits. These types of benefits do not react to changes in household incomes, unless income changes are reflected in the living conditions captured in the score and new data are gathered on households' living conditions. In practice, the same households remain within the system for years.

In Ethiopia, the recipients of social benefits are re-targeted every three to five years (Ministry of Agriculture 2014). During the coronavirus crisis, social distancing also meant that new data-gathering in the field about possibly changed income distribution became very difficult.

This is the backdrop for this paper, in which we compare the poverty-reduction efficiency and social insurance impacts of different kinds of benefit systems, first using a simple conceptual framework. We then simulate the poverty-reducing impact of the different benefit systems in a developing country—Ethiopia—during the COVID-19 pandemic and a counterfactual agricultural shock. We introduce the COVID-19 shock based on the deviation in sector-level GDP for 2020 from its linear growth trend. The agricultural shock is implemented by examining a hypothetical shock with a 10 per cent reduction in income. The shocks are modelled in the Ethiopian tax-benefit microsimulation model (ETMOD), by randomly transiting individuals from paid employment to unemployment with no market income. The two shocks are simulated separately. The idea is to evaluate how well the existing Ethiopian social benefit system, the Productive Safety Net Programme (PSNP), which is targeted using a hybrid variant of PMT principles, fares in poverty reduction in a situation preceding a crisis and when the crisis has reduced household incomes. This is compared with two alternative, more universal programmes, with the same costs for the government: a categorical benefit, given to households with certain demographic structures; and a complete universal basic income type of a benefit. We also compare how much more effective programmes with the same targeting but higher benefit amounts would be in poverty reduction, taking into account the additional financing burden of higher benefit levels.

The relative merits of different types of benefit arrangements have been extensively discussed in the literature, including in Brown et al. (2018), Gentilini et al. (2020), Hanna and Olken (2018), Lustig et al. (2021), and Warwick et al. (2022). These studies have focused on comparing poverty reductions in a normal, steady-state situation. Our paper, therefore, contributes to the literature by providing analysis of the different types of benefit arrangements when shocks take place.

The paper is organized as follows. Section 2 lays out a basic conceptual framework within which to compare the poverty reduction offered by different benefit schemes in normal times and when shocks hit. Section 3 describes the model used in the empirical illustration, while Section 4 introduces in more detail the scenarios considered. The simulation results are presented in Section 5, and Section 6 concludes.

2 Conceptual framework

The purpose of this section is to introduce three different kinds of benefits scheme and examine how they protect households when household incomes change. We compare the corresponding poverty reduction offered by targeted and more universal schemes. The section also examines how the poverty reduction impacts of these systems depend on the budget available for social protection.

The government can use three different kinds of transfer policies, all financed by commodity and income taxes, and income tax is only paid by those whose income exceeds the basic tax allowance level. Let us introduce the three different transfer policies and their implications for the household budget constraint.

2.1 Different social protection arrangements

Proxy means test (PMT)

In the PMT system, the individual is eligible for a subsidy if a score (s) which is a function of characteristics (χ) falls below a threshold value, s_L. The characteristics are positively correlated with households' poverty status; in other words, the characteristics are predictors of poverty. The budget constraint for a household, depending on its income level, can then be written as:

$$(1 + t_P)c = y + B_P \; if \; s(\chi) < s_L$$
$$(1 + t_P)c = y \; if \; s_L \leq s(\chi) \; \& \; y \leq y_L$$
$$(1 + t_P)c = y - T(y) \; if \; y > y_L$$

where c is consumption, t_P consumption tax rate, y income, B_P is the benefit under the PMT system, and $T(y)$ is the income tax. Households eligible for the transfer are those in the first segment of the budget constraint. If the individual is not eligible for the transfer but their income does not exceed the basic allowance (y_L) of the tax system, the middle version of the budget constraint applies. Finally, those earning higher incomes pay the income tax (last line of the budget constraint).

Note that this system implies that a person's consumption actually declines when their score increases at the threshold, implying a notch in the tax-benefit system. In practice, the impact of this on work incentives is diminished because the score is not updated regularly. But it may still influence behaviour over a longer period of time.

Now suppose there is a shock to household incomes. The change in consumption as a response to a change in income along the intensive margin is:

$$dc = \frac{1}{1+t_P} dy \ if \ s(\chi) < s_L$$
$$dc = \frac{1}{1+t_P} dy \ if \ s_L \leq s(\chi) \ \& \ y \leq y_L$$
$$dc = \frac{1-T'(y)}{1+t_P} dy \ if \ y > y_L$$

In other words, an income shock is smoothed by the tax-benefit system only for those not paying income tax to the extent that the household needs to pay less consumption tax.

If the person loses their job and ends up with a situation of zero income (an extensive-margin response), the budget constraint becomes:

$$\begin{matrix} (1+t_P)c = B_P \ if \ s(\chi) < s_L \\ (1+t_P)c = 0 \ otherwise \end{matrix},$$

where the benefit is given only to households whose PMTs in the initial period were below the threshold value. Those impoverished due to a shock receive nothing until the information that the PMT needs is gathered anew by the government.

Universal basic income (UBI)

Under a UBI, all households receive the same benefit, B_U.

$$(1+t_U)c = y + B_U \ if \ y \leq y_L$$
$$(1+t_U)c = y + B_U - T(y) \ if \ y > y_L$$

In the case of a shock, the households will still receive a benefit. The extent of automatic stabilization is:

$$dc = \frac{1}{1+t_U} dy \ if \ y \leq y_L$$
$$dc = \frac{1-T'(y)}{1+t_U} dy \ if \ y > y_L$$

The difference in the extent of automatic stabilization between targeted and universal schemes depends on the level of (indirect) taxation used to finance the scheme. If the government raises taxation to increase the benefit amounts, which otherwise would be very small since the same budget is spread across the entire population, the commodity tax rate is higher under universalism; hence $t_U > t_P$. Then the extent of automatic stabilization also increases.

In case of an extensive-margin shock (job loss), the budget constraint is

$$(1 + t_U)c = B_U$$

for all household types. They still receive the benefit.

Categorical benefit (CB)

In between the two polar cases (PMT targeting vs universal benefits) are systems where the benefits are targeted based only on simple demographic conditions, such as the number of children in the household or the presence of elderly household members. In the so-called categorical benefit scheme, targeting is based on a poverty score. Conceptually, PMT and CB are similar, as they both use an indirect proxy for targeting— a score constructed on the basis of many observable characteristics in the case of PMT, and just a handful of demographics in the case of CB.

Under a CB system, all households belonging to a group D receive the benefit, B_D. The budget constraint is now:

$$(1 + t_D)c = y + B_D(D) \text{ } if \text{ } y \leq y_L$$
$$(1 + t_D)c = y + B_D(D) - T(y) \text{ } if \text{ } y > y_L$$

where households receive a benefit if they belong to group D. Otherwise, the system behaves in the same way as the UBI system.

2.2 The poverty implications of income shocks

Suppose the government measures or minimizes an income poverty index of the Foster-Greer-Thorbecke (Foster et al. 1984) class. Overall poverty is then given by:

$$P^\alpha = \int_0^{y^z} \left[\frac{z - c}{z}\right]^\alpha f(y)dy$$

where the poverty line is given by z, and the corresponding gross income level at the poverty line by y^z, while $f(y)$ represents the density of the income distribution. With $\alpha = 1$, for example, the government's objective would be to minimize the poverty gap index.

We follow here the analysis of Kanbur and Keen (1989) and Kanbur et al. (1994), with interpretation to the present framework. It may be helpful to break the poverty index into two population subgroups, A and B. Then overall poverty can also be written as:

$$P^\alpha = \theta^A P_A^\alpha + \theta^B P_B^\alpha$$

where θ^k is the population share and P_k^α the subgroup poverty of group $k = A, B$. In the case of a PMT system, for instance, A can be thought of as the group initially receiving the benefit.

From the household budget constraint, abstracting, for simplicity, from indirect tax considerations, $c = (1 - t)y + B$, the poverty impact of a change in the gross income of household i belonging to group k in terms of poverty is given by:

$$\frac{dP^\alpha}{dy^i} = -\frac{\alpha\theta^k(1 - t)}{z} P_k^{\alpha-1}$$

for households who pay income tax. Poverty headcount, evaluated in consumption space, will react to changes in the gross income of those close to the poverty line, and these changes feed into household disposable income in a one-to-one manner, since the benefits received do not change if the household's income level is low enough for it to not have to pay taxes. The change in the poverty gap will also be the same as it would in the absence of a benefit system.

The efficiency in the targeting of benefits may be examined by the following exercise. Suppose that the two groups get different transfer levels, B^k. The impact on poverty of a small increase in the benefit to group A, financed by a reduction in transfer to group B, will reduce poverty if:

$$\frac{dP^\alpha}{dB^A} = \frac{\alpha\theta^A}{z}[P_B^{\alpha-1} - P_A^{\alpha-1}] < 0$$

which holds if $P_A^{\alpha-1} > P_B^{\alpha-1}$. This conveys the intuition that if the goal is to have the smallest possible poverty gap index, for instance, the transfers should be targeted to the group where the poverty headcount ratio is the greatest, i.e. where the marginal reduction in poverty gap is large.

In the case of a heterogeneous negative income shock, where the shock affects only those (group A) who received the transfer in the baseline situation, the benefit is still appropriately targeted if the condition above holds in the baseline case before the shock. This is because a reduction in incomes among households in group A can only increase $P_A^{\alpha-1}$ or leave it intact, depending on if $\alpha > 1$ or not.

If the income shock affects group B, $P_B^{\alpha-1}$ increases or stays the same while $P_A^{\alpha-1}$ does not change. If $P_B^{\alpha-1}$ does increase, the absolute value of the difference $P_B^{\alpha-1} - P_A^{\alpha-1}$ is reduced, and $P_B^{\alpha-1}$ may exceed $P_A^{\alpha-1}$. This implies that the relative efficiency of targeting benefits to group A is reduced, and if the shock on incomes among group B members is large enough, targeting benefits more universally between the two groups becomes desirable.

This discussion highlights the key trade-off that the government is facing: a system which minimizes poverty in a steady-state situation may not necessarily be optimal when incomes change relatively significantly and the correlation of the income shock with the initial targeting is negative.

2.3 Comparison of targeting versus universalism under different social protection budgets

In this subsection, we further investigate the poverty reduction that is offered by targeted versus more universal systems and demonstrate how this depends on the budget available for social protection.

We continue to denote income by y, with density $f(y)$ and cumulative distribution $F(y)$.

Suppose one has an exogenous resource (so it does not have to be raised within the system) available for poverty reduction. Let the amount available be R.

Normalize population size at unity so that the per capita resource available for poverty reduction is also R. The poverty line is still denoted by z.

A universal benefit gives R to every individual in the distribution. Then every individual with income y above $z - R$ will be out of poverty. Only those with income less than $\hat{y}^U = z - R$ will still be in poverty. Thus, the poverty headcount ratio with universal benefit, P_0^U, is $F(z - R)$.

Now consider perfect targeting. With resources R, the efficient procedure to reduce headcount is to go to the person closest to the poverty line and give this person just enough to reach the poverty line, then go to the next person down, and so on until the exogenously available resource is exhausted. This perfect targeting will reach down to income level $\hat{y}^T$, which is defined by:

$$\int_{\hat{y}^T}^{z} (z - y) f(y) dy = R$$

The poverty headcount ratio with perfect targeting is $P_0^T = F(\hat{y}^T)$. It should be clear intuitively that for a given R, $P_0^T \leq P_0^U$. For example, it can be checked[1] that if $f(y)$ is uniform between 0 and 1, then:

$$\hat{y}^T = z - \sqrt{2R}$$

As the available resource R becomes very small, $\hat{y}^U$ and $\hat{y}^T$ converge and thus the two headcounts converge to the pretransfer headcount ratio.

As the available resource increases from 0, in the perfectly targeted case a point will come when all poverty is eliminated—when $\hat{y}^T = 0$. At this resource level there will still be poverty in the universal benefit case, which will be eliminated only when the transfer is high enough to raise the lowest income to z.

The relationship can be seen clearly for the case where $f(y)$ is uniform between 0 and 1, so that:

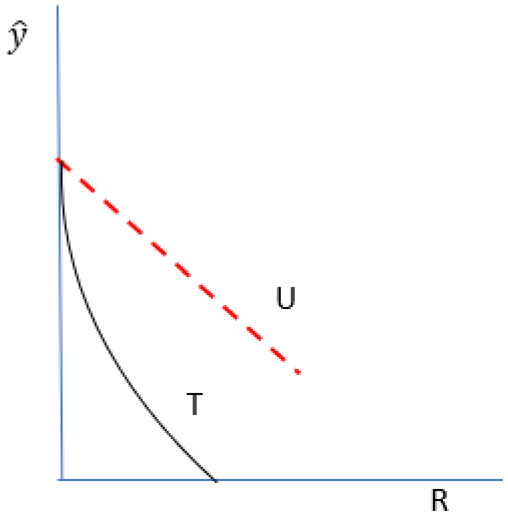
$$\hat{y}^T = z -; \quad \hat{y}^U = z - R$$

In Figure 1, the vertical axis is $\hat{y}$, the horizontal axis R. The two relationships are plotted as functions of R, with the same intercept, z, but different negative slopes. The T function, shown as the black solid line, is steeper and the absolute value of its slope is greater than unity, which is the slope for the untargeted case (U), shown as the red dotted line.[2]

[1] See Appendix C.

[2] This holds at least until poverty is eliminated in the T case. Therefore the U line is drawn until that level in R.

Figure 1: Illustration of the relation between poverty reduction and available budget



Source: authors' illustration.

Thus, the T curve lies above the U line, except when $R = 0$. This confirms the intuition that with the same resources, perfect targeting results in lower poverty. Further, the gap is small for small levels of poverty-reduction resources R.

However, note again that the T curve is steeper in R than the U line. This immediately implies that poverty is more responsive to crises of a particular type in the T case.

Why? Suppose a crisis is a simple additive reduction of income—the same for every individual. Then, analytically, the effect of measured poverty is the same as leaving the income distribution unchanged but lowering R. But we know from our analysis (specifically in the uniform density case) that the T line is steeper as a function of R. Hence, the impact on poverty of a crisis is greater in the T case than in the U case.

The above reasoning establishes the argument that the same system which is good for lowering poverty in the static sense may be worse for protection against poverty when there is a negative shock from a crisis.

This argument needs to be, and can be, generalized (for example to broader Foster-Greer-Thorbecke/FGT measures; Foster et al. 1984). But it stands as a way of capturing our basic intuition, which is also validated in the simulations.

Note that the above does not speak to the intermediate case of PMT and the way in which correlations between proxies and income, and how these change with a crisis, matter. This is a related but separate topic.

3 ETMOD model and data

The purpose of this section is to describe the simulation model we use to investigate whether the mechanisms discussed above emerge in a real-world situation with realistic income shocks.

3.1 Tax-benefit policies in Ethiopia

The Ethiopian tax system is similar to tax systems in other African economies. Income tax holds a considerable stake in the total tax revenue in the country. Indirect tax still accounts for the largest share of tax revenue. The contribution of taxes on imported commodities has declined, while the role of indirect tax on domestic production has shown a slight increment, in the past decade. The ETMOD country report by Shahir and Figari (2022) shows that direct tax revenue accounted for 35 per cent of total tax receipts in 2012/13. The importance of direct tax has grown over time, reaching 42 per cent in 2019/20.

Tax rates vary depending on the type of income. Incomes from employment and business profit are treated under a progressive system along seven bands, with tax rates ranging from 0 to 35 per cent. A monthly rate of 600 birr (ETB) is the upper threshold for personal income. In addition, a 30 per cent rate is imposed on income for incorporated entities. Rental income is taxed at a 15 per cent rate, interest on deposits and royalties is subject to a 5 per cent tax, and dividend is subject to a 10 per cent tax. The income tax legislation exempts employment income including that earned by casual workers, pension contributions by employers, health allowances, and salaries received from embassies.

A purchaser pays the value-added tax (VAT) or the turnover tax (TOT) only if the seller is registered for VAT/TOT. A business can collect VAT on behalf of the tax authority if its annual sales exceed the annual ETB500,000 threshold; otherwise, it will register for TOT. VAT is imposed at a 15 per cent rate on goods and services regardless of origin. Different TOT rates are levied on goods and services. Household consumption expenditure on goods is taxed at 2 per cent. Household expenditure on all services apart from contractors, grain milling, and services rendered using tractors and harvesters is subject to a 10 per cent rate, the latter taxed at a 2 per cent rate. VAT and TOT policies exempt expenditure on the rental of houses, financial services, medical services, religious services, educational services, books, childcare, transportation services, electricity, kerosene, tap water, and humanitarian aid.

The Ethiopian social benefits system includes pension, sickness, and disability benefits. The government also provides urban and rural PSNP packages in collaboration with development partners. The PSNP has supported millions of food-insecure households since 2005. The programme was initially confined to a rural part of the country but was expanded to reach urban poor after 2016. It has two components: direct support and public work. The direct-support segment provides unconditional cash to vulnerable households—those where no household member is fit to participate in developmental activities. The public-work component provides a conditional cash transfer to poor households with at least a single member who can contribute to a labour service, engaging in community-level development projects. The clients of the benefit packages are not entirely determined using PMT rules.

The kebele is the lowest administrative unit in the country, except in Addis Ababa where the woreda is the lowest. Groups of kebele form woreda. Kebele contain informal community structures with the role of selecting households for the PSNP. The Federal Food Security Coordination Directorate decides the number of clients for the benefits programme in every woreda. The Woreda Food Security Task Force (WFSTF) follows, fixing the number of beneficiaries for each kebele under its jurisdiction. Then the Kebele Food Security Task Force (KFSTF) confirms whether the number of beneficiaries approved by WFSTF meets its expectations based on past trends. Finally, the Community Food Security Task Force (CFSTF) identifies poor households that would be covered by the benefit scheme.

The rural and urban PSNPs apply PMT, but with different motives. PMT is inconsequential in targeting beneficiaries for the rural PSNP; households identified by the CFSTF automatically become clients. The rural PSNP utilizes PMT only during the annual reassessment of beneficiaries. Detailed information on beneficiaries feeds into the model used to estimate PMT. A household that is above the PMT threshold will be removed from the programme and replaced by a poor household within the community to correct inclusion and exclusion errors. PMT is very relevant in targeting beneficiaries for the urban PSNP. Households from a list identified by the CFSTF are randomly selected and requested to fill in a questionnaire designed to obtain data to compute PMT. If the PMT score indicates an inclusion error of larger than 20 per cent, beneficiaries in the woreda will be re-targeted. Otherwise, households initially proposed by the CFSTF become eligible to receive the benefit (Ministry of Agriculture, 2014; MUDC 2016).

We simulate the rural and urban PSNPs—the public-work and direct-support components—using ETMOD based on the criteria described below. Further information on the PSNP and eligibility criteria implemented on the model can be found in the ETMOD country report (Shahir and Figari 2022).

- Public-work components of the rural PSNP:
  - Households should reside in rural Ethiopia.
  - The absolute poverty line is applied to identify poor households.
  - A household must have at least one non-disabled member between age 16 and 65.
  - Up to five members in eligible households are entitled to receive the payment; each gets an amount equivalent to 15 kg of cereal and 4 kg of pulses[3] per month.
- Direct-support components of the rural PSNP:
  - Households should reside in rural Ethiopia.
  - Poor households are identified using the absolute poverty line.
  - Household members are either disabled, children (below 16), or in old age (above 65).
  - Up to five members in eligible households are entitled to receive the payment; each gets an amount equivalent to 15 kg of cereal and 4 kg of pulses per month.
- Public-work components of the urban PSNP:
  - The household should reside in one of 11 cities (Adama, Addis Ababa, Assayita, Asosa, Dessie, Dire Dawa, Gambela, Hawassa, Harari, Jijiga, and Mekelle).
  - Poor households are identified using the absolute poverty line.
  - A household must have at least one non-disabled person who is between the ages of 18 and 65.
  - Up to four members in eligible households receive the payment; each gets ETB300 per month.
- Direct-support components of the urban PSNP:
  - The household should reside in one of 11 cities (as above).
  - Poor households are identified using the absolute poverty line.

[3] We use average the retail prices of major cereals and pulses to convert the in-kind payment into monetary terms.

- Household members are either disabled, children (below 18), or in old age (above 65).
- Up to four members in eligible households receive the payment; each gets ETB170 per month.

Hence, we are unable to completely follow the community-based targeting applied in much of the PSNP system. However, both the modelling of the PSNP in ETMOD and its delivery in practice are meant to capture the poorest part of the population, and thus the system represents a targeted social protection programme.

3.2 Underpinning data

This paper evaluates the performance of different classes of social benefit schemes using the Ethiopian tax-benefit microsimulation model (ETMOD). ETMOD uses the EUROMOD platform, which embodies a user-friendly structure that defines a tax-benefit policy rule. ETMOD, developed under the SOUTHMOD project, operates with an underpinned micro-file containing representative household-level data on incomes and expenditures derived from the Ethiopian Socioeconomic Survey (ESS). It currently runs simulations using input files from the 2013/14, 2015/16, and 2018/19 rounds of the ESS and covers the 2014-21 policy systems. The results presented in this paper are produced using an input file generated from the 2015/16 waves of the survey. These micro-input data contain 4,952 unique households and 23,386 individuals.

3.3 Policies modelled in ETMOD

The latest and harmonized version of ETMOD (et_v2.4) simulates the rural PSNP, urban PSNP, employers' social contribution, employees' social contribution, employment income tax, business profit tax, VAT, and TOT. The model simulates direct taxes after correcting for informality. Due to a lack of clarity in the ESS on whether the buyer transacts with a seller who is registered either for VAT or TOT, ETMOD simulated only VAT or TOT at a time using a policy switch. Moreover, ETMOD includes on-model COVID-19 shocks and a school benefit programme for the 2020 policy system, allowing an annual adjustment option for interested users. The model offers the flexibility to undertake alternative distributional analysis by adding multiple poverty rates and equivalence scales. It includes the absolute poverty line and food poverty line with and without post-fiscal adjustment. This is composed as disposable income (gross income minus direct taxes plus direct benefits), from which indirect tax payments at the household level are subtracted. In addition, the model allows the use of a nationally defined equivalence scale, per capita equivalence scale, or square root equivalence scale.

3.4 Comparison of ETMOD predictions and external data

Shahir and Figari (2022) compare the simulated tax-benefit amounts and distribution indices from ETMOD with external sources. Simulated employment income tax in the benchmark year (2016) is closer to the figure given by an external source (the Ministry of Finance), with a 14 per cent deviation. However, the simulated business profit tax is much higher than the official figure. The ratio of business profit tax in ETMOD to that in external source for 2016 is 1.60. This huge gap implies massive tax evasion by businesses. In addition, simulated VAT accounts for 78 per cent of the aggregate VAT revenue reported by the Ministry of Finance.

The revised ETMOD country report also indicates that the ratio of the rural PSNP simulated using ETMOD to that in the external source (UNICEF) for 2016 is 0.62. The lack of data from external sources on the cost of the social benefit programme and the number of recipients for the direct-support and public-work components of the PSNP hinder the effort to validate the ETMOD output.

Official poverty and Gini indices in Ethiopia are commonly estimated using the expenditure approach. Hence, the simulated consumption-based distributional statistics are used in this study for comparison purposes. The headcount poverty rate based on the absolute poverty line from ETMOD for 2016 is 44.70 per cent, while it is 23.5 per cent from an external source (the Planning and Development Commission). Likewise, the Gini coefficient is 0.41 and 0.33 in ETMOD simulation and external sources, respectively. On the one hand, the Ministry of Planning and Development uses the most comprehensive budget survey in the country, the Household Consumption Expenditure Survey, to estimate poverty and inequality indicators. On the other hand, the underpinning input file for ETMOD is compiled using ESS rounds. The difference in consumption items coverage between the two surveys can explain the gap in distributional indices between the ETMOD simulation and the official source.

4 Modelling of shocks and simulation scenarios

4.1 The shocks considered

Two different kinds of shocks are examined: a decline in incomes because of the COVID-19 pandemic and a hypothetical shock on agricultural incomes and home production. The first, the pandemic shock, is modelled using the scenario in Lastunen et al. (2021). The second is implemented as a uniform reduction of all agricultural incomes and the value of own agricultural produce.

The modelling of the COVID-19 shock requires more explanation. Early studies conducted on COVID-19 predicted a massive economic effect of the pandemic in Ethiopia. Aragie et al. (2021) used a social accounting matrix (SAM) multiplier analysis to examine the economy-wide effect of the pandemic in Ethiopia. The authors found that the pandemic inflicted a 14.3 per cent reduction in GDP in 2020. A sizeable fall in output was projected in the service sector; agricultural activity, hardly covered by the lockdown measures, was predicted to lose 4.7 per cent of production due to linkages with the rest of the economy. Geda (2021) looked at the macroeconomic impact of the pandemic in Ethiopia based on the UN Global Policy Model. The findings indicated that GDP in 2020 was expected to decline by 6.6 per cent and 13.3 per cent in the best- and worst-case scenarios, respectively.

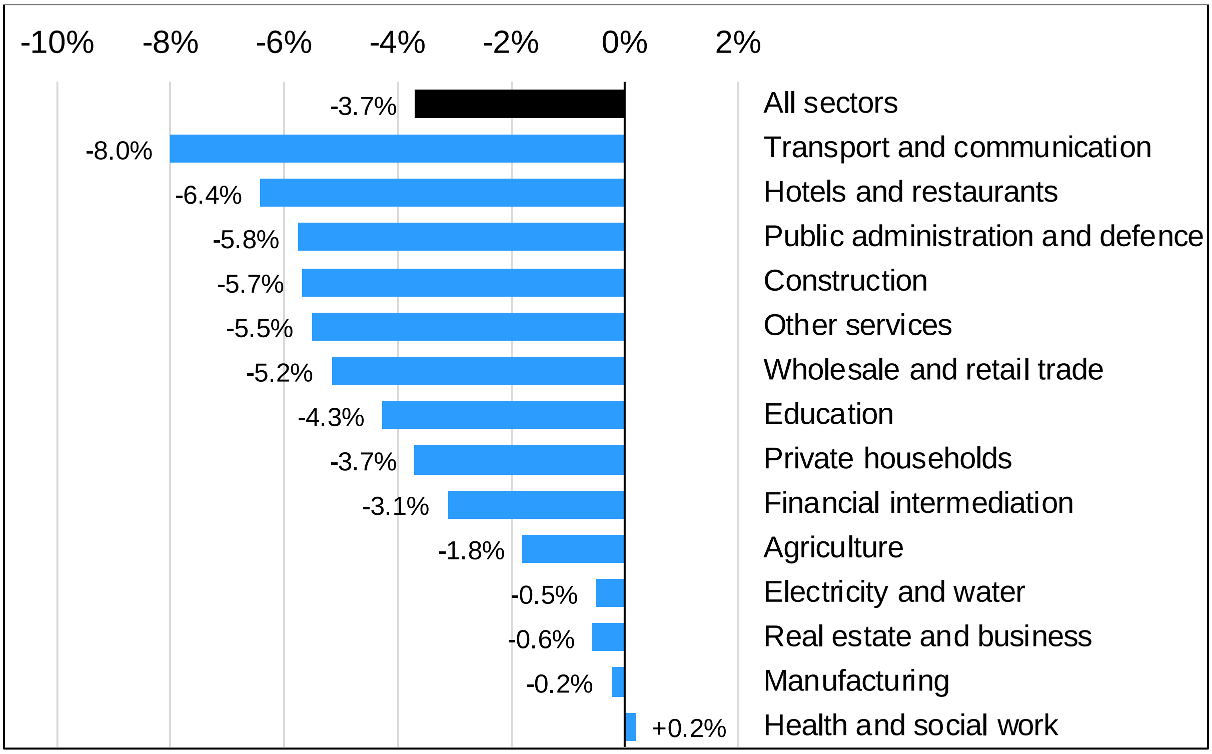
The year 2020 in the Gregorian calendar overlaps with two successive fiscal years in Ethiopia, 2012 and 2013. For instance, GDP for 2020 is contained in the 2012 and 2013 national account estimate (Ethiopian calendar). Ethiopian GDP in constant estimate grew by 6.1 per cent in 2012 and 6.3 per cent in 2013. The growth in these two years is much lower than the growth in the pre-pandemic period (2011) of 9.0 per cent (MoPD 2022). The agricultural sector performed well during the pandemic, except for a minor reduction in animal farming and hunting activities, whereas construction and most of the service sectors experienced considerable reductions in growth due to the crisis.

The different calendars make it challenging to compare our work with related studies elsewhere in world. We address this issue by decomposing annual GDP into a quarterly series using quarterly income tax data (based on the Ethiopian calendar) and re-annualizing it following the Gregorian calendar. After matching the calendar years, we use the 2017–19 linear growth trend to construct the baseline estimate for 2020. Using two years' mean growth results in a better projection for the short-run growth path of the economy compared with an estimate based on a single-year growth rate.

Figure 2 illustrates the effects of COVID-19 on sectoral GDP in Ethiopia. According to the estimates, the pandemic reduced overall GDP in 2020 by 3.7 per cent compared with a counterfactual figure derived from pre-pandemic trends from 2017 to 2019. The effects vary between sectors; the pandemic hampered most production activities characterized by interpersonal interaction, such as most service and construction industries. On the other hand, the health sector appeared to marginally benefit from the pandemic. The massive relocation of funding from public administration to improve the capacity of health service delivery may explain this minor positive shock in the health sector.

To sum up, the pandemic is modelled to lower incomes—against a benchmark of more rapid growth. The impact varies among sectors, and this is achieved in the model by randomly allocating individuals to losing their job so that the income foregone in a given sector matches with the aggregate reduction in the same sector.

Figure 2: Industry-level GDP shocks in 2020, Ethiopia



Source: authors' illustration based on national GDP data provided by the Ministry of Planning and Development (MoPD).

4.2 Simulation scenarios

Results are calculated for three different benefit systems:

- the existing targeted benefit system (the Ethiopian PSNP), PMT for short;
- a categorical benefit with a monthly cash transfer (ETB32) to those over 65 and households with more than four children (the old-age benefit targets individuals while the child component makes a transfer to the household; for illustration, a household with five children and an elderly member is eligible for the benefit twice); and

- completely universal benefits: a monthly ETB11 transfer to everyone regardless of the level of earnings or any other criteria.

The benefit levels in these three systems are set such that the overall government expenditure on each is the same. In addition, we consider budget-neutral expansions of the systems, where benefit amount increases are financed by raising indirect taxation. In all of these scenarios, the overall budget for social assistance is ten times larger than in the baseline. Since targeting in terms of recipients stays the same, the benefit amounts are increased ten-fold too. The expansion of benefits is rendered budget-neutral by increasing the VAT rate from 15 to 17.8 per cent. The model simulates VAT with a constant budget share assumption, and hence a shock in income is also reflected in indirect tax revenue. The consequences for the government budget are depicted in Table A1.

The programmes with higher spending are named Higher PMT, Higher CB, and Higher UBI.

The poverty-reducing impacts of these scenarios are tested in two different states. First, a base scenario is considered which represents the situation in the first quarter of 2020, before the coronavirus pandemic hit. This is based on updated household data, where the demographic characteristics of the data are nowcast to early 2020 levels. The second scenario represents a crisis situation, where household incomes are adjusted downwards following the sector-level economic developments amid the pandemic, in 2020.

This means that we consider altogether 18 different cases (six default and higher-benefit programmes, in crisis and in non-crisis times). In the case of PMT policies, we keep the set of benefit recipients fixed to reflect the plausible real-world scenario where it is difficult to gather the information required to calculate the PMT in crisis conditions. The impacts on poverty are calculated at the household level, with the existing Ethiopian equivalence scale in the space of the so-called post-fiscal income. This implies that the purchasing-power-reducing effect of indirect tax increases is also accounted for. As the poverty line, we use the lower Ethiopian poverty line, i.e. the food poverty line.

5 Results

This section briefly discusses the poverty-reduction role of different benefits systems amid the COVID-19 pandemic and the counterfactual shocks in the agricultural sector. We begin by presenting the findings from the COVID-19 simulation and then discuss results related to the alternate crisis, the agricultural shock.

5.1 The COVID-19 pandemic

Table 1 provides a comparison of poverty headcount under the current benefit system in Ethiopia, with and without crisis. Even before the crisis, poverty is only slightly reduced (−0.08) because of the benefits. The presence of benefits implies that the poverty increase caused by the pandemic is marginally smaller than without the benefits.

Table 1: Poverty with and without actual benefits

Base		Crisis		Change	
No benefits	With benefits	No benefits	With benefits	No benefits	With benefits
43.54	43.46	44.01	43.83	0.47	0.37

Source: authors' construction based on ETMOD v2.4.

Table 2 describes the incidence of impoverishment as a result of the crisis. Column 3 indicates the impacts under the business-as-usual scenario (PMT). The numbers refer to those households whose income was above the poverty line in the baseline scenario but which are classified as poor after the crisis, as a proportion of those initially non-poor. This relative impoverishment is more widespread among household with fewer household members, households with young children, wage earners, and urban households. All households in the bottom two quintiles were poor before the crisis, hence the new poor come from the upper three quintiles, with quintiles calculated on the basis of pre-crisis data. Table 2 also indicates that the percentage of crisis-induced poor is equal across the three benefits programmes at the default level of expenditure; poverty increased by about 0.8 per cent.

Table 2: Percentage of additional poor due to COVID-19 shock, under different benefit scenarios

Indicators		Baseline level of benefit			Higher benefit amount		
		PMT	CB	UBI	PMT	CB	UBI
Overall		0.830	0.798	0.830	0.797	0.820	0.856
Household size	1	1.599	1.685	1.576	1.685	1.545	2.346
	2	1.459	1.449	1.453	1.449	1.412	1.441
	3	1.042	1.049	1.047	1.049	1.029	0.909
	4	1.065	1.047	1.067	1.046	1.070	0.681
	5+	0.690	0.654	0.689	0.653	0.680	0.815
Age groups	Aged 0–14	0.853	0.810	0.853	0.810	0.846	0.837
	Aged 15–18	0.852	0.791	0.852	0.791	0.812	0.968
	Aged 19–59	0.842	0.835	0.842	0.832	0.852	0.859
	Over 60	0.550	0.479	0.545	0.477	0.450	0.790
Employment types	Pre-school	1.195	1.124	1.197	1.122	1.168	1.177
	Farmer	0.245	0.235	0.245	0.234	0.240	0.302
	Self-employed	1.365	1.329	1.366	1.327	1.344	1.273
	Employee	2.917	3.018	2.917	3.018	3.010	3.176
	Family worker	0.366	0.369	0.369	0.369	0.368	0.093
	Student	0.551	0.521	0.551	0.521	0.533	0.651
	Sick or disabled	0.906	0.879	0.899	0.879	0.838	0.726
	Others	1.100	1.047	1.098	1.046	1.125	1.001
Residence	Rural	0.453	0.430	0.453	0.430	0.449	0.494
	Urban	2.186	2.219	2.167	2.219	2.200	2.184
Quintiles	1						
	2						
	3	0.986	0.897	0.992	0.897	0.931	1.125
	4	0.390	0.499	0.388	0.499	0.527	0.456
	5	1.134	1.005	1.134	1.005	1.015	1.033

Source: authors' construction based on ETMOD v2.4.

Table 3 compares poverty headcount ratios under the different scenarios. In the PMT case, poverty headcount increased by 0.47 percentage points due to the crisis. Hence, the increase in poverty due to the COVID-19 crisis appears small in Ethiopia. The increase was more pronounced for household with a low number of household members, households with children, wage earners, and urban households (not shown; available on request).

Table 3: Poverty rate for baseline and COVID-19 crisis, under different benefit scenarios

Indicators	PMT		Higher PMT		CB		Higher CB		UBI		Higher UBI	
	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis
Poverty rate	43.36	43.83	41.45	41.92	43.35	43.82	42.73	43.20	43.42	43.89	43.13	43.62
Difference in poverty rate between baseline and crisis		0.47		0.47		0.47		0.47		0.47		0.49

Source: authors' construction based on ETMOD v2.4.

A CB system would lead to a slightly lower poverty headcount in both the baseline and the crisis situation. This shows how equal—or in our case, better—targeting of the benefit could be achieved with a simple categorical rule. This result is in line with Brown et al. (2018). However, the increase in the poverty headcount due to crisis is similar under PMT and CB.

A completely universal system (UBI) would, in turn, be less well targeted and would hence lead to marginally lower poverty reduction in the baseline scenario. Poverty headcount would also be higher during a crisis under UBI than in the case of the PMT system. When the budget available for social protection is low, the differences in the poverty headcount reduction between targeted and more universal system are also small, as our theoretical discussion predicts.

Table 4: Poverty gaps for baseline and COVID-19 crisis, under different benefit scenarios

Indicators	PMT		Higher PMT		CB		Higher CB		UBI		Higher UBI	
	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis
Poverty gap	0.236	0.241	0.223	0.227	0.238	0.243	0.231	0.236	0.238	0.243	0.235	0.239
Difference in poverty gap between the baseline and crisis		0.005		0.005		0.005		0.004		0.005		0.005

Source: authors' construction based on ETMOD v2.4.

Table 4 provides similar results for the poverty gap. These results also depend on income developments among those who are consistently poor, especially households in the bottom two deciles. It appears that PMT is best in targeting benefits, since the poverty gap is the smallest under this scenario. Since the increase in the poverty gap following the crisis is the same across the three systems, PMT would result in the lowest poverty gap also during the crisis. CB functions as effectively as UBI during and without the coronavirus crisis. When benefit amounts are raised, PMT still leads to the lowest poverty gap.

In order to understand the reasons for these results, Table 5 presents the incidence of benefits and VAT payments (which become relevant in scenarios where higher benefits are financed by indirect tax payments) by consumption quintiles, with quintiles ordered using base-period values. PMT benefits are very concentrated at the bottom of the distribution, whereas categorical benefits are quite evenly spread across the distribution. The uniform benefits appear to be somewhat concentrated at the top of the distribution, because these households typically have fewer members. These observations make it understandable that the poverty gap is reduced the most with PMT before the crisis, and if the distributional changes arising from the pandemic are not very large—as is the case in COVID-19 simulations—PMT continues to provide the most poverty gap reduction even post-crisis. When poverty headcount is relatively high as in Ethiopia, even less well targeted benefits can push households below the poverty line. This we have seen in the simulations where CBs perform as well as PMTs do when considering the reduction of the number of poor households.

Table 5: Mean monthly benefit and VAT, by quintiles of consumption expenditure

Quintiles	Benefits						VAT					
	PMT	Higher PMT	CB	Higher CB	UBI	Higher UBI	PMT	Higher PMT	CB	Higher CB	UBI	Higher UBI
1	11.82	118.19	3.16	31.60	2.05	20.48	42.96	62.13	42.11	53.03	42.06	51.83
2	2.65	26.54	2.79	27.89	2.38	23.82	62.65	76.43	62.68	76.85	62.84	76.60
3	-	-	2.82	28.24	2.56	25.57	88.81	105.37	88.99	108.03	88.75	107.46
4	-	-	2.65	26.53	2.96	29.64	117.05	138.88	117.13	141.04	117.44	141.71
5	-	-	2.69	26.89	3.99	39.89	293.69	348.48	294.00	350.68	293.98	352.12

Source: authors' construction based on ETMOD v2.4.

Overall, the changes in the poverty rates across the different types of benefit systems are small. This is because in the baseline, expenditure on social transfers is ETB2,700 million, whereas the aggregate poverty gap amounts to about ETB140,000 million.

Since the COVID-19 crisis turned out to be less severe than was forecast, we also examine what would have happened to poverty under the different scenarios in a hypothetical case where the shock had the same incidence for different industries but its magnitude was greater. The results for the headcount index are shown in Table 6.[4] Had the shock been five times greater, the poverty headcount would have increased by 2.6 percentage points. Now the increase in poverty is somewhat smaller in UBI with the greater benefit level, which illustrates the point raised in the

[4] The corresponding results for the poverty gap are available upon request.

theory section: if the profile of the poor changes due to the shock, the original targeting works less well.

In the COVID-19 shock, this has indeed happened, as indicated by the results shown in Table 7. The incidence of job loss is greater among the previously non-poor, and the correlation coefficient between the initial poverty gap at the household level and job loss is mildly negative. This makes it understandable why the initial targeting loses precision.

The fact that we are considering a budget-neutral expansion of benefit systems may mute the differences across different benefit arrangements. This is why we also consider a case where the benefit amount is ten times greater than before but indirect taxes are not raised at the same time. In other words, we are considering an unfunded benefit expansion. The corresponding results for the poverty gap are depicted in Table 8. In this case, the difference in the poverty increase under the universal system versus the PMT system is somewhat larger, but still not drastic.

This suggests that the theoretical discussion pertaining to poverty-reduction changes under different degrees of universalism predicts the direction of headcount changes in the Ethiopian case, but the magnitude of the effects is very moderate.

Table 6: Poverty rate for baseline and magnified COVID-19 crisis, under different benefit scenarios

Indicators	PMT		Higher PMT		CB		Higher CB		UBI		Higher UBI	
	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis
Poverty rate	43.36	45.99	41.45	43.97	43.35	45.97	42.73	45.32	43.42	46.05	43.13	45.64
Difference in poverty rate between baseline and crisis		2.63		2.52		2.63		2.58		2.63		2.51

Source: authors' construction based on ETMOD v2.4.

Table 7: Incidence of job loss by initial poverty status in the magnified COVID-19 shock

Population	
Poor in baseline	41,900,000
Job lost due to shock	277,086
Ratio	0.66
Population	
Non-poor in baseline	54,700,000
Job lost due to shock	1,037,095
Ratio	1.90
Correlation coefficient for job loss and base poverty gap	−0.0194

Source: authors' construction based on ETMOD v2.4.

Table 8: Poverty rate for baseline and COVID-19 crisis with ten-times-higher benefit, under different benefit arrangements (unfunded)

Indicators	PMT		Higher PMT		CB		Higher CB		UBI		Higher UBI	
	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis
Poverty rate	43.36	45.99	40.03	42.66	43.35	45.97	41.37	44.01	43.42	46.05	42.11	44.63
Difference in poverty rate between the baseline and crisis		2.63		2.63		2.63		2.64		2.63		2.52

Source: authors' construction based on ETMOD v2.4.

5.2 Counterfactual agricultural shock

Agriculture is a dominant economic activity in Ethiopia, accounting for 65 per cent of country-level employment and absorbing 77.3 per cent of rural employed people (Central Statistics Agency 2021). Thus, a shock in this sector would enormously distort the economy and hit the poor. Our finding supports this premise; Table 9 shows that a hypothetical 10 per cent fall in agricultural income would result in a noticeable increase in the percentage of poor under all benefit scenarios. A baseline UBI and an improved CB benefit amount end up with lower impoverishment. In general, households with many members, young people, farmers, and rural residents suffer the most. The result reveals that the COVID-19 (Table 1) and agricultural shocks affect different household groups.

Table 9: Percentage of additional poor due to agricultural shock, under different benefit scenarios

Indicators		Baseline level of benefit			Higher benefit amount		
		PMT	CB	UBI	PMT	CB	UBI
Overall		5.184	5.002	5.155	5.032	5.154	5.159
Household size	1	0.444	0.434	0.438	0.434	1.132	0.429
	2	3.710	3.703	3.695	3.703	3.608	3.663
	3	2.811	2.830	2.826	2.830	2.942	2.828
	4	4.554	4.476	4.560	4.473	4.573	4.505
	5+	5.834	5.561	5.778	5.601	5.758	5.823
Age groups	Aged 0–14	5.176	4.971	5.125	4.986	5.131	5.159
	Aged 15–18	7.112	6.886	7.114	6.949	7.091	7.084
	Aged 19–59	4.837	4.707	4.821	4.732	4.839	4.819
	Over 60	4.690	4.431	4.653	4.520	4.529	4.619
Employment types	Pre-school	3.314	3.163	3.258	3.159	3.260	3.312
	Farmer	7.811	7.459	7.758	7.480	7.714	7.710
	Self-employed	1.643	1.651	1.645	1.648	1.679	1.653
	Employee	0.290	0.295	0.290	0.295	0.294	0.291
	Family worker	0.710	0.716	0.715	0.716	0.714	0.721
	Student	5.857	5.714	5.834	5.757	5.855	5.859
	Sick or disabled	1.450	1.407	1.439	1.407	1.340	1.424
	Others	5.219	4.857	5.208	4.897	5.197	5.229
Residence	Rural	6.574	6.232	6.538	6.280	6.486	6.533
	Urban	0.184	0.188	0.182	0.188	0.187	0.185
Quintiles	1						
	2						
	3	6.051	5.638	5.992	5.758	5.455	5.657
	4	5.595	5.398	5.566	5.398	6.011	5.907
	5	4.018	4.018	4.018	4.018	4.035	4.018

Source: authors' construction based on ETMOD v2.4.

Table 10 presents the headcount poverty rate due to the agricultural shock. The poverty rate increases by 2.9 percentage points due to the crisis under PMT with the baseline regime. The effect is much more severe for a household with more than four members, individuals below 18, and rural households.

Table 10: Poverty rates for baseline and agricultural crisis, under different benefit scenarios

Indicators	PMT		Higher PMT		CB		Higher CB		UBI		Higher UBI	
	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis
Poverty rate	43.36	46.29	41.45	44.40	43.35	46.26	42.73	45.68	43.42	46.33	43.13	46.07
Difference in poverty rate between the baseline and crisis		2.93		2.95		2.92		2.95		2.91		2.94

Source: authors' construction based on ETMOD v2.4.

Analogously to the COVID-19 crisis scenario, CB provides better protection for the poor in the case of hypothetical shock in the agricultural sector. It delivers the lowest headcount poverty rate with and without crisis and a lower increase in poverty rate compared with PMT. These findings imply that CB performs better than PMT during this kind of a massive economic shock.

UBI offers inferior targeting, resulting in a higher headcount poverty rate with and without crisis relative to the other scenarios, considering a baseline benefit amount. However, it has a slightly smaller increase in the poverty rate due to the shock. The UBI system provides better protection for households slightly above the poverty line before crisis or in the third quintile.

The study looked at how the three benefit types would perform in the counterfactual agricultural crisis at higher benefit amounts. According to Table 10, higher PMT has the lowest poverty rates with and without crisis. With the higher budget, the difference in poverty reduction between PMT (the most targeted) and UBI (completely universal) is close to two percentage points in the base scenario. This finding is in line with the predictions of the theoretical framework.

Table 11: Poverty gaps for baseline and agricultural crisis by different benefit scenarios

Indicators	PMT		Higher PMT		CB		Higher CB		UBI		Higher UBI	
	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis	Base	Crisis
Poverty gap	0.236	0.276	0.223	0.262	0.238	0.278	0.231	0.271	0.238	0.279	0.235	0.275
Difference in poverty gap between the baseline and crisis		0.040		0.039		0.040		0.040		0.040		0.040

Source: authors' construction based on ETMOD v2.4.

Table 11 illustrates poverty gaps with agricultural shock under the different benefit scenarios. The results are in line with the findings discussed in the previous section: PMT with baseline and higher benefit amounts results in lower poverty gaps. The result shows that PMT better targets the poor with and without crisis. The lower poverty gap is attributed to relatively higher mean benefits with PMT for households in the bottom two quintiles. A sizeable distortion in income distribution due to the shock would be the reason for a slightly higher increase in the poverty gap, with higher PMT compared with the remaining two scenarios.

6 Conclusion

This study has examined the poverty-reduction capacity of different types of benefit arrangements with and without crisis in Ethiopia. To this end, we first presented some theoretical observations, according to which systems which are targeted to offer the greatest poverty relief in normal times, such as PMT transfers, may lead to greater poverty rate increases when the incidence of poverty changes due to shocks. We then examined, using tax-benefit microsimulation methods, the poverty impacts of the COVID-19 pandemic and a hypothetical agricultural shock for Ethiopia. Incomes in the underpinning micro-data for the tax-benefit model for Ethiopia, ETMOD, were adjusted downward, altering the individual's income using the deviation in sectoral GDP from its linear growth path and a 10 per cent income fall for the COVID-19 crisis and agricultural shocks, respectively.

The following conclusions are drawn from the microsimulation part of the study. The poverty impact of the actual COVID-19 shock was mild, and since the actual social assistance budget in Ethiopia is tiny in comparison to the depth of poverty, the social insurance offered by the actual PMT transfer system is very limited. In counterfactual scenarios where the same social assistance budget is used for either categorical benefits, CB (where transfers are given to households with certain demographic characteristics—in our case, large families and households with older members), or completely universal basic income (UBI), the achieved poverty reduction is close to that offered by the existing PMT system. In larger shocks, such as the hypothetical agricultural shock, and if the budget available for social protection were much larger, differences start to emerge. In the baseline scenario, the PMT system provides a much greater reduction of poverty headcount (about two percentage points more) than UBI.

This discussion is, in principle, in line with the predictions of our theoretical framework: when social protection budget is small, even accurate targeting leads to a very limited poverty reduction, whereas the benefit in absolute poverty reduction provided by targeting is more significant with larger resources. However, if the profile of the poor changes due to a crisis, the original targeting performs somewhat less well and the corresponding difference in poverty between the baseline and crisis scenario is smaller in more universal systems. The actual practical relevance in terms of the magnitude of the latter finding has turned out to be limited in the Ethiopian case. In further research, it would be interesting to examine how different crises would impact on poverty under various benefit arrangements in other country contexts.

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Appendix

A Additional tables

Table A1: Annual Ethiopian government tax revenue and expenditure on social protection with COVID-19 shock, million ETB

Revenue and expenditure	Baseline	Crisis with existing benefit expenditure			Baseline with higher benefit	Crisis with higher benefit expenditure		
		PMT	CB	UBI		PMT	CB	UBI
Government revenue	286,908	272,895	272,876	272,874	310,814	307,816	307,586	307,587
Direct taxes	138,501	133,273	133,273	133,273	138,501	137,486	137,486	137,486
Indirect taxes	115,081	110,491	110,472	110,470	138,987	138,011	137,781	137,782
Social security	33,325	29,130	29,130	29,130	33,325	32,319	32,319	32,319
Government expenditure	9,322	9,322	9,322	9,322	33,223	33,223	33,223	33,223
Social assistance	2,656	2,656	2,655	2,655	26,556	26,556	26,556	26,556
Pension benefits	6,667	6,667	6,667	6,667	6,667	6,667	6,667	6,667

Source: authors' construction based on ETMOD v2.4.

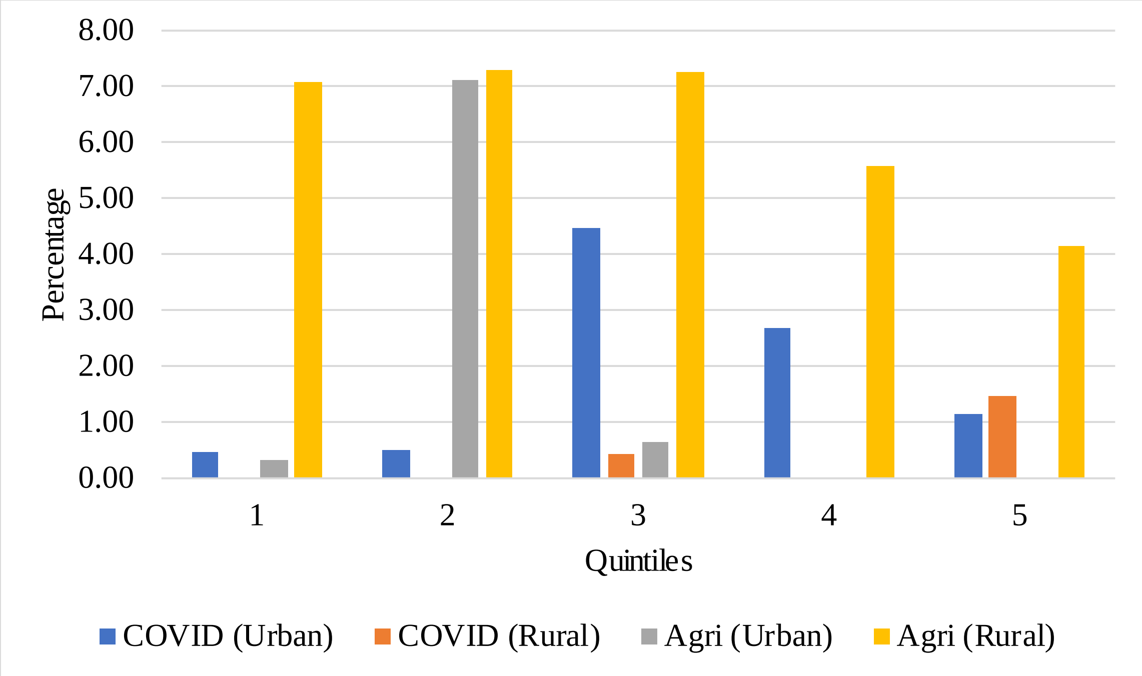
Table A2: Annual Ethiopian government tax revenue and expenditure on social protection with agricultural shock, million ETB

Revenue and expenditure	Baseline	Crisis with existing benefit expenditure			Baseline with higher benefit	Crisis with higher benefit expenditure		
		PMT	CB	UBI		PMT	CB	UBI
Government revenue	286,908	285,709	285,689	285,689	310,814	309,391	309,155	309,158
Direct taxes	138,501	138,501	138,501	138,501	138,501	138,501	138,501	138,501
Indirect taxes	115,081	113,882	113,862	113,862	138,987	137,565	137,328	137,331
Social security	33,325	33,325	33,325	33,325	33,325	33,325	33,325	33,325
Government expenditure	9,322	9,322	9,322	9,322	33,223	33,223	33,223	33,222
Social assistance	2,656	2,656	2,655	2,655	26,556	26,556	26,556	26,555
Pension benefits	6,667	6,667	6,667	6,667	6,667	6,667	6,667	6,667

Source: authors' construction based on ETMOD v2.4.

B Additional figures

Figure A1: Percentage of income reduced due to COVID-19 shock and agricultural shocks, by quintile



Source: authors' construction based on ETMOD v2.4.

C Calculations for the theory section

The analysis below explains how poverty reduction and the available budget are linked in the targeted case, discussed in Section 2.3.

The income level $\hat{y}^T$ is defined via this relationship:

$$\int_{\hat{y}^T}^{z} (z-y)f(y)dy = R$$

When $f(y)$ is uniform, this becomes:

$$\int_{\hat{y}^T}^{z} (z-y)dy = R$$

We solve for the relation by integrating the left-hand side and by some additional manipulations as follows:

$$\int_{\hat{y}^T}^{z} zdy - \int_{\hat{y}^T}^{z} ydy = R$$

$$\leftrightarrow z(z - \hat{y}^T) - \left[\frac{y^2}{2}\right]_{\hat{y}^T}^{z} = R$$

$$\leftrightarrow z^2 - 2z\,\hat{y}^T + \hat{y}^{T^2} = 2R$$

$$\leftrightarrow (z - \hat{y}^T)^2 = 2R,$$

which yields $\hat{y}^T = z - \sqrt{2R}$. Remember also that $\hat{y}^U = z - R$.

The derivatives of these two are:

$$\hat{y}^{U'} = -1 \text{ and } \hat{y}^{T'} = -\frac{1}{\sqrt{2R}}$$

We want to investigate when $\hat{y}^{T'} < \hat{y}^{U'}$. They are equal if:

$$-1 = -\frac{1}{\sqrt{2R}} \leftrightarrow \sqrt{2R} = 1 \xrightarrow{yields} R = \frac{1}{2}$$

and when $R < \frac{1}{2}$, $\hat{y}^{T\prime} < \hat{y}^{U\prime}$.

Since the available resources are fixed to unity because of the assumptions, z cannot exceed 1. If $z = 1$ and $R = \frac{1}{2}$, poverty is eliminated in the targeted system. Hence, in the area until zero poverty is reached in the targeted system, poverty is lower under system T and also the slope of the T curve is steeper.