World Development 139 (2021) 105271

Contents lists available at ScienceDirect

World Development

journal homepage: www.elsevier.com/locate/worlddev

Regular Research Article

Locked down and locked out: Repurposing social assistance as emergency relief to informal workers

Ihsaan Bassier [a], Joshua Budlender [a], Rocco Zizzamia [b,*], Murray Leibbrandt [c], Vimal Ranchhod [c]

[a] University of Massachusetts Amherst, United States
[b] University of Oxford; SALDRU, University of Cape Town, South Africa
[c] SALDRU, University of Cape Town, South Africa

ARTICLE INFO

Article history:
Accepted 22 October 2020
Available online 8 December 2020

Keywords:
Social policy
Welfare measurement
Social protection
Informal employment
COVID-19
South Africa

ABSTRACT

The COVID-19 pandemic presents a particular challenge to countries with high levels of labour market informality. Informal workers and their households are especially vulnerable to the negative economic consequences of the pandemic and associated lockdown measures, while the very fact of their informality makes it difficult for governments to quickly provide targeted economic relief. Using South Africa as a case study, we examine how an established social assistance system – not originally designed to support informal workers – can be re-purposed to provide emergency relief to these workers and their households. We examine how expansions of this system on the intensive margin (increasing the value of existing social grants) and extensive margin (introducing a new feasibly-implemented grant) can be used to mitigate this COVID-19-associated poverty. We compare the efficacy of the different policies by using pre-pandemic nationally representative household survey data to project how a negative shock to informal incomes can be mitigated by the different social grant measures, with a particular emphasis on poverty impacts. We find that an intensive-margin expansion of the existing Child Support Grant is complementary to the extensive-margin introduction of a new Special COVID-19 Grant, and that this combined policy intervention performs best out of the options considered. However conclusions as to this "optimal policy" are not simple technical determinations. We show that these conclusions are in fact sensitive to both unavoidable technical assumptions about how resources are consumed and shared within the household, as well as to normative value judgments about which populations to prioritise and how to value poverty reduction spillovers amongst the non-targeted group. While our approach helps identify a range of sensible policy approaches, there is no escaping the limits to our knowledge or the issue of normative goals – a finding likely applicable to a broad range of empirical policy analyses.

1. Introduction

No country has been spared the economic fall-out of the ongoing COVID-19 crisis. Middle-income countries such as South Africa, however, find themselves facing a particular policy challenge. On the one hand, like high-income countries, many middle-income countries have the fiscal and institutional capacity to deliver some form of direct economic relief to their populations. On the other hand, like low-income countries, these countries also face high levels of informality within the labour force, with these informal workers and their households often being particularly vulnerable to the negative economic consequences of COVID-19 lockdown measures. Informal workers, whether self-employed or employed in the formal sector, are excluded from contributory insurance mechanisms through which government relief can be channeled, and yet are more likely to lose income during the crisis than formal workers (International Labour Organisation, 2020). For these reasons, extending emergency support to informal workers and their households has been a priority of governments in high- and middle-income countries throughout the world (Gentilini, Almenfi, Dale, Demarco, & Santos, 2020). The dilemma faced by these countries is that while many have the resources and capacity to deliver some relief to vulnerable workers, a substantial number of these workers remain – by virtue of their informality – largely invisible to the bureaucratic systems which could disburse this relief. An important question, therefore, is how these countries can leverage both existing systems, which are not explicitly targeted at informal workers, as well as new purpose-built measures,

* Corresponding author.
E-mail addresses: ibassier@umass.edu (I. Bassier), jbudlender@umass.edu (J. Budlender), rocco.zizzamia@qeh.ox.ac.uk (R. Zizzamia), murray.leibbrandt@uct.ac.za (M. Leibbrandt), vimal.ranchhod@uct.ac.za (V. Ranchhod).

https://doi.org/10.1016/j.worlddev.2020.105271
0305-750X/

to mitigate the COVID-19 poverty impact among this subset of vulnerable workers. This urgent question must often be addressed in contexts where real-time data is not available.

In this paper we consider the case of South Africa, a middle-income country likely severely impacted by the economic consequences of the COVID-19 crisis, partly because of stringent lockdown measures which were adopted in the early stages of the outbreak. A third of South Africa's labour force is either employed in the informal sector or engaged in unprotected and unregulated work in the formal sector (own calculations). Throughout this work we refer to both these forms of employment as informal employment, as per the ILO's definition (Hussmanns, 2004; International Labour Organisation, 2003). These workers are disproportionately concentrated in poor and vulnerable households, do not have access to contributory social insurance, and the firms they work at are less likely to be eligible for state support. Initial economic relief measures in South Africa were focused on tax-registered businesses and the formally employed, with no existing system available for targeted relief to informal workers. However, South Africa, like many other middle-income countries, has a large non-contributory social assistance infrastructure, consisting of various means-tested unconditional cash grants. Over half of South Africans live in a household with income from a child support grant (CSG) or state old age pension (OAP) (Seekings & Nattrass, 2015).

We analyse how an expansion of this existing grant system could alleviate poverty amongst informal workers and their households. We consider expansions on both the intensive margin (increasing the value of existing cash grants), and on the extensive margin (introducing a new feasibly-implemented grant). We undertake this exercise under the conditions faced by South African policymakers – that is without access to real-time economic data, or retrospective data on the consequences of the pandemic and lockdown.[1] Using nationally-representative household survey data, we impose a negative shock to incomes from informal work, and then examine how the different cash grant options mitigate the resulting poverty increase.

The three grant options that we investigate are: (*a*) a top-up to the existing OAP; (*b*) *a top-up to the existing CSG; and (c) the introduction of a new "Special COVID-19 Grant*" *(Co-G) broadly targeting the unemployed and those in informal employment. Defining informal-worker household members as the target population of interest, we evaluate the effectiveness with which each of these grant options reaches the target group, and estimate both inclusion and exclusion errors.*

While both the CSG and Co-G commit substantial inclusion errors, in the case of the CSG this policy leakage accrues disproportionately to the poorest South Africans, and is therefore highly progressive. Ultimately, we find that an intensive-margin expansion of the existing CSG is highly complementary to the extensive-margin introduction of the new Co-G, and this combined policy intervention performs best out of the options considered.

The effectiveness of existing grant options in reaching the target population of interest depends on the demographic correlates of existing grant receipt (such as age) and the overlap, through household co-residency, with the target population. The extent of this overlap is highly context specific. The fact that in South Africa we find that the CSG and Co-G have far superior coverage of the target population than the OAP is partly explained by the fact that far fewer prime-aged informal workers are co-resident with OAP recipients.

However, conclusions as to the "optimal policy" are not simple technical determinations. We show that while we can identify a range of sensible policy options, specific determinations are in fact sensitive to both unavoidable technical assumptions about how resources are consumed and shared within the household, as well as to normative value judgments about which populations to prioritise. In particular, we show how using equivalence scales rather than per capita measures affects the results, as does relaxing the assumption of perfect intra-household sharing of emergency relief – which is implicit in per capita measures. We highlight two unavoidable normative decisions which affect the policy recommendation: the extent to which one weights poverty reduction spillovers *outside* the targeted group of informal-worker household members as a desirable policy goal, and the extent to which one prioritises reducing *severe* poverty. We conclude our analysis with a numerical optimisation routine which transparently shows how the "optimal policy" depends on these considerations.

Apart from these specific policy results, our analysis also makes new contributions to the South African literature on informality and social assistance by investigating how grants reach prime-aged adults. First, we find that a substantial share of informal workers belong to small households without alternative sources of support. Using a per capita measure of income these small households are judged to be relatively well-off, but are vulnerable to negative income shocks. Second, we find surprisingly sharp differences in the reach of South Africa's social grants into informal-worker households, with high rates of penetration of child support grants into informal worker households and low rates of penetration for state old age pensions.

Our analysis proceeds as follows: In Section 2 we start with a brief discussion of informal work and COVID-19 social policy in middle-income countries, and then examine the South African case in-depth. In Section 3 we describe our data and the general data challenges associated with COVID-19 emergency responses in middle-income countries, and define key concepts for our paper such as informal employment, our welfare-measurement approach, and the new "Special COVID-19 Grant." Our empirical analysis begins in Section 4, which presents the different policy coverage rates and discusses the associated concepts of targeting and leakage. In Section 5 we present our approach to modeling the COVID-19 shock on informal workers' incomes, which includes both a distributional (by decile) analysis as well as a more conventional poverty analysis using the FGT measures. Finally, in Section 6 we illustrate how the "optimal policy" determination is sensitive to the technical assumptions and normative value-judgments discussed above. Section 7 concludes.

2. Informal workers and social policy

2.1. The broader context

All available evidence on the labour market impacts of the COVID-19 crisis in developed countries (where COVID-19 struck earlier and where real-time data is more available) point to unprecedented increases in unemployment (Coibion, Gorodnichenko, & Weber, 2020; Bartik et al., 2020; Adams-Prassl, Boneva, Golin, & Rauh, 2020; Alon, Doepke, Olmstead-Rumsey, & Tertilt, 2020). Economists have expressed alarm that the consequences in developing countries could be even more catastrophic (Sanchez-Paramo, 2020; Sumner, Hoy, & Ortiz-Juarez, 2020), especially in Sub-Saharan Africa (Mahler, Laknner, Aguilar, & Wu, 2020). Part of the reason that the economic impact is expected to be more severe in developing countries is that rates of labour market informality are higher, and informal workers are expected to be most economically vulnerable: informal workers are unprotected by the contributory social insurance available to their formally-employed counterparts, and most work in occupations which can-

[1] Indeed this research was first undertaken as part of a policy-advisory project commissioned by the South African Presidency.

not operate under conditions of social distancing (Gerard, Imbert, & Orkin, 2020).[2]

Income replacement directed at informal workers has been an explicit priority for many middle-income countries which have introduced emergency relief measures through social assistance. As Gentilini et al. (2020, p. 11) state, informal workers occupy the policy gap which "falls between social assistance and insurance." Expanding social assistance to plug this gap has been the preferred approach for most middle-income countries.[3] For countries which have existing social assistance mechanisms in place, governments have used these existing administrative and delivery systems to quickly expand relief on the intensive margin (Gentilini et al., 2020; International Labour Organisation, 2020). Gentilini et al. (2020) count 46 countries which have increased the value of benefits in their existing cash transfer programmes. For instance, Indonesia has increased the value of each grant disbursed through it's PKH conditional cash transfer programme and in Colombia each beneficiary of the Familias en Acción cash transfer programme received a once-off "bonus" payment. The effectiveness of these existing systems in reaching informal workers will depend on the extent to which existing recipients (who, by design, are not necessarily informal workers themselves) share benefits with informal workers, either through intra-household redistribution or through remittances.

In 159 countries, governments have expanded existing social assistance programmes on the extensive margin, increasing the *number* of beneficiaries in existing programmes or introducing new grants (Gentilini et al., 2020). The high administrative costs to adding new beneficiaries can be substantially reduced in countries in which national social registries with broad coverage can be used to identify new beneficiaries and transfer benefits directly via online payments. Brazil, Peru, Jordan and Thailand are among many middle-income countries which have expanded coverage to informal workers and their households in this way (Gentilini et al., 2020). In other contexts in which social registries do not have broad coverage, eligibility has sometimes been determined by cross-checking ID numbers against social insurance and social assistance databases. Namibia and South Africa, for instance, have introduced emergency relief grants using this targeting model (Ministry of Finance of the Republic of Namibia, 2020; The Presidency, Republic of South Africa, 2020).

2.2. Informal work in South Africa

It bears repeating that in this paper we understand the informal economy to encompass both those working in the informal sector as well as those in unprotected employment arrangements, whether in the informal, formal, or household sector (see Hussmanns (2004)). There is a general consensus that there is a strong positive correlation between working poverty and informal employment and that "most people enter the informal economy not by choice, but as a consequence of a lack of opportunities in the formal economy and in the absence of other means of livelihood" (International Labour Organisation, 2018, p. 49).[4] According to the International Labour Organisation (2018), 61 percent of the world's employed population is employed informally. In Africa, the rate is 86 percent, compared to 68 percent in Asia and the Pacific, and 53 percent in Latin America and the Caribbean.

Globally, 85 percent of informal workers work in the informal *sector*, with the remainder being employed in the formal sector or in households. In this regard, South Africa is an outlier – the International Labour Organisation (2018) estimates that in Southern Africa 70 percent of informal workers are employees, compared to 30 percent in the rest of Africa, 50 percent in the Americas, and 34 percent in Asia and the Pacific. South Africa's exceptionalism in this regard is explained by its relatively large formal sector and the high prevalence of "informalised" forms of employment within this sector (Theron, 2010).

In Table 1, we profile informal workers in South Africa (comparing them to formal workers) and households which contain informal workers (comparing these to all households). Details on how we operationalise the ILO definition of informal workers using South African survey data are discussed in Section 3.3.1. Approximately one third of all workers in South Africa are classified as informally employed. While this is substantially lower than the global average (61 percent) and the average for middle-income countries (67 percent) (International Labour Organisation, 2018), this should not detract from the important role that informal work has in sustaining the livelihoods of millions of South Africans.

Informal workers in South Africa typically live in slightly larger households than formal workers, and are more likely to live in rural areas. Importantly, informal workers are also more likely to live in households with multiple sources of income, including from remittances and from social grants.[5] Fully 44 percent of informal workers live in a household which has a member who receives one of South Africa's Child Support Grants (CSG), but only 16 percent are co-resident with a member who receives a state Old Age Pension. Finally, the median informal worker's earnings are less than a third of the equivalent for formal workers. Table A1 in Appendix A shows the same statistics for informal workers but disaggregates by sector and type of employment. The proportion of women informal workers varies substantially by sector, which is correlated with the likelihood of having a child support grant recipient in the household. The age of an informal worker is also consequential for grant receipt in the household: Table A2 in Appendix A shows that very few young informal workers are co-resident with OAP recipients, while CSG receipt is much more common in informal-worker households. The importance of age and gender for grant receipt is revisited in the next section.

The rightmost super-column of Table 1 reports summary statistics profiling informal-worker household *members*, comparing these to the general population. This general population includes members of households with no employed household members, formally employed household members, and informally employed household members. 28 percent of South Africans live in households which contain informal workers. These household members are typically in larger households and are less urban than average. The 25th and 50th percentile of per capita household income are similar for informal-worker households members and the general population, while the 75th income percentile is substantially lower for those co-resident with informal workers. This reflects greater income dispersion at the top of the income distribution among the general population, which includes those co-resident with formal workers. Informal-worker household members are more likely to be co-resident with social grant recipients, though it is notable

[2] It is also worth noting that it is likely that the COVID-19 crisis will lead to rising labour market informality as formal jobs are cut and businesses are closed (International Labour Organisation, 2020).

[3] As of 22 May 2020, a total of 168 countries have expanded or instituted cash-based social assistance programmes in response to COVID-19. See Gentilini et al. (2020) for a detailed and frequently-updated review.

[4] While informal employment can sometimes be preferable to formal employment, as noted by Fields (1990), it is our view that this is not the general rule (International Labour Organisation, 2018). For more on the role of informal employment in development see La Porta and Shleifer (2014), and on the role of the informal sector in South Africa, see Rogan and Skinner (2017, **?**, **?**).

[5] Note that, despite the larger-than-average size of informal worker households, there remains a substantial share (approximately 40 percent) of informal workers who live in small households (on average 1.7 members) with no grant or formal labour market income – see Table 4. The specific policy challenges posed by these different sorts of informal worker households are discussed in depth in Section 6.1.

Table 1
Characteristics of informal workers and informal-worker household members.

	Workers		Household members	
	Formal	Informal	All	Informal
Frequency (millions)	11.12	5.08	56.51	15.69
Average household size	3.5	3.8	4.9	5.7
Proportion female	43%	45%	51%	49%
Proportion urban	78%	64%	64%	62%
Remittance receiving household (%)	14%	18%	23%	22%
Remittance sending household (%)	37%	24%	20%	22%
Co-resident with:				
Child Support Grant	30%	44%	52%	64%
Old Age Pension	10%	16%	23%	25%
Special COVID Grant	41%	85%	67%	83%
Income percentile:	*(Indiv. earnings)*		*(Per capita hhold income)*	
25th percentile (Rands)	3,775	1,013	821	821
50th percentile (Rands)	6,417	1,963	1,698	1,446
75th percentile (Rands)	13,669	3,349	4,045	2,484

Notes: Table shows characteristics of formal versus informal workers (first super-column) and all individuals versus informal-worker household members (second super-column). Informal-worker households are households which include an informal worker. "Average household size" is the average across individuals, not households. The second super-row shows the proportion of workers (first super-column) and household members (second super-column) who are co-resident with an individual with the particular income support indicated. This additional income support may or may not be attached to the worker herself. Income percentiles are reported in February 2020 monthly Rands. In the first super-column these are percentiles of individual worker earnings; the second super-column shows per capita household incomes. Authors' calculations using NIDS Wave 5 and post-stratified weight.

that this difference is much more apparent for the CSG than the OAP.

As elsewhere, informal workers in South Africa are disproportionately concentrated at the bottom of the earnings distribution. Informal-worker households are, relative to the general population, more heavily reliant on earnings than other sources of income – especially towards the bottom of the distribution (see Fig. A1 in Appendix A). Therefore, even small earnings shocks could precipitate descents into extreme poverty for the households that informal workers support (International Labour Organisation, 2020). Even before the COVID-19 crisis, South Africa's high levels of employment volatility (Kerr, 2018) were associated with a high vulnerability to poverty (Carter & May, 2001; Finn & Leibbrandt, 2017; Woolard & Klasen, 2005; Zizzamia, Schotte, & Leibbrandt, 2020). A contributing factor to this vulnerability to labour market shocks is that household savings are low for vulnerable worker households – Chatterjee, Czajka, and Gethin (2020) show that the average household wealth in the bottom 50 percent of the wealth distribution in South Africa is slightly *negative*, suggesting extreme financial precariousness. A large labour market shock like the COVID-19 crisis will likely lead to descents into poverty for millions of individuals living in households which are reliant on income from informal employment. Those affected may sell-off productive assets, leading to a poverty trap (Carter & May, 2001), and reduce food consumption, with potentially lasting negative effects for children (Strauss & Thomas, 1998).[6] There are thus concerns that the poverty impact, unless mitigated, will be persistent.

2.3. Social assistance in South Africa

South Africa's social grant system provides an essential source of income for South Africa's poorest and "has saved many millions from starvation and misery" (Ferguson, 2015, p. 19). Approximately 18 million social grants are paid out each month by the South African Social Security Agency (SASSA) (up from 4 million in 1993), at a cost of 3.4 percent of GDP (South African Social Security Agency, 2018). One third of all South Africans receive a state grant, over fifty percent live in households with grant income, and grants comprise the most important source of income for half of these households (Seekings & Nattrass, 2015). Social grants in South Africa consist most notably of old age pensions (OAP), disability grants (DG), and child support grants (CSG). Disability grants (1 million grants) and old age pensions (3.5 million grants) are respectively paid to those who are disabled or who are 60 years old or more, and currently amount to R1780 per month each. The child support grant (12.5 million grants) is paid to the primary caregiver of a child aged 18 or under. At R440 per qualifying child, the value of these grants is substantially lower than the poverty line and is means-tested using more restrictive criteria than the OAP or DG.

Research on the impact of these social grants on household welfare has shown broad-ranging benefits (Woolard & Leibbrandt, 2013). The CSG has been associated with improved child nutrition (Aguero, Carter, & Woolard, 2007), decreased poverty (Triegaardt, 2005), increases child school enrollment (Eyal & Woolard, 2013) without any increases in fertility (Makiwane, 2010). The OAP has been shown to lead to improved health and nutrition for children co-resident with female OAP recipients (Dufo, 2003), reduced child poverty (Case & Deaton, 1998) and leads to changes in living arrangements through which economically vulnerable adults move into pension receiving households (Hamoudi & Thomas, 2014). The effects of the OAP on labour force participation are more contentious: while Posel, Fairburn, and Lund (2006), Ardington, Case, and Hosegood (2009) find that the OAP increases labour market participation through job-search driven migration amongst prime aged women, others identify declines in the labour market participation amongst prime-aged adults (Bertrand, Mullainathan, & Miller, 2003; Abel, 2019) and the elderly (Ranchhod, 2006).

However, to our knowledge there has been no research on how these social grants might also be used to reach households reliant on (often meagre) earnings from informal work. The South African social protection architecture – as in Latin America and elsewhere – is built on the foundational assumption that "support is needed only for 'dependent' categories such as the elderly, those caring for children, and the disabled" (Ferguson, 2015, p. 17). Able-bodied, prime-aged men, "in contrast, are all counterfactually presumed to be able to support themselves through their labor" (Ferguson, 2015, p. 17) and are thus excluded from receiving cash grants. However, as Ferguson points out, this social democratic view neglects the fact of mass, structural unemployment among

[6] Both Finn and Leibbrandt (2017) and Schotte, Zizzamia, and Leibbrandt (2018) have found that independent of other determinants of poverty, the experience of poverty itself is responsible for poverty persistence in South Africa.

prime-aged adults in South Africa. The importance of age and gender for determining grant receipt is evident in Table A3 in Appendix A. Two thirds of OAP recipients and 97% of CSG caregiver recipients are women, while almost all OAP recipients report being at least 60 years old and 78% of CSG caregiver recipients are between the ages of 18 and 45. However these grant-receiving individuals support individuals outside their own age brackets – unsurprisingly almost half of the typical CSG recipient's household is under the age of 18 18 and 77% are younger than 36. In contrast, half of a typical OAP recipient's household is made up of people younger than 36 with 28% being under the age of 18. The way in which grant receipt disrupts common assumptions about earners and dependents in the household is evident in comparing the "age dependency ratio" (the standard international dependency ratio of those younger than 15 and older than 64 to those of prime-age) to what we call the "income dependency ratio" (the ratio of those without individual labour or grant income to those with labour or grant income). While OAP households have the highest *age* dependency ratio of the categories we consider (because of few prime-aged adult co-residents) they have the lowest *income* dependency ratio due to grant receipt.

In reality, few households depend exclusively on grant or labour income, but sustain themselves through complex "hybrid livelihood portfolios", comprising a multitude of complex strategies to survive and maintain a level of security and wellbeing (Neves & Du Toit, 2013). These portfolios will often include informal wage labour, improvisatory self-employment, leveraging distributional claims on others both within and outside the household, engaging in unpaid care work, and accepting, rejecting or expelling new household members (and the social grants that often come with elderly or young dependants) (Neves & Du Toit, 2013; Zizzamia, 2020). Transfers of people and resources across space (remittances, household reconfiguration and migration) occur with a frequency which has led several scholars to suggest that households are not geographically bounded but are often "translocal" or "spatially stretched", with flows of resources and people spanning urban–rural divides (Greiner, 2010; Du Toit & Neves, 2007; Posel et al., 2006). The opacity of household boundaries acts both as a form of informal social insurance against specifically idiosyncratic shocks (Du Toit & Neves, 2007; Arnall, Furtado, Ghazoul, & De Swardt, 2004) as well as a constraint to individual upward mobility (Di Falco & Bulte, 2011). However, Leibbrandt, Woolard, Finn, and Argent (2010) find that since 1993, government grants have largely crowded out remittances as a major source of household income for the bottom half of the income distribution.

The COVID-19 crisis will deliver a simultaneous shock to the income generating capacity of households as well as the effectiveness of informal safety nets, which are not well suited to responding to simultaneous shocks (Arnall et al., 2004; Dercon, 2002; Devereux, 2016). Lockdown regulations also delivered a shock to households' ability to respond to the economic shock through migration and household reconfiguration. Since grant income is expected to remain constant, the COVID-19 shock will further increase reliance on social grants for those who have access to them whether directly or indirectly (through intra- or inter-household redistribution).

2.4. South Africa in the time of COVID-19

The social distancing measures adopted by South Africa in response to the COVID-19 crisis have been, from an international perspective, unusually rapid and stringent. On 23 March 2020, before South Africa had registered a COVID-19 death, a three week nationwide lockdown was announced and was later extended by an additional two weeks. Gustafsson (2020) has classified South Africa as one of thirty countries which are rated to have imposed the most stringent set of measures globally. Initial measures completely shut down the informal economy – even informal enterprises providing essential goods and services were not permitted to operate. On 2 April 2020, some regulations restricting "essential" informal enterprises were relaxed. Nevertheless, the impact of these social distancing measures on those engaged in informal employment is expected to be devastating (Ebrahim, 2020).

Unlike many other middle-income countries, South Africa waited until more than a month into the lockdown before extending social assistance as emergency relief in response to the crisis. Despite a rhetorical commitment to providing relief to informal workers, to the extent that the state provided relief to households it initially did so almost exclusively through contributory social insurance (the national Unemployment Insurance Fund) aimed at formally employed workers (Department of Labour, Republic of South Africa, 2020).

On 21 April 2020, almost a month after the commencement of the lockdown, the South African government announced an ambitious set of social assistance measures aimed at delivering relief to those households which were not covered by the social insurance measures announced previously (The Presidency, Republic of South Africa, 2020). These consisted of: (*a*) an increase to the Child Support Grant of R300 for one month, followed by an increase of R500 per month from June to October (but limited during the latter period to one increase per caregiver); (*b*) an increase to all other social grants (such as the Old Age Pension and the Disability Grant) of R250 per month until October, and; (*c*) the installment of a new "COVID-19 Social Relief of Distress grant", of R350 per month, introduced for people who are unemployed but not receiving any other grant or support from the Unemployment Insurance Fund.[7]

3. Data and definitions

3.1. Scope of analysis

An early version of the research presented in this paper helped inform the design of some aspects of the social assistance interventions mentioned in Section 2.4. This research (Bassier, Budlender, Leibbrandt, Ranchhod, & Zizzamia, 2020; Special Covid Grant Working group, 2020) considered a range of options which included the expansion of existing grants (along the intensive margin) and the introduction of a new "Special COVID-19 grant". The Special COVID-19 grant was initially conceptualised as targeting informally employed adults not receiving social grants – as these workers would not be covered by the initial COVID-19 protections put in place by the South African state nor the existing social assistance programme (Philip, 2020). However with the state being unable to "see" informal workers in its administrative systems, and no time to conduct a means-testing approach, the scope of the proposal became significantly determined by what was understood to be a feasible targeting system. In this case this meant not being in formal employment (so no individual payroll tax nor contributory social insurance record), nor being registered in the existing social grant registry. This would mean significant errors of inclusion given a target group of the informally employed – both the unemployed and, perhaps more seriously, those not in the labour force, would be included as recipients. The Special COVID-

[7] It is worth noting that increasing attention has been given to calls for the introduction of a Basic Income Grant (BIG) since the COVID-19 crisis. After momentum in the campaign for a BIG faded in the early 2000's, Ferguson (2015) has re-ignited the debate around a progressive "politics of distribution" in which the BIG is centred. Since the COVID-19 crisis, public debates around the merits of introducing a BIG have gained urgency, especially as the COVID-19 basic package of support is due to expire in October (Dominic Brown, 2020; Naudé Malan, 2020; Mary Burton, 2020)

19 grant was thus ultimately envisaged as a basic income grant with easily implementable exclusion restrictions linked to existing administrative registries, similarly to other countries which have introduced novel interventions (see Section 2.1).

At the time of writing, it is somewhat unclear how the South African government will implement the "COVID-19 Social Relief of Distress grant", and how close the design of this grant will be to the "Special COVID-19 grant" proposed in [reference redacted for review-process anonymity]. Additionally, the reason the South African state chose to implement the CSG June-October increase of R500 per month as a *per caregiver* increase – which requires a new administrative infrastructure, hence the implementation delay – is also unknown. While we do reproduce and discuss our main poverty graph for something approximating the actually existing South African package in Appendix B, our primary analysis considers a clearly-defined "Special COVID-19 grant" rather than the still somewhat nebulous "COVID-19 Social Relief of Distress grant", and when evaluating CSG increases we do so on a per-child basis. We also examine the impact of increases in the OAP, but do not include the Disability Grant and other smaller grants in our main analysis.

3.2. Data

Unlike some high-income countries, middle-income countries frequently will not have access to high-frequency administrative unemployment data. While the unemployment impact of the COVID-19 pandemic can be seen almost in real-time in the US, for example, via its Unemployment Insurance Weekly Claims Report, there is no regular release of statistics from South Africa's Unemployment Insurance Fund. In any case, administrative unemployment insurance data will generally be inappropriate for measuring unemployment in middle-income countries where informal work is widespread and discouraged work-seekers may be an important subset of the non-employed. Without being able to rely on close to real-time data, researchers in middle-income country contexts will need to make do with existing data and undertake a forward-looking analysis under certain unavoidable stability assumptions.

The policy question we analyse in this paper concerns the extent to which expanding existing or introducing new social assistance programmes compensate for the negative impact labour market shocks would have on household welfare. Household-level data is therefore crucial, and household survey data in particular can be valuable. However for this data to be appropriate for the task at hand it needs to be nationally representative, contain information on household size, composition and income, individual or household access to state grants, and have detailed labour market information for adult household members, including information required to identify informal workers.

Although South Africa has rich data, only one dataset fulfils all these criteria: The National Income Dynamics Study (NIDS). NIDS, implemented by the Southern African Labour and Development Unit at the University of Cape Town, is South Africa's first national household panel study (Brophy et al., 2018). The first wave of data was collected in 2008 with a nationally representative sample of over 28,000 individuals in 7,300 households. NIDS surveys each member of a household on grant receipt and labour market activity, as well as surveying the household head on household level variables, such as household income. This paper only uses the fifth and final wave of the panel, which was collected in 2017, and contains a sample of 40,944 individuals in 10,842 households. This fifth wave includes a "Top-Up" sample to address panel attrition which made earlier waves increasingly unrepresentative of the national population (Branson, 2019). Throughout our analysis we use post-stratified sampling weights released with each wave of NIDS (Branson & Wittenberg, 2019). All monetary values are inflated using the Statistics South Africa headline Consumer Price Index to February 2020 rands.

Using retrospective data such as NIDS clearly has significant costs: With NIDS's three-year lag, we cannot incorporate changes in household structure and income distribution since 2017. While certain developments can be modeled and imposed on the data, in cases where the phenomenon is complex this may introduce more error and less transparency than the alternative of simply being clear about study limitations.[8]

3.3. Definitions

3.3.1. Informal employment

We apply the ILO's definition of informal work. It bears repeating that informal *employment* under this definition is a more expansive category than the informal *sector*, and includes certain forms of vulnerable workers employed in the formal sector.[9]

We classify a worker as informally employed in the NIDS data if the following conditions obtain: If regularly employed, the individual has no written contract, no medical aid deductions, is not registered with the UIF, *and* has no pension deductions.[10] If self-employed, the individual's business is not registered for income tax/VAT. Casual workers and subsistence workers are all classified as informally employed.[11]

Since much of our analysis is carried out at the household level, we also identify households which contain informal workers: Someone in a household which contains an informal worker is called an informal-worker household member. This person could be the informal worker herself, or someone co-resident with the informal worker.

3.3.2. Welfare

While the COVID-19 shock we explore is presented as a shock to incomes of informal *workers*, for assessing overall welfare impacts we are interested in impacts on *informal-worker household members*. This is both because we want to incorporate impacts on dependents of informal workers, and also because informal workers themselves may be supported by heterogeneous income sources attached to their household members. Throughout our analysis we focus on per capita household income as the

[8] For example, a national minimum wage was introduced in South Africa in 2019. Whatever effect this policy has had on the labour market cannot be seen in the 2017 NIDS data. In lieu of real-time data, and being hesitant to undertake the involved and contentious exercise of modeling the impact of the national minimum wage, we instead operate under stability assumptions which are likely to be at least somewhat unrealistic.

[9] The ILO defines informal employment as a *job* rather than *enterprise* based concept. Informal employment includes "all remunerative work (i.e. both self-employment and wage employment) that is not registered, regulated or protected by existing legal or regulatory frameworks, as well as non-remunerative work undertaken in an income-producing enterprise". Importantly, this definition includes workers in the *formal* sector who "do not have secure employment contracts, workers' benefits, social protection or workers' representation" (ILO Thesaurus)

[10] In the few cases of item non-response in some of these questions, we still classify the individual as informally employed provided that the conditions are met for the non-missing questions. In cases of non-response in all four questions, we assign a missing value to informality status for that individual.

[11] Some 762 (population-weighted 1.2 million) regularly-employed adults were not available for personal interviews at the time of NIDS enumeration, and "proxy" questionnaires were filled out on their behalf by a household member. These proxy questionnaires do not contain questions on job characteristics needed to classify these individuals as formally or informally employed, and in our baseline specification their informality status is missing. As a sensitivity test, we reproduce our main results excluding these proxy employees from the sample entirely, and results remain substantively the same.

individual-level welfare concept. Since part of our analysis is concerned with comparing outcomes in larger and smaller households, and evaluating an intervention (the CSG) targeted to households with children, the choice of using an equivalence scale or a simple per capita measure may make a material difference in terms of welfare interpretations. In Section 6.2 we therefore supplement our household per capita measure with an adult-equivalised income measure designed to adjust for household economies of scale and the ratio of children to adult.[12] Poverty is defined using the Statistics South Africa upper-bound poverty line and the Statistics South Africa food poverty line (Statistics South Africa, 2019).[13] Expressed in February 2020 rands, these poverty lines are respectively R580 and R1,265 per capita, per month.

3.3.3. The "Special COVID-19 grant"

As discussed above, our analysis includes evaluation of a new grant targeted at adults who are not formally employed nor registered in the existing social grant registry. We operationalise this "Special COVID-19 grant" (or Co-G) in NIDS by defining a recipient of the grant as someone aged 18–59 who is not formally employed (formality is defined as the converse of our informality definition above) *and* does not report receiving any social grant.[14] This definition also excludes those who receive grants from SASSA nominally on behalf of others, but who are understood to control the spending of the grant – the most important case is that of CSG caregivers, who are not deemed eligible for the COVID-19 grant by virtue of their receiving grants on behalf of CSG-eligible children. Given that some of these grant recipients may be informally employed, this is a non-trivial exclusion rule.

4. Reach of policy options

4.1. Coverage & Targeting

A key question in evaluating different social policy options is how effectively a target population is reached under different policy alternatives (Van deWalle, 1998; Besley & Kanbur, 1991; Bibi et al., 2007; Grosh & Baker, 1995). In our analysis, the target population is informal-worker household members. In Fig. 1 we compare the coverage of four policy options. These are: (*a*) the OAP; (*b*) the CSG; (*c*) the Co-G; (*d*) a combination of the CSG and the Co-G.[15] The population is ordered by decile of the pre-intervention per capita household income distribution. In addition, in each bar (representing the decile of the income distribution), individuals are divided according to whether they are in a household which:

1. has an informal worker and does not have a co-resident grant recipient (blue).
2. has an informal worker and has a co-resident grant recipient (green)
3. does not have an informal worker and has a co-resident grant recipient (various colours)
4. does not have an informal worker and does not have a co-resident grant recipient (grey)

Areas shaded in blue represent the informal-worker household members who are *not* reached by the grant under consideration. This can be interpreted as representing the magnitude of exclusion errors across the distribution. Areas shaded in green represent the informal-worker household members who *are* reached by the grant under consideration. The combined green and blue areas represent the proportion of the population in each decile who co-reside with an informal worker. The unique colour in each graph in Fig. 1 (yellow for the OAP, etc) represents the proportion of those in a given decile who are reached by the grant under consideration but who are *not* informal-worker household members. This can be interpreted as representing the magnitude of inclusion errors across the distribution. Finally, the areas shaded in grey represent those in a given decile who are not reached by the grant under consideration, but who also do not belong to the target population.

The OAP (Panel (a) of Fig. 1) is the worst performer in terms of coverage – the overwhelming majority of informal-worker household members are not reached by the grant (blue bars as a proportion of blue plus green). The CSG (Panel (b) of Fig. 1), on the other hand, is effective at reaching a very large majority of informal-worker household members. Both exclusion errors (blue bars) and inclusion errors (red bars) are substantial. However, along both these dimensions the CSG remains highly progressive: Exclusion errors are smallest at the bottom of the income distribution and largest at the top, while inclusion errors are largest at the bottom of the distribution and smallest at the top – likely the most benign distribution of these errors if they are unavoidable. In combination with the CSG's effectiveness in reaching vulnerable households, this leads to a strongly favourable evaluation of the CSG's candidacy as a mechanism for distributing emergency relief to informal worker households.

Substantial gaps in coverage remain, especially in deciles six, seven and eight. It is important to keep in mind that households in these deciles are frequently in poverty or highly vulnerable to falling into poverty in the South African context (Schotte et al., 2018)[16]. The Co-G (Panel (c) of Fig. 1) in contrast to the CSG, has very good coverage of informal-worker household members in these upper-middle deciles. Overall, the Co-G offers better coverage to informal-worker households than the CSG. However, the Co-G's exclusion errors (blue bars) and inclusion errors (purple bars) lack the progressivity of the CSG's.

The CSG and the Co-G are not mutually exclusive. Panel (d) of Fig. 1 illustrates that, when combined, the CSG and the Co-G offer effectively universal coverage of informal-worker households. This suggests that those households which are missed by the CSG in almost all cases contain a member who would be eligible for the Co-G. Inclusion errors remain progressive. In contrast, the OAP and Co-G combination (Fig. E) presents only a marginal coverage improvement compared to the Co-G by itself, which is unsurprising given the poor coverage of the OAP.

As implied by the substantial exclusion and inclusion errors apparent in Fig. 1, effective coverage does not mean that targeting is perfect. A distinction between the concepts of *coverage*, *targeting*, and *leakage* is helpful in this regard (Grosh & Baker, 1995; Van deWalle, 1998).[17]

[12] Specifically, we use the Original-OECD equivalence scale, which assigns a value of 1 to the household head, 0.7 to each additional adult member and 0.5 to each child.

[13] Both lines are calculated using Ravallion (1998)'s cost-of-basic-needs approach. According to Ravallion's methodology, the food poverty line represents the level of income below which individuals are not able to purchase sufficient food to meet caloric requirements, even if all expenditure is dedicated to food. We will sometimes refer to those who fall below this line as being in *extreme* poverty. The upper-bound poverty line is intended to indicate the income level at which individuals can on average satisfy their essential food and non-food needs.

[14] We observe receipt of social grants directly in the 2017 survey, including the actual amount received.

[15] The equivalent figure for a combination of the OAP and the Co-G is shown in the Appendix – see Fig. E.

[16] Poverty here is defined using the Stats SA upper-bound poverty line

[17] Though she does not define rates like we do, these three concepts are important in Van deWalle (1998), which presents a careful discussion of targeting approaches in public spending programmes.

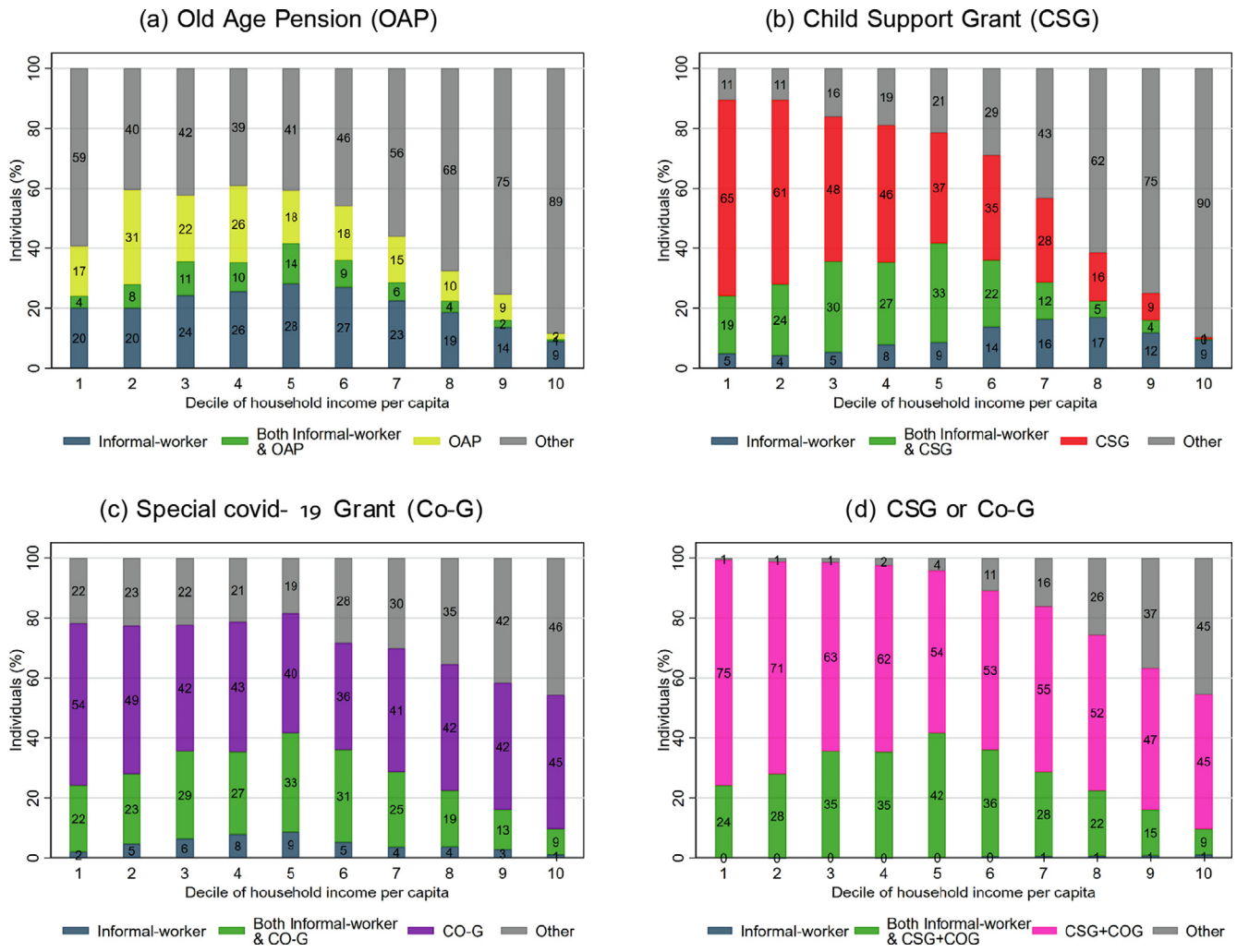


Fig. 1. Coverage of social assistance programmes, by decile. *Notes*: Figure shows coverage of different South African social assistance programmes (grants), for all individuals by decile of per capita household income. Particular attention is placed on coverage of informal-worker household members. Informal-worker households are households which include an informal worker. Each bar consists of four exhaustive and mutually exclusive sets of individuals: those in informal-worker households which do not have a co-resident grant recipient (blue), those in informal-worker households which do have a co-resident grant recipient (green), those in households which have a co-resident grant recipient but no informal worker (various colours), and those in households with neither informal workers nor grant recipients (grey). "CSG or Co-G" means the household is covered by at least one of these two programems. Authors' calculations using NIDS Wave 5 and post-stratified weight. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

1. **Coverage** is the proportion of the target population which is reached by a given intervention. If there were 100 individuals in a target population and a given intervention reaches 40 of them, then the intervention has a 40 percent *coverage rate*.
2. **Targeting** is the proportion of intervention-receiving individuals who belong to the target population. If there are 100 individuals who receive an intervention, and 30 of these belong to the target population, then the intervention has a 30 percent *targeting rate*.
3. **Leakage** is the opposite of the targeting rate and can be used to quantify inclusion errors. In the previous example which has a 30 percent targeting rate, this intervention has a 70 percent leakage rate.

Table 2 reports targeting and coverage figures by intervention. As before, we count a grant beneficiary as someone either co-resident with a direct grant recipient or the direct recipient herself. The OAP is the smallest grant in terms of reach (13 million household members) while the Co-G is substantially larger (38 million household members). As expected from Fig. 1, the coverage rate of the OAP is low – only one in four informal-worker household members are reached. In contrast, the coverage rates of the CSG and Co-G are much higher. The Co-G also has a better coverage rate than the CSG, covering 83 percent of informal-worker household members compared to the CSG's 64 percent. The CSG and Co-G are complimentary in coverage, together reaching 99 percent of informal-worker household members. The OAP and Co-G combination again makes little improvement compared to the Co-G by itself.

The targeting rates of the interventions are all low: Approximately one third of those who receive grants under the various interventions are informal-worker household members. This is unsurprising in a setting where the target group (informal workers) cannot be directly identified by the state, and broad social assistance interventions must be used for emergency relief. Again, the OAP is the worst performer. Of those receiving a CSG, marginally fewer are in informal-worker households than is the case for the Co-G. Similarly to the targeting rate of individuals reached, the targeting rate per rand spent is approximately one third for the CSG and Co-G, and one fourth for the OAP. That is, per rand dis-

Table 2
Coverage and targeting of informal-worker household members, by social grant intervention.

	OAP	CSG	Co-G	CSG & Co-G	OAP & Co-G
Individuals					
Household members with grant (millions)	13.3	29.6	37.7	48.1	41.6
Informal-worker household members (millions)	15.7	15.7	15.7	15.7	15.7
Informal-worker household members w/ grant (millions)	3.9	10.1	13.1	15.5	13.7
Coverage rate	25%	64%	83%	99%	87%
Targeting rate	29%	34%	35%	32%	33%
Funding					
Funding to household members with grant (Rands, billions)	8	8	8	8	8
Funding to informal-worker household members w/ grant (Rands, billions)	1.9	2.6	3.0	2.8	2.4
Targeting rate	24%	33%	37%	35%	31%

Notes: Table shows coverage and targeting rates of informal-worker household members, by social grant intervention. "OAP" is the Old Age Pension top-up, "CSG" is the Child Support Grant top-up, "Co-G" is the Special COVID-19 Grant, "CSG & Co-G" is a simultaneous increase in the CSG and introduction of the Co-G, and "OAP & Co-G" is a simultaneous increase in the OAP and introduction of the Co-G. Informal-worker households are households which include an informal worker. The *coverage* rate for a particular social grant intervention is the proportion of informal-worker household members who have a grant recipient in their household, out of all informal worker household workers. The *targeting* rate is the proportion of informal-worker household members out of all household members who have a grant recipient in their household. The second-super row shows targeting of funding: the proportion of total grant funding which goes to informal-worker households, out of total funding for all grant-receiving households. For illustrative purposes we show absolute funding numbers when the grant intervention receives R8 billion per month, but the funding targeting rate is invariant in the size of the budget. Authors' calculations using NIDS Wave 5 and post-stratified weight.

pensed through the CSG, 33 cents is received by informal-worker household members, compared to 37 cents for the Co-G.

In evaluating an intervention using the targeting rate, attention ought to be paid to the distributional implications of leakage.[18] If the leakage of a welfare intervention accrues disproportionately to those with the lowest welfare, this leakage should not be evaluated as harshly. Thus, while Table 2 reports marginally better targeting rates for the Co-G compared to the CSG, Fig. 1 demonstrates that the CSG's leakage is arguably more acceptable than the Co-G's.

5. Modeling the shock and the response

5.1. Modeling approach

While the previous section gives an overview of how informal-worker household members are reached by different grant interventions, this section directly assesses the extent to which the interventions compensate for collapsing informal earnings. We first simulate the effects of the COVID-19 shock by imposing a loss to the earnings of informal workers, and then simulate the positive social assistance increase under different grant scenarios – by increasing the grant amount (in the case of the OAP and CSG) or assigning new grants under certain eligibility criteria (in the case of the Co-G).

Specifically we impose a 75 percent loss of income to all informal workers as the COVID-19 lockdown effect. The choice of a 75 percent loss of informal earnings is based on conjecture and serves as a benchmark rather than an estimate. There are reasons to believe the actual loss might be higher (if job-losses and business-closures persist) or lower (if non-compliance is high or widespread exemptions are made).[19]

Having imposed this shock to informal earnings, we then investigate how the different grant interventions mitigate the household income loss and poverty increase associated with the shock, by adding income from these hypothetical policies back to recipient households.

These estimates are *not* attempts to predict the *overall* poverty impacts associated with the COVID-19 lockdown in South Africa. This would be a much more involved exercise requiring simulation of income losses of the *formally* employed as well as various COVID-19 costs. We avoid this exercise because it distracts from our key interest – how social assistance can be repurposed to relieve those outside the existing formal labour market safety net. Additionally, we do not pretend to be able to predict the overall poverty impact given our lack of real-time data.

For this exercise we set a total budget for emergency grant expenditure.[20] Following the size of the social grant support package introduced by the South African government on the 21st of April (see Section 2.4), we set a budget of R50 billion over 6 months, which is 1 percent of South Africa's annual GDP. More relevant for our analysis, the total monthly budget is R8 billion. In evaluating each intervention, we assign this entire budget to the grant(s) under consideration. With the different grant programs having widely varying numbers of direct beneficiaries, the increase per grant associated with the R8 billion budget varies substantially by intervention. It implies an increase of R2444 per month for the 3.27 million recipients of the OAP, an increase of R636 per month for the 12.6 million child beneficiaries of the CSG, and a R525 per month Co-G grant for its 15.2 million recipients, as shown in Table 3. In specifications evaluating a mixed CSG and Co-G or OAP and Co-G package we assign R4 billion to each grant, leading to an increase in the CSG of R318 per month or the OAP of R1,222 per month, and a Co-G at R263 per month.

5.2. Impacts along the income distribution

For now abstracting away from the poverty loss of the COVID-19 lockdown, Panel (a) of Fig. 2 shows the average absolute increase in per capita household income (in rands) in each income decile, from each of the OAP increase (yellow), CSG increase (red), and Co-G introduction (purple). The increase in per person household income associated with the OAP top-up is largest in the middle of the income distribution. The average increase per household member is much lower than the per-recipient top-up (R2444), reflecting the relatively low frequency of OAP co-residence among the general

[18] Bibi et al. (2007, p. 110) note that "the use of exclusion errors and under-coverage ratios will often fail to present a distribution-sensitive picture of the impact of programs on the poor". Grosh and Baker (1995, p. 13) argue that "[the] best way to judge whether the levels and trade-offs between under-coverage and leakage are acceptable is to calculate the changes in the poverty indices that result from the different models. The model that reduces poverty the most given a fixed budget is the most acceptable."

[19] In results not reported here, our substantive findings about the relative effectiveness of the different interventions are robust to very different assumptions about the loss to informal incomes, such as 25%, 50%, and 100% losses. Our results are also robust to applying differently sized shocks to those in the informal sector versus those informally employed in the formal sector.

[20] We show how some results change as the budget varies in Fig. C1 of Appendix C.

Table 3
Grant increases associated with R8 billion budget

	OAP	CSG	Co-G	CSG & Co-G	OAP & Co-G
Number of grants (millions)	3.3	12.6	15.2	27.8	18.5
Beneficiary household members (millions)	13.3	29.6	37.7	48.1	41.6
Usual monthly value per grant (Rands)	1780	440	0	440 & 0	1780 & 0
Per grant increase (Rands)	2444	636	526	318 & 263	1222 & 263

Notes: Table shows size of South Africa's largest existing social grants, and increases per grant which would be associated with an R8 billion emergency budget applied solely to expanding each intervention. "OAP" is the Old Age Pension top-up, "CSG" is the Child Support Grant top-up, "Co-G" is the Special COVID-19 Grant, "CSG & Co-G" is a simultaneous increase in the CSG and introduction of the Co-G, with the total budget split between the two interventions, while "OAP & Co-G" is the same for a simultaneous increase in the OAP and introduction of the Co-G. A "beneficiary household member" is any person co-resident with a recipient of the particular grant, and includes the grant recipient herself. The Co-G would be a new emergency grant, hence its "usual monthly payment value" being 0. In the bottom two rows of the last two columns where there are two numbers per cell: the first is for the CSG or OAP, the second for the Co-G. As of 22 May 2020, one US dollar at market prices was worth 17.69 South African Rands, while in OECD PPP-adjusted terms one US dollar was equivalent to 6.3 South African Rands. Authors' calculations using NIDS Wave 5 and post-stratified weight.

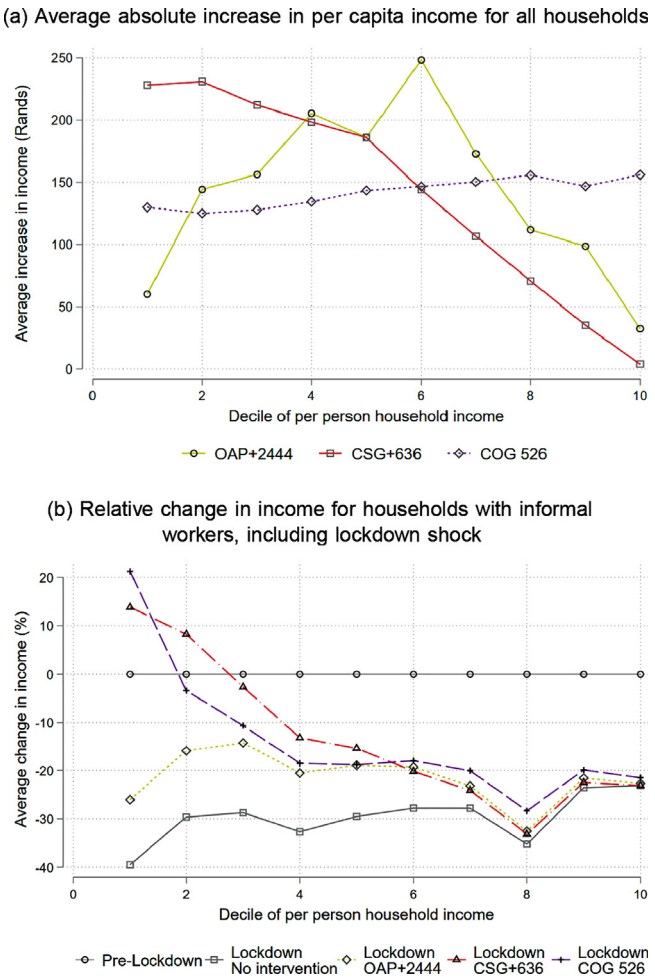


Fig. 2. Impacts on household income per capita, by intervention. *Notes*: Figure shows impacts on per capita household incomes of various social assistance interventions (grants), when a total budget of R8 billion per month is separately assigned to each grant intervention. "OAP + 2444" means an increase in each Old Age Pension of R2444 per month, "CSG + 636" means an increase in each Child Support Grant by R636 per month (per child), and "Co-G 526" means the introduction of a Special COVID-19 Grant at the value of R526 per month. Panel (a) presents statistics for the entire South African population, and shows by decile the average absolute monthly Rand increase in per capita household incomes, without considering income losses due to lockdown. Panel (b) presents statistics just for informal-worker household members, and shows net percentage changes in per capita incomes from pre-lockdown levels by (national per capita) income decile, after imposing a lockdown shock of 75% loss of income for informal workers and then applying the various emergency interventions. Informal-worker households are households which include an informal worker. Authors' calculations using NIDS Wave 5 and post-stratified weight.

population (see Panel (a) of Fig. 1) as well as large household sizes. The CSG in contrast is highly progressively targeted, with income increases largest at the bottom of the distribution and consistently declining in income. The Co-G is somewhat *regressive*, with similar increases across the distribution but larger increases near the top. This likely reflects an anti-poor feature of the Co-G's design: (means-tested) grant recipients are not eligible for direct receipt of the Co-G, while non-grant recipients not in the labour force, even if they are members of rich households, will be eligible.

In Panel (b) of Fig. 2 we focus on impacts on informal-worker households members, and project *net* effect of the policy measures in restoring income after informal workers have faced losses due to the COVID-19 lockdown. Specifically, Panel (b) of Fig. 2 shows the relative change in per capita household income *for informal-worker household members*, after imposing the lockdown shock of 75 percent loss to informal earnings. Deciles are still the national per capita income deciles of Panel (a), but now changes in the income of only informal-worker household members are shown. The dark grey horizontal line shows pre-lockdown changes – which by definition are at 0 percent. The light grey line shows declines in per capita household income due to the lockdown shock we impose. A reduction in informal earnings by 75 percent decreases per capita incomes of informal-worker household members by about 30 percent for most of the distribution, with sharper declines at the 1st and 8th deciles.

The yellow (OAP increase), red (CSG increase) and purple (Co-G introduction) lines then show the extent to which these interventions restore incomes of informal-worker household members to pre-lockdown levels, by adding the social grant interventions to the lockdown (i.e. post-shock) household incomes. The OAP performs worst of the 3 measures, and is always dominated by either the CSG or Co-G. The CSG and Co-G perform similarly, with the CSG doing better than Co-G for informal-worker household members in deciles 2 to 5, and the Co-G doing better in deciles 6 to 8. The policies make a substantial impact in mitigating the lockdown shock in the bottom deciles, but decrease in efficacy higher up the distribution.

5.3. Poverty impacts

Our main focus is simulated poverty impacts associated with the loss of informal earnings in lockdown and the different grants. We impose the lockdown shock, determine poverty in this "no intervention" scenario, and then examine how poverty changes as our different interventions are applied.

We use the three "FGT" poverty measures: the headcount ratio (FGT_0), the poverty-gap index (FGT_1), and the squared poverty-gap index (FGT_2) (Foster, Greer, & Thorbecke, 1984):

$$FGT_\alpha = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{(z-y_i)\cdot \mathbb{1}(y_i < z)}{z}\right)^\alpha. \quad (1)$$

The FGT parameter is given by α, while y_i is the income of individual i, N is the total population, $\mathbb{1}$ is the indicator function and z is the poverty line. The headcount ratio indicates poverty *incidence*. For the headcount ratio we use the Statistics South Africa food poverty line and upper-bound poverty line discussed in Section 3.[21] The poverty gap index indicates poverty *depth* (the average proportional difference between the individual income of the poor and the poverty line) while the squared poverty gap can be understood as indicating poverty *severity* (by assigning greater significance to more extreme poverty). For the two poverty-gap indices we use the Statistics South Africa upper-bound line.

Panel (a) of Fig. 3 shows the headcount ratio using the upper-bound (lighter shades) and food poverty line (darker shades), under various lockdown scenarios. The left-most group of bars shows poverty outcomes for the general population, while the right-most bars show poverty amongst informal-worker household members. The first light-grey bars show poverty rates before the lockdown is implemented – i.e. poverty rates in the NIDS 2017 data – while the second dark-grey bars show how poverty increases as informal earnings are decreased by 75 percent. As is clearly apparent, poverty increases are much more dramatic for informal-worker household members (by design), but even among households in the general population food poverty increases by about 30 percent (4.4 percentage points). The remaining bars then show how lockdown poverty is mitigated by the OAP increase (yellow), the CSG increase (red), the Co-G introduction (purple), a simultaneous CSG increase and Co-G introduction, each with half their original budget (pink), or the same kind of split between an OAP increase and the Co-G (blue).

The interventions are not greatly differentiated in how they reduce *upper-bound* poverty, and do little to decrease the upper-bound headcount ratio for informal-worker household members. This finding can be explained with recourse to the distributional analysis of Panel (b) of Fig. 2, which shows that the interventions are quite similar in their relative income effects above the 5th decile, and that these ameliorating effects are small. However, the significant and differentiated impacts at the bottom deciles of Fig. 2 are also evident in the food-poverty headcount ratios, which are very responsive to the grant interventions. The OAP performs the worst, and does especially poorly for informal-worker household members. The CSG in contrast is the single-best intervention, dramatically reducing general-population food poverty to below-lockdown levels, and performing almost identically to the CSG–Co-G hybrid policy among informal-worker household members. The Co-G performs similarly to the CSG amongst informal-worker household members, but notably worse amongst the general population – reflecting how CSG "leakage" is highly progressive. The OAP–Co-G hybrid performs worse than the Co-G and CSG at the food poverty line for all populations.

Panel (b) shows the FGT_1 and FGT_2 poverty gap measures using the upper-bound line, to more rigorously combine our twin concerns about poverty incidence and poverty severity. Similarly to the food poverty headcount ratio results, these measures show the OAP performing consistently worst, the CSG performing by far the best for reducing general household poverty, and the combined CSG–Co-G policy performing best in mitigating poverty amongst informal-worker household members. The OAP–Co-G hybrid again performs poorly and is strictly dominated by the CSG and Co-G. Amongst informal-worker household members, the Co-G and CSG separately perform similarly. A policy preference ordering would depend on how strongly one weighs up poverty reduction amongst the targeted informal-worker household members versus poverty reduction spillovers to the general population, an issue we return to in the next section. However we can comfortably conclude that the OAP increase is the least desirable policy, followed by the OAP–Co-G hybrid and the Co-G, and that the CSG and hybrid CSG–Co-G policy are ultimately quite similar in their poverty-reducing efficacy.

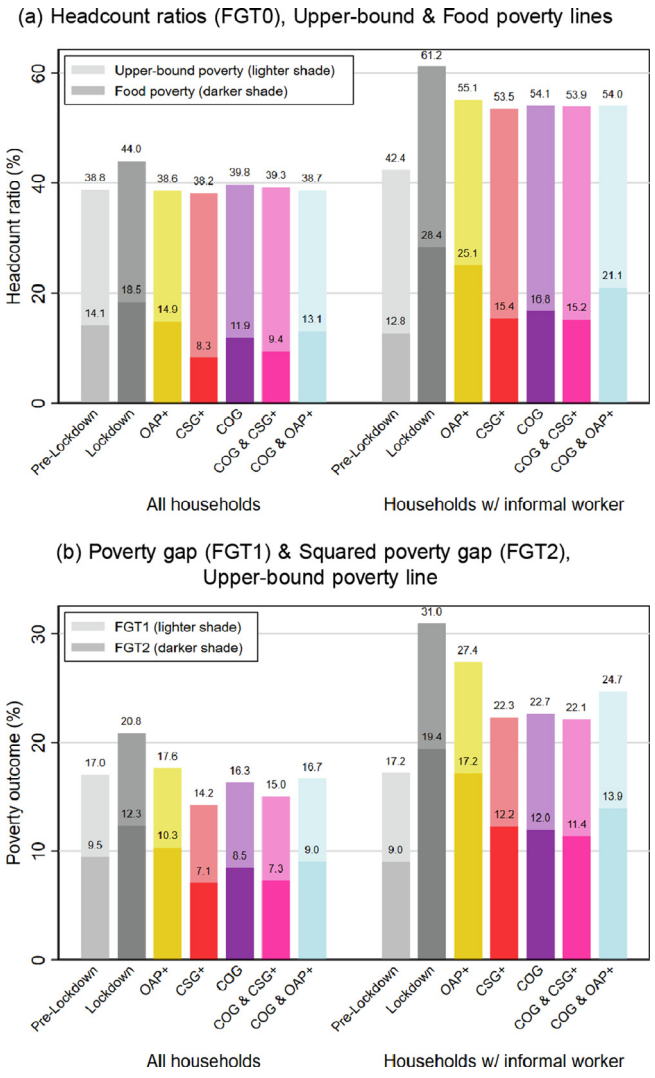


Fig. 3. Poverty impacts by lockdown scenario. *Notes*: Figure shows simulated poverty impacts of lockdown accompanied by different social assistance interventions (grants), when a total budget of R8 billion per month is separately assigned to each grant intervention. "OAP+" (yellow) is an increase in each Old Age Pension of R2444 per month, "CSG+" (red) is an increase in each Child Support Grant (CSG) by R636 per month (per child), "Co-G" (purple) is the introduction of a Special COVID-19 Grant (Co-G) at the value of R526 per month, "COG & CSG+" (pink) is a simultaneous increase in the CSG of R318 per month and the introduction of a Co-G at R263 per month, and "COG & OAP+" (blue) is a simultaneous increase in the OAP of R1222 per month and the introduction of a Co-G at R263 per month. Poverty impacts are simulated by imposing a lockdown shock of 75% loss of income from informal work, and then applying the various interventions. Panel (a) presents the headcount ratio (FGT0) for the Upper-bound Poverty Line (light shade) and Food Poverty Line (dark shade). Panel (b) presents the Poverty Gap (FGT1, light shade) and Squared Poverty Gap (FGT2, dark shade), using the Upper-Bound Poverty Line. The left group of bars show poverty for the population-at-large, while the right group of bars shows poverty amongst informal worker household members. Informal-worker households are households which include an informal worker. Poverty is evaluated using per capita household income. Authors' calculations using NIDS Wave 5 and post-stratified weight. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

[21] Expressed in February 2020 rands, these poverty lines are respectively R580 and R1,265 per capita, per month. Readers are also referred to endNote 13, where more details on these thresholds are provided.

Table 4
Characteristics of informal workers and informal-worker household members, by source of additional household income support.

	Workers co-resident with:			Household members co-resident with:		
	Formal	Grant, no formal	Neither	Formal	Grant, no formal	Neither
Frequency (millions)	1.13	1.86	2.09	5.55	6.97	3.17
Average household size	5.89	4.84	1.66	7.40	5.75	2.41
Number of children	2.1	2.1	0.2	3.0	2.7	0.6
Proportion female	56%	64%	23%	52%	55%	31%
Proportion urban	71%	55%	69%	68%	52%	72%
South African ID	92%	96%	89%	88%	88%	88%
Remittance receiving household	20%	22%	14%	23%	23%	18%
Remittance sending household	34%	15%	26%	31%	15%	23%
Age structure:						
0–17	2%	2%	0%	36%	45%	13%
18–35	50%	44%	48%	37%	28%	41%
36–45	16%	27%	25%	9%	11%	21%
46–59	26%	18%	24%	13%	9%	20%
60+	5%	10%	2%	5%	8%	4%
Income percentile:		*(Indiv. earnings)*			*(Per capita hhold income)*	
25th percentile (Rands)	955	901	1,107	1,211	645	1,183
50th percentile (Rands)	1,974	1,689	2,283	1,746	1,015	2,250
75th percentile (Rands)	3,375	2,925	3,849	2,900	1,596	4,316

Notes: Table shows characteristics of informal workers (first super-column) and informal-worker household members (second super-column), disaggregated by additional sources of household income. Informal-worker households are households which include an informal worker. Additional sources of income are divided in three exhaustive and mutually exclusive categories: "Formal" means a formal worker in the household, "Grant, no formal" means no formal worker but a grant recipient in the household, and "Neither" means no grant recipient nor formal worker in the household. In the case of household grant receipt, this could be the informal worker herself, and grant receipt means receipt of any South African social grant excluding the Special COVID-19 grant, but including grants such as the Disability and Foster Care Grants. Note that the households in the "formal worker" set may or may not also receive grant income."Average household size" is the average across individuals, not households. "South African ID" is the proportion of workers who report having a South African national identity document. Income percentiles are reported in February 2020 monthly Rands. In the first super-column these are percentiles of individual worker earnings; the second super-column shows per capita household incomes. Authors' calculations using NIDS Wave 5 and post-stratified weight.

6. Intra-household dynamics, normative goals, and optimal policy

The previous analysis suggests that a CSG increase is similar or perhaps slightly superior to a combined CSG–Co-G response to the COVID-19 lockdown in South Africa. However, as this section will show, this conclusion is sensitive to technical assumptions implicit in our use of a per capita income measure, and also depends on normative goals about who the policy is intended to prioritise. Specifically a per capita measure assumes that (1) there are no economies of scale in household production and that all household members have the same consumption needs (as noted in Section 3.3.2), and (2) household income is perfectly shared between all household members. These are both very strong assumptions regarding how production, consumption, and distribution take place *inside* the "black-box" of the household. These technical issues have non-trivial implications for determination of the "optimal policy", and highlight the unavoidability of two normative questions: (1) to what extent should the positive poverty-reducing spillover for the non-targeted population be considered a desirable policy goal, versus an exclusive focus on poverty reduction amongst informal worker households? and (2) to what extent should reducing *extreme* poverty take priority over reducing poverty *incidence*?

6.1. Decomposition by co-resident income support

Not all informal-worker households are equally dependent on the informal earnings they receive. Table 4 presents descriptive characteristics of informal workers (first super-column) and their household members (second super-column), depending on the additional sources of income in their household. These additional sources of income are divided into three exhaustive and mutually exclusive categories: (a) a formal worker is present in the household, (b) there is no formal worker in the household but there is an existing grant recipient, and (c) there is no formal worker nor existing grant recipient in the household. "Existing grant receipt" does not include the new Co-G, but includes in addition to the CSG and OAP other South African grants which we do not focus on in this paper, such as the Disability Grant and Foster Care Grant.

Table 4 shows that of 5.08 million informal workers, 2.09 million (approximately 40 percent) live in households in which income from informal work is not supplemented by income from grants or from formal work. We can consider these households "informal-work-dependent". While 40 percent of informal workers live in informal-work-dependent households, a significantly smaller minority of *informal-worker household members* live in informal-work-dependent *households* – 3.17 million individuals out of 15.69 million, or 20 percent. This is because informal workers *without* additional income support are typically in much smaller households (1.66 household members on average) with fewer children (0.2 children on average) than informal workers *with* additional income support (between 4.84 and 5.89 household members on average, and 2.1 children).

These informal-work dependent workers are similarly urban compared to informal workers co-resident with formal workers, but 77% are male – much higher than 44% for those workers with formal income in their household. Informal-work dependent workers have a similar age structure compared to workers with other sources of income in their households (mostly young and prime-aged adults), but clearly the age structure of their household members is quite different. The small household size (1.66), low number of children, and high proportion of male household members (69%) suggests that these are singe male and small disproportionately male households.

In the presence of household economies of scale, and children potentially having lower consumption needs than adults, a per capita welfare metric may overstate the relative poverty of these larger households with children, and comparatively understate

the poverty of the smaller and relatively childless informal-work-dependent households.[22]. This is particularly problematic for our analysis, because it is precisely these larger households which have additional income sources. The co-variance of household size and household age-composition with household income motivates the use of equivalence scales in Section 6.2.

Another aspect of household income support which must be considered in the South African context is remittance flows between narrowly-defined households (Posel, 2001; Du Toit & Neves, 2007). While our analysis below relaxes various assumptions about consumption and distribution *within* these households, we cannot include an in-depth analysis of the implications for poverty of flows *between* these households. Partly this is a simple data constraint. Ideally, we could present a specification which somehow expands the "household" to include remittance senders and receivers. However while NIDS offers unusually rich remittance data for a household survey, we do not know crucial characteristics of remittance senders and receivers necessary for our poverty analysis – such as whether they are informal workers, whether they receive grant income, or their household characteristics (including income). The data constraint is not the only issue, however. Remittances also present conceptual difficulties regarding how to define the household, and how to reasonably model sharing between narrow households. We therefore do not model changes in remittance flows, and recognise this as a limitation of our analysis.

However we think that our results are likely robust to incorporating remittance flows. Tables 1, 4, A1, A2 and A3 all show household remittance sending and receiving – and few dramatic differences emerge across the categories of heterogeneity considered. One important pattern is that remittance flows do seem to play a "cushioning" role, with poorer households (e.g. those with grants) less likely to send remittances and more likely to receive, while the converse applies to richer households (e.g. those with formal workers). This is directly evident in Fig. A1, which shows that remittance income is more important for poorer households. However Fig. A1 also shows that remittance income is a relatively small share of household income in 2017 (Leibbrandt et al. (2010) show that remittance income has sharply declined in importance relative to grants since 1993), and that its relative importance is not very different for informal worker households compared to the population at large.

6.2. Household size and equivalence scales

The potential biases of per capita measures discussed above do not necessarily make any particular equivalence scales superior to per capita measures for converting a household-level income measure to an individual-level welfare indicator. Justifying a particular equivalence scale parameterisation can be difficult, and the approach can generally lead to less transparent results.[23] With that being said, the evidence in Section 6.1 provides good reason to repeat our main analysis with equivalised income to check sensitivity to our use of per capita measures.

It is not obvious *ex ante* how equivalence scales will affect our relatively consistent result that the CSG is superior to the Co-G as an emergency intervention. On the one hand, the OECD equivalence scales introduced in Section 3.3.2 will tend to increase our individual income measure in large households, especially those with many children. This can be expected to reduce the effect that the CSG has on poverty, as many CSG households (which are large and by definition include children) will now be judged to be *ex ante* less poor than per capita measures would suggest. On the other hand, however, the smaller "size" of these adult-equivalised households means that CSG increases will have more of an effect on our new measure of individual income. For a family of two adults and two CSG-receiving children, the two grant increases are split not between 4 people, but between 2.7 adult equivalents (1 + 0.7 + 0.5 + 0.5).[24] This effect will not be as dramatic for smaller and relatively childless informal-work-dependent households. We can therefore expect ambiguous effects on our evaluation of the CSG versus the Co-G.

The lockdown poverty results are sensitive to the use of adult-equivalent income, as shown in Fig. 4. The key differences between Fig. 4 (using equivalence scales) and Fig. 3 (using per capita income) is that the performance of the Co-G improves relative to the CSG, and the hybrid CSG–Co-G measure is likely the preferred poverty-reducing measure. An interesting exception to this general conclusion is that the CSG now performs notably better than any other measure in reducing upper-bound poverty. This interesting change is likely because the twin effects of equivalence scales discussed above (CSG households become less poor, and the grant increase does more for CSG households) now move a non-trivial proportion of CSG household members around the upper-bound poverty line, whereas before these households were too poor and the increase too meager to have an effect at this threshold.

We now consider one more feature of intra-household resource allocation, which is the sensitivity of our results to the implicit assumption of perfect resource sharing within the household.

6.3. Intra-household distribution

Both per capita and adult-equivalised income measures assume that household resources are perfectly shared within the household.[25] However there is an expansive literature suggesting that this is a dramatic over-simplification, with the distribution of resources to each individual within a household depending on such varied factors as age, wage, gender and the relationship to the household head, or bargaining power and outside options more generally (Aizer, 2010; Anderson & Eswaran, 2009; Attanasio & Lechene, 2002; Browning, Bourguignon, Chiappori, & Lechene, 1994; Doss, 2013; Kanbur, 2016; Bertrand et al., 2003). We therefore explore the implications of relaxing our perfect-sharing assumption.

With the particular intra-household sharing parameters likely highly context-specific, we do not attempt to specify some kind of realistic intra-household sharing rule. Instead, to provide outer bounds on the effect of intra-household sharing, we present an extreme scenario of pure selfishness, where the grant recipient does not share the grant relief at all, to be contrasted with our perfect sharing per capita analysis. In order to isolate the impact of sharing dynamics on the *effectiveness of emergency relief*, we still assume pre-lockdown household income is shared on a per capita basis, and that the loss of informal earnings is similarly shared across the household. It is only the emergency grant relief – the CSG and OAP top-ups, or the introduction of the Co-G – which is

[22] See Fig. D1 in Appendix D

[23] Foundational references on equivalence scales include Deaton and Muellbauer (1986) and Deaton and Paxson (1998). Lanjouw and Ravallion (1995) discuss handling equivalence scales under uncertainty. Klasen (2000) suggests that an equivalence scale assuming large economies of scale may be appropriate for South Africa.

[24] See Note 12 above for the Original-OECD equivalence scale parameters.

[25] Note that while many equivalence-scale implementations (including the OECD scales we use) assume that children are less expensive than adults, and this has a bearing on *between–household* welfare evaluation, it does not mean assigning differential shares of income *within* a household. Consider household A with 1 adult and 1 child, and an otherwise-similar household B with 2 adults. Using the OECD scales, the effective household sizes are 1 + 0.5 = 1.5 and 1 + 0.7 = 1.7 respectively. Thus a R100 increase to household income will improve the individual welfare of members of A more than B – because of their smaller effective household size. But in terms of operationalizing the adult-equivalized income concept, the child and adult *within* household A each receive an *equal* increase of R100/1.5. More generally the logic is that income is shared perfectly according to household members' needs.

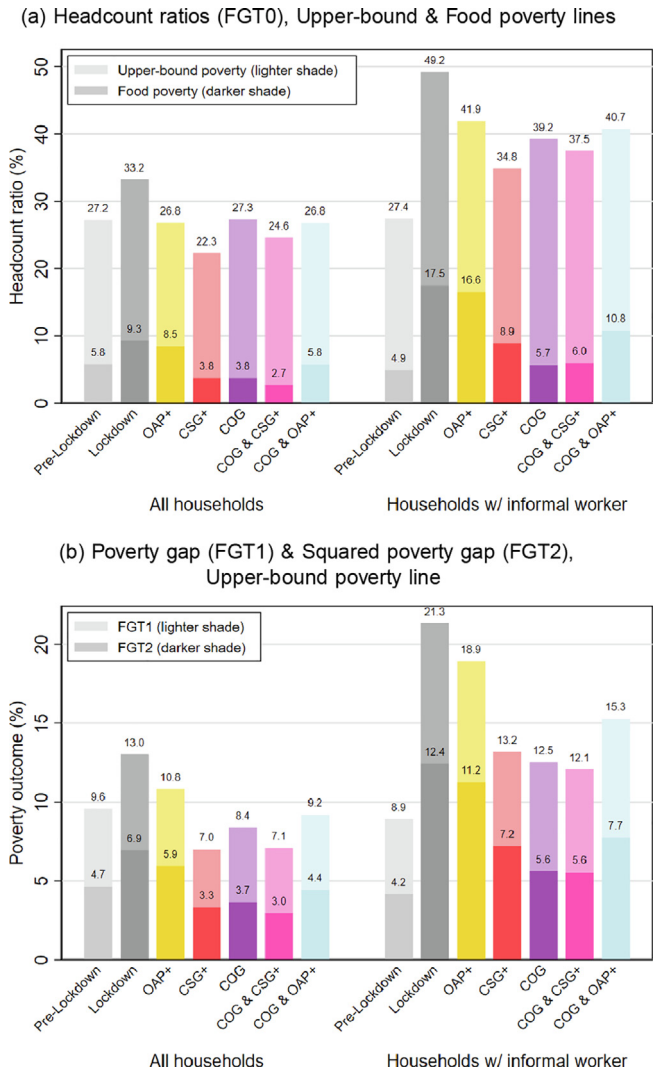


Fig. 4. Poverty impacts by lockdown scenario, adult-equivalised income. *Notes*: Figure shows simulated poverty impacts of lockdown accompanied by different social assistance interventions (grants), when a total budget of R8 billion per month is separately assigned to each grant intervention and household income is adult-equivalised. "OAP+" (yellow) is an increase in each Old Age Pension of R2444 per month, "CSG+" (red) is an increase in each Child Support Grant (CSG) by R636 per month (per child), "Co-G" (purple) is the introduction of a Special COVID-19 Grant (Co-G) at the value of R526 per month, "COG & CSG+" (pink) is a simultaneous increase in the CSG of R318 per month and the introduction of a Co-G at R263 per month, and "COG & OAP+" (blue) is a simultaneous increase in the OAP of R1222 per month and the introduction of a Co-G at R263 per month. Poverty impacts are simulated by imposing a lockdown shock of 75% loss of income from informal work, and then applying the various interventions. Panel (a) presents the headcount ratio (FGT0) for the Upper-bound Poverty Line (light shade) and Food Poverty Line (dark shade). Panel (b) presents the Poverty Gap (FGT1, light shade) and Squared Poverty Gap (FGT2, dark shade), using the Upper-Bound Poverty Line. The left group of bars show poverty for the population-at-large, while the right group of bars shows poverty amongst informal worker household members. Informal-worker households are households which include an informal worker. Authors' calculations using NIDS Wave 5 and post-stratified weight. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

consumed completely selfishly by the direct recipient (see Appendix C for a formal representation). Because it is adults who exercise control of CSG funds, we specify the CSG adult caregiver as the recipient in this exercise, and she still receives a CSG grant top-up for each child under her care, but she consumes it all herself.

We re-iterate that this "no-sharing" assumption is not intended to be a realistic household sharing rule. This is simply a bounding exercise to be compared to another extreme of "perfect sharing" – implicit in a per capita measure – in order to see how sensitive our results are to the assumed sharing dynamic.

Fig. 5 presents the familiar poverty graph under these conditions. It is immediately apparent that the food poverty rates associated with the interventions are higher under these conditions than they were in Fig. 3, as would be expected. The upper-bound poverty headcount ratio is sometimes lower, because direct recipients now have a greater individual benefit from the grants. However the poverty gap measures showing the *overall* poverty impact unambiguously demonstrate that a lack of intra-household sharing increases poverty compared to the counterfactual of perfect sharing. The most important conclusion from the figure is that the CSG becomes a much less effective intervention. The Co-G, and combined CSG–Co-G, now almost everywhere dominates the CSG as an intervention, demonstrating that the CSG disproportionately requires household-sharing to be effective. The combined CSG–Co-G in contrast does not perform *dramatically* worse when income is not shared, especially when considering FGT_1 poverty gap rather then the FGT_2. A general conclusion is that lack of sharing is most deleterious when it comes to reducing *extreme* poverty.

In evaluating these conclusions it should be kept in mind that our "no sharing" specification is an extreme case where individual characteristics of the recipient and the co-residents do not affect sharing. This stands in contrast to the intra-household bargaining literature mentioned above, and existing evidence on the salience of grant recipient gender in South Africa, which shows that women share more of their grant income than men (Dufo, 2003; Posel et al., 2006). Indeed, examining poverty impacts by gender when grant relief is not shared (Fig. C3) shows interesting results – the CSG increase becomes very effective and the Co-G ineffective for women while the converse is true for men. This reflects gendered patterns of grant receipt, evident in Table A3. Fig. C3 also presents a cautionary tale regarding conclusions about grant desirability based solely on aggregate impacts. While the Co-G does more to reduce *aggregate* poverty than the CSG when there is no sharing, it does much worse for women. This combined with the finding that women share more of their grant income than men in South Africa provides evidence *against* the superiority of the Co-G when sharing is imperfect. The broader significance of these results is that assumptions regarding intra-household sharing can be consequential, and policy determination requires consideration of local evidence on this question.

6.4. Optimal grant allocation

We end our analysis with an exercise which directly shows how using different technical and normative assumptions affects what we calculate as the "optimal" policy.

6.4.1. Normative considerations

A normative framing prompts consideration of an issue first hinted at in Section 5.3, and which becomes increasingly important in the above sections – the tension that emerges when one policy (the CSG) is better for reducing poverty in the general population, but a different policy (the CSG–Co-G hybrid) is sometimes superior for reducing poverty among informal worker household members.

This is a specific case of a more general targeting dilemma involving the question of how to evaluate inclusion and exclusion errors. The minimising of exclusion errors is usually best achieved with broad targeting (as in the CSG–Co-G hybrid – see Fig. 1, panel (d)). However, this strategy has the consequence of committing substantial inclusion errors – i.e. delivering benefits to those not part of the target population. In contrast, policies which commit fewer inclusion errors also tend to commit more exclusion errors (as in the CSG grant – see Fig. 1, panel (b)). How the trade-off

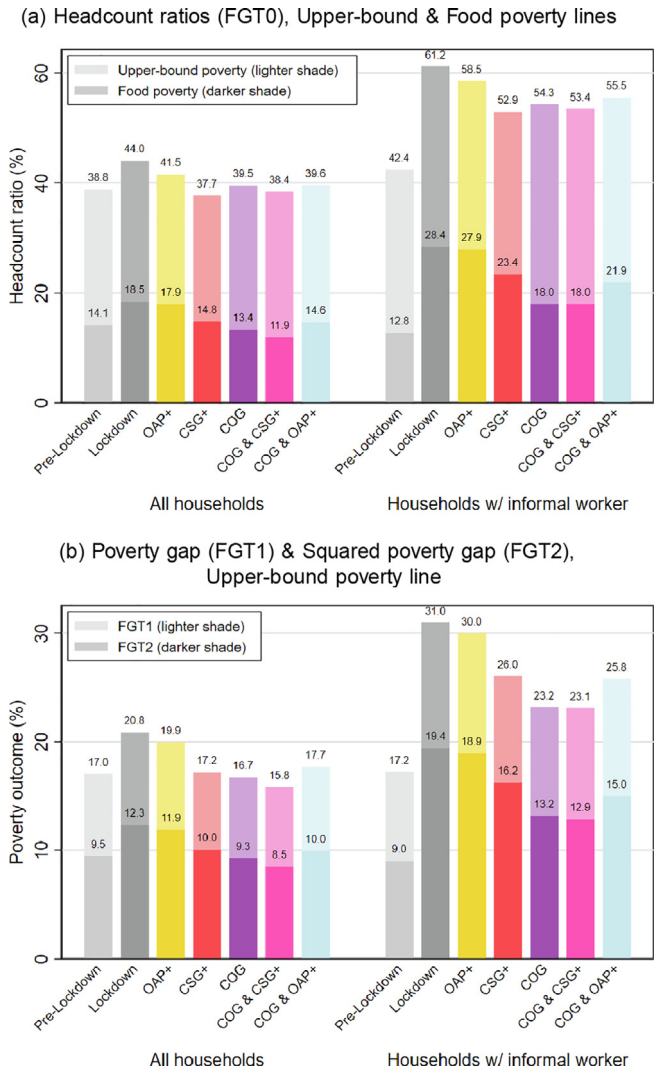


Fig. 5. Poverty impacts by lockdown scenario, no grant sharing. *Notes*: Figure shows simulated poverty impacts of lockdown accompanied by different social assistance interventions (grants), when a total budget of R8 billion per month is separately assigned to each grant intervention and emergency grant income is not shared within the household. "OAP+" (yellow) is an increase in each Old Age Pension of R2444 per month, "CSG+" (red) is an increase in each Child Support Grant (CSG) by R636 per month (per child), "Co-G" (purple) is the introduction of a Special COVID-19 Grant (Co-G) at the value of R526 per month, "COG & CSG+" (pink) is a simultaneous increase in the CSG of R318 per month and the introduction of a Co-G at R263 per month, and "COG & OAP+" (blue) is a simultaneous increase in the OAP of R1222 per month and the introduction of a Co-G at R263 per month. Poverty impacts are simulated by imposing a lockdown shock of 75% loss of income from informal work, and then applying the various interventions. It is assumed here that only the direct individual recipient of the grant receives the emergency relief; there is no household sharing of the income from the interventions. Pre-lockdown income is assumed to be distributed on a per capita basis within the household, as is the negative lockdown shock to informal income. For the CSG, the individual recipient is taken to be the adult caregiver. Panel (a) presents the headcount ratio (FGT0) for the Upper-bound Poverty Line (light shade) and Food Poverty Line (dark shade). Panel (b) presents the Poverty Gap (FGT1, light shade) and Squared Poverty Gap (FGT2, dark shade), using the Upper-Bound Poverty Line. See notes to Fig. 3 for additional details. Authors' calculations using NIDS Wave 5 and post-stratified weight. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

between inclusion and exclusion errors is resolved depends on how these inclusion and exclusion errors are evaluated.

In this paper our analysis focuses on how poverty among informal workers and their households may be alleviated by various policies. It is not an analysis of general poverty-reduction options. We do not consider other poverty-alleviating or COVID-19 programs such as support for formal workers and tax credits, and our analysis is explicitly motivated by a context where existing poverty-alleviating strategies may be inaccessible to informal workers.

However if a side-effect of the policies evaluated here is to reduce poverty beyond informal-worker households – as our analysis has shown is the case – this consideration is relevant for determination of the optimal policy. The question then becomes how significantly to weight these beneficial policy "spillovers" (i.e. inclusion errors) when determining the optimal overall policy. As a bounding exercise we have presented two extreme cases throughout our analysis. The poverty estimates for informal-worker household members attach a weight of 0 to the poverty of those not in informal-worker households, thereby placing a high value on minimising inclusion errors. The estimates for the "general population" in contrast assign an equal weight to the poverty of informal-worker household members and those not in informal-worker households.[26] The question of the "correct" weight does not have a technical resolution – it is a normative value judgment.

Optimal grant allocation will also depend on another normative question – the extent to which the optimal policy should more highly weight reducing *extreme* poverty versus poverty *incidence* generally. In the analysis above, there can sometimes be a tension between choosing a policy which reduces the proportion of individuals below the upper-bound poverty line (poverty "incidence") or the "extreme" food poverty line (poverty "severity"). The FGT measures discussed in Section 5.3 provide a clear, axiomatically-consistent representation of these trade-offs. To briefly recapitulate, the differences between the FGT_1 and FGT_2 measures reflect extra consideration of the extremely poor when using the latter. We therefore undertake our optimal policy exercise using both measures.

6.4.2. The optimal policy calculation

The optimal policy calculation itself is relatively straightforward. For simplicity we do not consider the OAP or OAP–Co-G packages as additional policy measures here due to their clearly inferior performance in the previous analysis. We implement a numerical optimisation procedure which finds the optimal mixture of CSG and Co-G values to minimise the given poverty gap measure (either FGT_1 or FGT_2), given the budget of R8 billion. The resulting optimal grant allocations are sensitive to whether we use per capita income or equivalence scales, whether we minimise poverty only among informal-worker household members or consider the general population, whether we seek to minimise the FGT_1 poverty gap or FGT_2 squared poverty gap, and whether we allow intra-household sharing. We should emphasize that in reality policy-makers may be concerned about equity and other issues which may make the allocations we calculate undesirable – our reference to "optimal" policy is in the narrow sense of minimizing the FGT poverty measures discussed. Incorporating other normative desiderata such as equity would only strengthen our point that "optimal policy" remains dependent on technical assumptions as well as normative judgments. We provide detail on the implementation of the optimal policy calculation in Appendix C.

Table 5 shows the optimal per-grant allocations which result from this exercise. It is apparent that the optimal allocation depends greatly on whether poverty is minimized amongst all households or informal-worker households, whether per capita measures, equivalence scales, or "no-sharing" specifications are used, and whether the poverty gap FGT_1 or squared poverty gap FGT_2 is minimized. When perfect sharing per capita measures are

[26] We show how one can think about these weights explicitly in Eq. 3 in Appendix C.

Table 5
Optimal grant allocations.

	All individuals			Informal-worker household members		
	Per capita	Equivalence	No sharing	Per capita	Equivalence	No sharing
Minimize FGT_1						
CSG increase	636	493	251	414	224	162
Co-G value	0	118	318	184	341	392
Minimize FGT_2						
CSG increase	560	349	222	286	169	165
Co-G value	63	237	342	289	386	390

Notes: Table shows optimal grant allocations between a Child Support Grant (CSG) increase and new Special COVID-19 Grant (Co-G), calculated by finding the values of these grants which numerically minimise the given poverty measure, subject to a total budget constraint of R8 billion. There are 12 specifications, which are the combinations of the following three choices: minimizing poverty amongst all individuals *or* amongst informal-worker household member; using household per capita income *or* adult-equivalised income *or* assuming the entire grant increase is consumed by the direct recipient ("no sharing"); and minimizing the poverty gap (FGT_1) *or* the squared poverty gap (FGT_2). Values indicated are per grant per month, in February 2020 Rands. In the "no sharing" specification it is only the emergency grant relief which the direct recipient consumes completely herself. Pre-lockdown income is assumed to be distributed on a per capita basis within the household, as is the negative lockdown shock to informal income. For the CSG, the individual recipient is taken to be the adult caregiver. Informal-worker households are households which include an informal worker. Authors' calculations using NIDS Wave 5 and post-stratified weight.

used and the goal is to reduce the FGT_1 poverty gap amongst all individuals, the optimal policy is to allocate all funding to the CSG – but when equivalence scales or "no sharing" is used and the goal is to reduce the FGT_2 squared poverty gap amongst informal-worker household members, the Co-G receives a much larger allocation than the CSG.[27] In general, the use of perfect sharing per capita measures, minimising poverty among the general population, and use of the FGT_1 poverty gap all lead to allocations more favourable to the CSG.

In Appendix C we show how the optimal grant allocation varies for changes in the total budget (Fig. C1), and for changes in the weight assigned to the non-targeted poverty reduction spillover (Fig. C2). When the budget is low, a pure CSG top-up is optimal, but an increasingly equal mix between the CSG and Co-G becomes optimal as the budget increases. A mix between the CSG and Co-G becomes optimal as the spillovers are weighted less, but even relatively low weights result in the pure CSG top-up as optimal.

On the one hand, this overall "optimal policy" indeterminacy reflects technical limitations. We do not know how production, consumption and allocation of resources occurs inside the household, and so we are left to choose between three crude sets of assumptions about intra-household allocation (per capita measures, equivalence scales, and "no sharing"), which unfortunately diverge in their implications for our optimal policy. On the other hand, the decision of what priority to put on positive spillovers to general poverty reduction cannot be resolved by more data or better techniques. This is a normative question, as is the decision about whether the poverty-gap or squared poverty-gap should be minimized. That these decisions affect the optimal policy reflects the limitations of technical work to provide an unambiguous "solution" to this type of question. While this work can provide some guidance – for example it seems clear that increasing the OAP is an ineffective lockdown poverty-reduction tool, and the CSG and CSG–Co-G perform well – ultimately the optimal policy decision comes down to a value judgment.

7. Conclusion

Informal workers – and by extension the households they support – are amongst those most exposed to the economic shock of the COVID-19 lockdown. Informal workers are also ineligible for contributory social insurance available to the formally employed, and non-contributory social assistance is typically targeted to "dependent" categories – children, caregivers, the elderly and the disabled. Without emergency relief, the impact of the COVID-19 crisis has the potential to devastate the livelihoods of informal workers.

We use South Africa as a case study to present a focused and necessarily stylised analysis into how social assistance measures may be repurposed as emergency relief for informal workers. This paper abstracts from many features of the South African COVID-19 reality, such as implementation problems, the administrative costs of intensive- and extensive-margin grant increases, losses to formal incomes, price changes, household recomposition responses to cope with shocks, and various emergency in-kind food parcel distribution efforts. Instead, we develop a straightforward analysis which suggests an optimal policy mix in the South African case of a combined Child Support Grant top-up and new Special COVID-19 Grant.

However in the course of this analysis we learn that a series of technical and normative assumptions can be consequential for our results. The optimal allocation is sensitive to technical assumptions implicit in per capita measures, with results varying when equivalence scales are used, or if imperfect sharing within the household is introduced. Other issues cannot be technically resolved and require normative judgments: the extent to which one weights poverty reduction spillovers *outside* the targeted group is important, as is the priority one attaches to reducing *severe* poverty.

Our approach nonetheless provides a guide for policy. Our results put bounds on a range of sensible policy options. Some results in the South African case are quite definitive – the OAP is not an effective vehicle for informal-worker emergency relief. Others are more murky – the optimal mix between the CSG and Co-G will depend on a variety of parameters. In general, our results are sensitive to the demographic and household structure of the targeted population. Our research emphasizes the importance of engaging with local evidence to inform policy design – for example incorporating what research there is on how resources are consumed and shared within the household. Optimal policy determination cannot escape normative judgments, but can be assisted by careful consideration of the evidence.

CRediT authorship contribution statement

Ihsaan Bassier: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Software, Visualization, Writing - original draft, Writing - review & editing. **Joshua Budlender:** Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Software, Visualization, Writing - original draft, Writing - review & editing. **Rocco Zizzamia:** Conceptualization, Data curation, Formal analysis, Project administration, Software, Visualization, Writing - original draft, Writing - review & editing. **Murray Leibbrandt:** Conceptualization, Funding acquisi-

[27] Note that with there being 15.2 million Co-G recipients and 12.6 million CSG recipients, the lopsidedness of this split is under-played by the per-grant figures in the table.

tion, Supervision, Writing - review & editing. **Vimal Ranchhod:** Conceptualization, Supervision, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

Bassier, Budlender and Zizzamia contributed equally to this work. For both the initial impetus in undertaking this research, as well as constant comments and queries during the first phases of this project, we owe special thanks to Kate Philip. We are also very grateful to participants of a SALDRU seminar and an Oxford Department of International Development DPhil workshop, and to Aliya Chikte, Stefan Dercon, Leila Gautham, Ronak Jain, Surbhi Kesar, Pramila Krishnan, Catherine MacLeod, and Caroline Skinner for useful comments on earlier versions of this work. Any errors remain our own. Leibbrandt acknowledges the Research Chairs Initiative of the Department of Science and Innovation and National Research Foundation for funding his work as the NRF/DSI Chair in Poverty and Inequality Research. Zizzamia, Bassier and Budlender acknowledge financial support from the NRF/DSI Chair in Poverty and Inequality Research in producing this paper.

Appendix A. Characteristics of informal workers and their households

Table A1 disaggregates informal workers by type of employment and employment sector. A large minority (29 percent) of informal workers are self-employed. The largest single sector for informal employees is private households. There are stark gender differences across the different sectors, with private households being the most female and construction the most male. Informal workers in construction also have the smallest average household size, and are by far the least likely to have CSG receipt in the house-

Table A1
Informal worker characteristics, by sector

	Self- employed	Private household	Agriculture	Construction	CSP (incl. outsourced)	Other
Frequency (millions)	1.49	0.98	0.34	0.45	0.50	1.31
Average household size	3.55	3.72	4.32	3.19	3.98	4.03
Proportion female	44%	71%	33%	4%	57%	40%
Proportion urban	66%	66%	32%	66%	68%	67%
South African ID	91%	91%	92%	94%	92%	94%
Remittance receiving household	17%	18%	13%	14%	21%	21%
Remittance sending household	27%	22%	27%	25%	24%	21%
Co-resident with:						
Child Support Grant	41%	51%	45%	26%	51%	46%
Old Age Pension	17%	12%	18%	14%	14%	20%
Special COVID-19 grant	84%	80%	88%	96%	81%	85%
Earnings percentile						
25th percentile (Rands)	951	788	1,231	996	901	1,258
50th percentile (Rands)	1,711	1,689	1,971	2,531	1,902	2,516
75th percentile (Rands)	4,427	2,531	2,710	3,965	3,208	3,849

Notes: Table shows characteristics of informal workers by employment sector. The employment sectors are exhaustive and mutually exclusive. "CSP" is the Community, social and personal services sector, which includes many outsourced workers. "Average household size" is the average across individuals, not households. "South African ID" is the proportion of workers who report having a South African national identity document. The second super-row shows the proportion of workers who are co-resident with an individual with the particular income support indicated. This additional income support may or may not be attached to the worker herself. Earnings percentiles are reported in February 2020 monthly Rands. Authors' calculations using NIDS Wave 5 and post-stratified weight.

Table A2
Characteristics of informal workers, by age.

	15–17	18–35	36–45	46–59	60+
Frequency (millions)	0.1	2.4	1.2	1.1	0.3
Average household size	5.5	3.8	3.5	3.8	4.4
Proportion female	12%	41%	46%	53%	49%
Proportion urban	60%	66%	61%	67%	51%
Remittance receiving household	42%	20%	11%	20%	21%
Remittance sending household	48%	27%	23%	20%	14%
Income dependency ratio	1.4	0.8	1.0	0.9	1.0
Age dependency ratio	0.6	0.5	0.5	0.4	1.1
South African ID	27%	93%	91%	95%	94%
Co-resident with:					
Child Support Grant	68%	44%	46%	41%	43%
Old Age Pension	13%	15%	12%	10%	79%
Special COVID-19 grant	76%	86%	86%	88%	57%
Earnings percentile					
25th percentile (Rands)	338	1019	1110	774	1116
50th percentile (Rands)	1125	2039	2139	1688	2123
75th percentile (Rands)	1218	3359	3378	3329	4500

Notes: Table shows characteristics of informal workers by age group. The "Income dependency ratio" is the ratio of non-income earners to income-earners (labour and grant income) per household. The "Age dependency ratio" is the ratio of those aged below 15 or above 65 to those aged 15–64 per household."Average household size", like the dependency ratios, is the average across individuals, not households. "South African ID" is the proportion of workers who report having a South African national identity document. The second super-row shows the proportion of workers who are co-resident with an individual with the particular income support indicated. This additional income support may or may not be attached to the worker herself. Earnings percentiles are reported in February 2020 monthly Rands. Authors' calculations using NIDS Wave 5 and post-stratified weight.

Table A3
Characteristics of individual grant recipients.

	All	OAP	CSG	CO-G	CSG & Co-G	OAP & Co-G
Frequency (millions)	56.5	3.3	7.5	15.2	22.7	18.5
Average household size	4.9	4.9	5.7	4.3	4.8	4.4
Number of children in household	1.8	1.5	2.4	1.1	1.6	1.2
Proportion female	51%	66%	97%	39%	58%	44%
Proportion urban	64%	50%	56%	68%	64%	65%
Remittance receiving household	23%	22%	27%	23%	25%	23%
Remittance sending household	20%	12%	16%	18%	18%	17%
Income dependency ratio	1.7	1.1	1.7	1.8	1.8	1.7
Age dependency ratio	0.8	1.2	1.0	0.4	0.6	0.6
South African ID	90%	96%	95%	91%	93%	92%
Co-resident with informal worker	28%	24%	32%	37%	36%	35%
Income percentile						
25th percentile (Rands)	821	944	638	901	766	911
50th percentile (Rands)	1698	1598	1050	1883	1525	1795
75th percentile (Rands)	4045	2598	1796	4366	3183	3916
Age of recipient						
0–17	35%	0%	2%	0%	1%	0%
18–35	33%	1%	56%	62%	60%	51%
36–45	13%	1%	22%	18%	20%	15%
46–59	12%	4%	15%	20%	18%	17%
60+	8%	95%	5%	0%	2%	17%
Household member age composition						
0–17	35%	28%	45%	22%	30%	23%
18–35	33%	20%	32%	41%	38%	38%
36–45	13%	6%	10%	15%	14%	14%
46–59	12%	6%	8%	17%	14%	15%
60+	8%	40%	5%	5%	5%	11%

Notes: Table shows characteristics of individual grant recipients. In the case of the CSG, the adult "caregiver" is considered the recipient. The "Income dependency ratio" is the ratio of non-income earners to income-earners (labour and grant income) per household. The "Age dependency ratio" is the ratio of those aged below 15 or above 65 to those aged 15–64 per household."Average household size", like the dependency ratios, is the average across individuals, not households. "South African ID" is the proportion of workers who report having a South African national identity document. "Number of children" is the average number of household members younger than 15. Household per capita income percentiles are reported in February 2020 monthly Rands. The last two super-rows show the age composition of the individual grant recipient and their households respectively. Each column of each super-row adds up to 100%. Authors' calculations using NIDS Wave 5 and post-stratified weight.

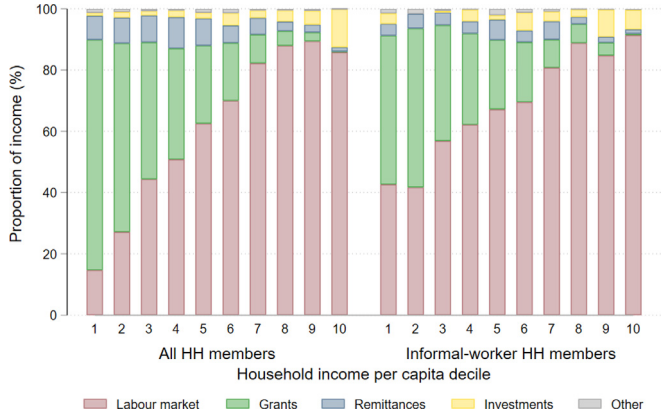


Fig. A1. Household income sources, by decile. *Notes*: Figure shows the proportion of total household income due to different income sources, by per capita household income decile. The left panel shows this for all household members (the entire population), while the right panel shows this for informal-worker household members. In both panels the deciles are those of the national income distribution. The category of "grants" includes income from all government social grants as of 2017; it does not include income from a new Special COVID-19 Grant. Informal-worker households are households which include an informal worker. Authors' calculations using NIDS Wave 5 and post-stratified weight.

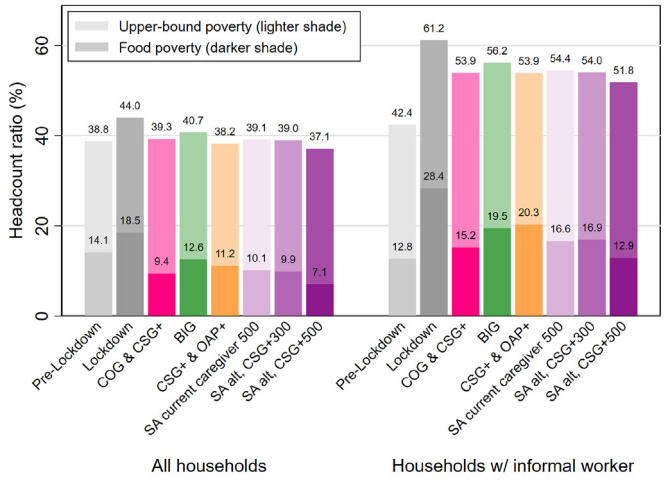
hold. However they have the highest rate of Co-G receipt. Earnings diverge across the sectors, with those in private households having the lowest earnings and those in construction having amongst the highest median and 75th percentile earnings.

Appendix B. Alternative policy packages

Fig. B1 below shows analogous poverty statistics to Fig. 3, and reproduces the CSG and Co-G combination increase of that figure as a benchmark, but otherwise considers alternative packages. The green bars show the impact of a hypothetical basic income grant (BIG) to each working age adult. Interestingly, the value of this grant from the R8 billion budget – R246 per month – is similar to the actual South African government top-up to non-CSG grants (R250 per month). The BIG performs poorly in Fig. B1 – with generally similar outcomes to the combined OAP increase and CSG increase package (orange).

The last three purple lines show different variants of the actual package introduced by the South African government (discussed in Section 2.4). An important caveat is that because we do not know how the "COVID-19 Social Relief of Distress grant" will actually be implemented, we use our Co-G specification to proxy for this grant, with the value of the Co-G being determined by what is left in the R8 billion budget after the costs of other grants are subtracted out. The lightly shaded purple bars show roughly the package implemented for June to October: a *per caregiver* increase in the CSG of R500 per month, a R250 increase to other grants, and the remainder attached to a Co-G. The medium-shaded purple bars show something like the May package (CSG increase of R300 per child): otherwise the same as the light-shaded bars, the CSG budget is reallocated to a per-child basis, resulting in a package where the CSG increase is R297 per-child. The total CSG (and overall) budget between these two options is by construction identical, and differences in the results therefore purely reflect the effects of how CSG top-ups are distributed. As can be see from the figure, at least with per capita measures this makes no appreciable difference to the resulting poverty profiles. The dark shaded purple bars in contrast reflect a budget increase: this is the same package as before but now CSG increases are R500 per child. As can be seen, this budget increase results in an appreciable poverty reduction, with better efficacy than even the CSG and Co-G benchmark package.

(a) Headcount ratios (FGT0), Upper-bound & Food poverty lines



(b) Poverty gap (FGT1) & Squared poverty gap (FGT2), Upper-bound poverty line

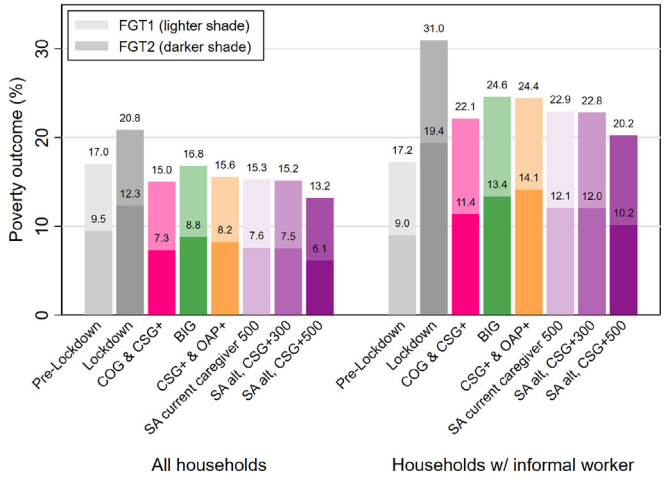
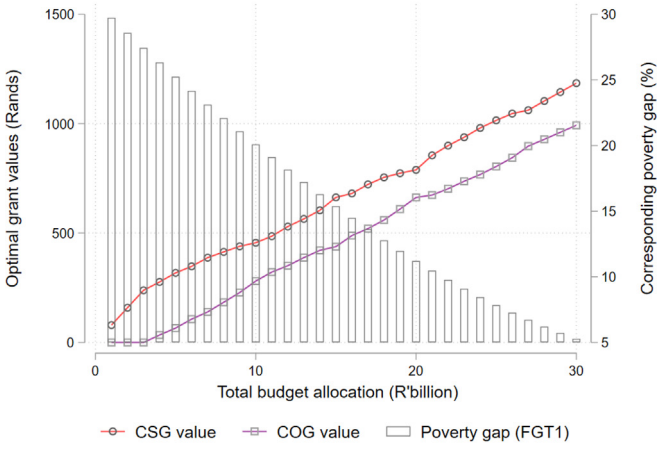


Fig. B1. Poverty impacts by lockdown scenario, additional packages. *Notes*: Figure shows simulated poverty impacts of lockdown accompanied by a social assistance intervention (grants) similar to that implemented by the South African government, as well as poverty impacts of comparator packages. We assign a total budget of R8 billion per month to each intervention. "COG & CSG+" (pink) is a simultaneous increase in the Child Support Grant (CSG) of R318 per month (per child) and the introduction of a Special COVID-19 Grant (Co-G) at R263 per month. "BIG" (green) is the introduction of a basic income grant for each working-age adult, at the value of R246 per month. "CSG+ & OAP+" (orange) is the simultaneous increase of the CSG by R318 per month (per child) and the Old Age Pension (OAP) by R1222 per month. "SA current caregiver 500" (light purple) is an increase in the CSG by R500 per month *per caregiver* (so not every CSG is increased), an increase in all other existing South African grants by R250 per month, and the introduction of a Co-G R202 per month. "SA alt, CSG + 300" (medium purple) is the same package as "SA current caregiver 500", but instead of a top-up of R500 per CSG caregiver, this CSG budget is re-allocated per child, leading to an increase in the CSG of R297 per CSG child. "SA alt, CSG + 500" (dark purple) is the same as "SA alt, CSG + 300", except that the increase to the CSG grant is R500 (per child) – so the package budget is greater than R8 billion. For additional details, see notes to Fig. 3. Authors' calculations using NIDS Wave 5 and post-stratified weight. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Appendix C. The "optimal policy calculation and additional results

For the cases with perfect sharing, we start with the existing household income and household composition structure of NIDS, and then construct a "post-shock" $(t+1)$ individual income variable $y_{t+1,i,j}$ for each individual i in household j according to

(a) FGT1 reduction among informal-worker household members



(b) FGT1 reduction among general population

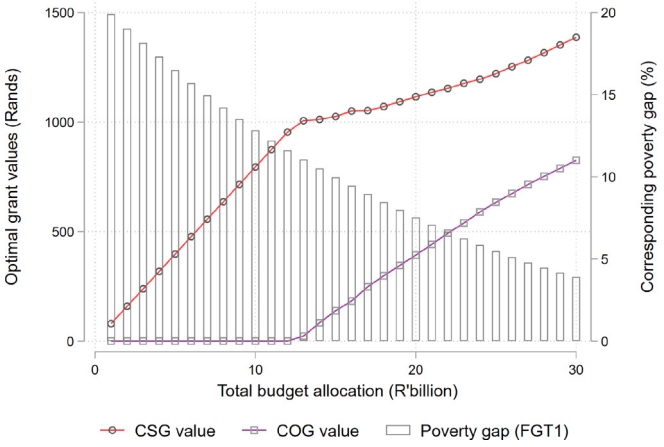


Fig. C1. Optimal grant allocations by total budget. *Notes*: Figure shows results of our "optimal policy" exercise of Section 6.4 for various emergency relief budgets, when the policy goal is to choose Child Support Grant (CSG) increases and the value of new Special COVID-19 Grant (Co-G) to minimize the FGT_1 poverty gap, using per capita household income. Panel (a) shows the results when the goal is poverty reduction amongst informal-worker household members, whereas Panel (b) shows the same for a goal of poverty reduction amongst the general population. The x-axis is the total budget available for emergency relief. The left axis shows the optimal monthly value of each grant, with the CSG increase shown in red and the Co-G in blue. The white bars show the FGT_1 poverty gap associated with the optimal policy at each budget constraint, with the poverty gap reported as a percentage on the right axis. Authors' calculations using NIDS Wave 5 and post-stratified weight.

$$y_{t+1,i,j} = \left[Y_{t,i,j} - 0.75 \cdot Y^{\text{INF}}_{t,i,j} + \left(g_{\text{CSG}} \times n_{j,\text{CSG}}\right) + \left(g_{\text{COG}} \times n_{j,\text{COG}}\right)\right] / \tilde{n}_{i,j}, \tag{2}$$

where $Y_{t,i,j}$ is the pre-shock (ie observed-in-data) household income, $Y^{\text{INF}}_{t,i,j}$ is the household's informal earnings, g_{CSG} is the value of the CSG increase, $n_{j,\text{CSG}}$ is the number of CSG recipients in household j, g_{COG} is the value of the Co-G grant, and $n_{j,\text{COG}}$ is the number of Co-G recipients in household j. We use $\tilde{n}_{i,j}$ as the "effective household size" measure. When using per capita measures $\tilde{n}_{i,j}$ is the actual household size of household j, whereas when using equivalence scales it is the adult-equivalised household size of j. Individual "post-shock" income therefore incorporates both a 75 percent loss of informal earnings and attendant emergency grant relief to the household.

For the "no sharing" specification, (2) is amended slightly, such that

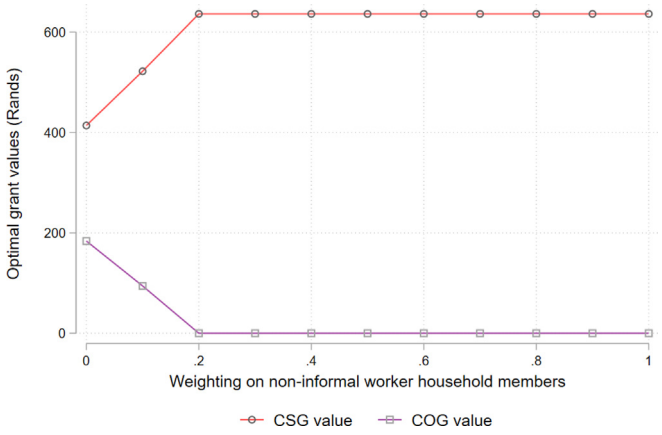


Fig. C2. Optimal grant allocations by weight $\overline{w}$. *Notes*: Figure shows results of our "optimal policy" exercise of Section 6.4 for various value of the weight $\overline{w}$, when the policy goal is to choose Child Support Grant (CSG) increases and the value of new Special COVID-19 Grant (Co-G) to minimize the FGT_1 poverty gap using per capita household income and the total budget is R8 billion per month. The weight $\overline{w}$ is the weight given to poverty reduction of individuals not in informal-worker households, as per Eq. 3. The x-axis is the value of the weight $\overline{w}$. The y-axis shows the optimal monthly value of each grant, with the CSG increase shown in red and the Co-G in purple. Informal-worker households are households which include an informal worker. Authors' calculations using NIDS Wave 5 and post-stratified weight.

$$y_{t+1,i,j} = \left(Y_{t,i,j} - 0.75 \cdot Y^{\text{INF}}_{t,i,j}\right)/\tilde{n}_{i,j} + \left(g_{\text{CSG}} \times I_{i,\text{CSG}}\right) + \left(g_{\text{COG}} \times I_{i,\text{COG}}\right),$$

where $I_{i,\text{CSG}}$ is the number of CSG grants received by individual i, and $I_{i,\text{COG}}$ is the number of Co-G grants received by i (which will never be greater than one). The key difference here is that while all individuals share the pre-shock household income, and also share the shock to informal income, only the direct recipient of the CSG (meaning the caregiver) or Co-G receives the emergency relief income, and they individually receive the whole value of the relief.

We find the optimal values for g_{CSG} and g_{COG} by numerically solving the following problem:

$$\begin{aligned} \underset{g_{\text{CSG}}}{\text{minimize}} \quad & \frac{1}{N}\sum_{i=1}^{N} w_{i,j}\left[\frac{\left(z - y_{t+1,i,j}\right)\cdot \mathbb{1}\left(y_{t+1,i,j} < z\right)}{z}\right]^{\alpha} \\ \text{subject to} \quad & g_{\text{COG}} = \frac{\left(B - g_{\text{CSG}} \times \sum^{N_j} n_{j,\text{CSG}}\right)}{\sum^{N_j} n_{j,\text{COG}}} \end{aligned} \tag{3}$$

where z is the upper-bound per person poverty line, $\mathbb{1}$ is the poverty indicator function, α is the FGT_α parameter, B is the total of R8 billion, and $\sum^{N_j}$ denotes summation over each *household* in the population N. The weight $w_{i,j} = 1$ when individual i is an informal-worker household member and $w_{i,j} = \overline{w}$ otherwise, where $0 \leqslant \overline{w} \leqslant 1$. It is apparent that the minimand of (3) is simply the FGT poverty measure of (1), with a weighting $\overline{w}$ attached to the poverty outcomes of those not in informal-worker households. When looking only at informal worker households $\overline{w} = 0$, and when looking at poverty of the general population we have $\overline{w} = 1$. The constraint in (3) indicates that the total spending on the Co-G is determined by the difference between the total budget B and the total spending on the CSG, with the amount per Co-G grant simply being this total Co-G spending divided by the number of Co-G recipients. We numerically solve the minimization problem of (3).

Fig. C1 shows the optimal allocations to the CSG and Co-G when perfect sharing per capita income is used and the policy goal is reducing the FGT_1 poverty gap, but the budget B is allowed to vary. Specifications of both informal-worker household members ($\overline{w} = 0$) and the general population ($\overline{w} = 1$) are shown. As

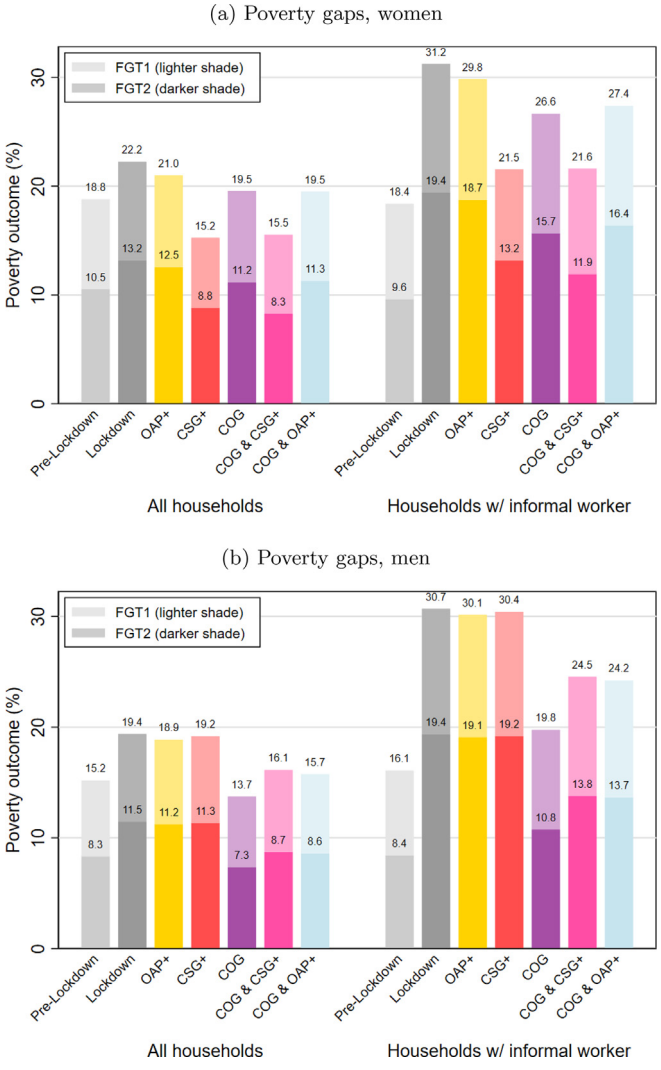


Fig. C3. Poverty impacts without grant-relief sharing, separately for men and women. *Notes*: Figure shows simulated poverty impacts of lockdown when the "no-sharing specification" is applied to emergency grant relief, for men and women separately. See notes to Fig. 5. Poverty is evaluated using per capita household income, but Panel (a) presents poverty outcomes for women only while Panel (b) does the same for men. Authors' calculations using NIDS Wave 5 and post-stratified weight.

expected, poverty decreases as the total emergency relief budget is increased. However while optimal poverty reduction amongst informal-worker household members (Panel (a)) requires roughly linear increases in each of the CSG and Co-G as the budget increases, when general poverty is weighted equally to informal-worker household poverty (Panel (b)) the budget must be quite substantial before any allocation is made to the Co-G. After this point, an increasingly equal allocation between the CSG and Co-G is required, at least up until the maximum budget shown. The total expenditure on emergency relief is itself not a dispassionate technical question, but requires normative judgments about government spending priorities. That the budget itself affects the optimal allocation further complicates any policy recommendation.

Fig. C2 shows how the choice of weight $\overline{w}$ affects the optimal allocation with a fixed budget and varying values for weight $\overline{w}$, with the per capita FGT_1 specification. Perhaps surprisingly, a very low weight on the poverty of those not in informal-worker households ($\overline{w} = 0.2$) is sufficient for the entire budget to be allocated to the CSG.

Appendix D. Poverty effects by co-resident income support

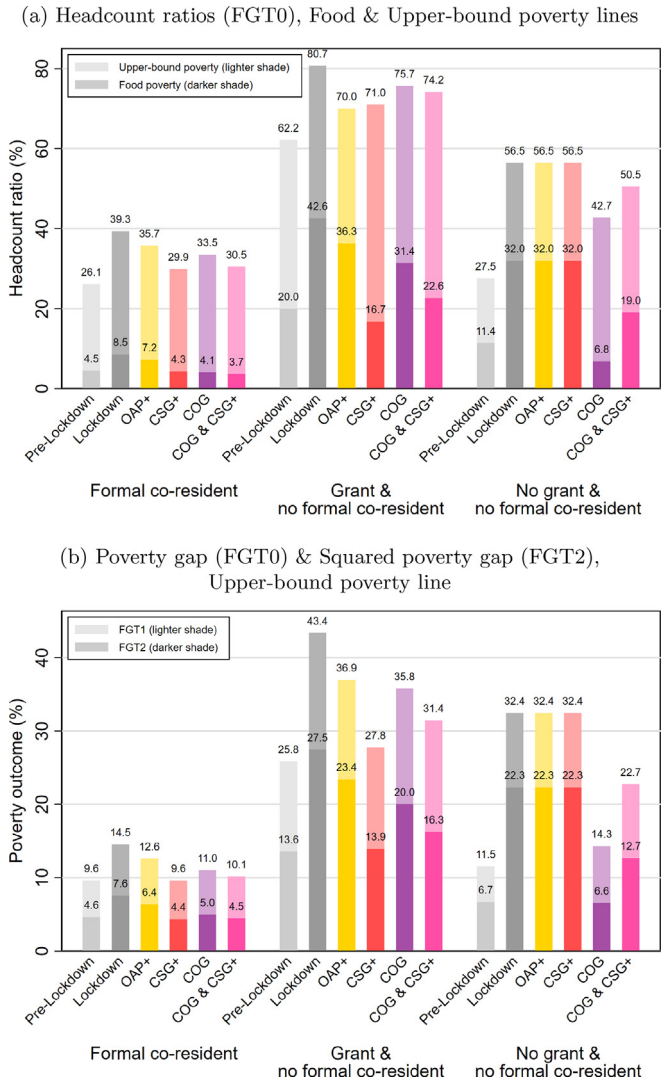


Fig. D1. Poverty impacts for informal-worker households, by lockdown scenario and additional household income support. *Notes*: Figure shows simulated poverty impacts of lockdown on informal-worker household members, for different subgroups of informal-worker households by additional income support, when a total budget of R8 billion per month is separately assigned to each social assistance (grant) intervention. "OAP+" (yellow) is an increase in each Old Age Pension of R2444 per month, "CSG+" (red) is an increase in each Child Support Grant (CSG) by R636 per month (per child), "Co-G" (purple) is the introduction of a Special COVID-19 Grant (Co-G) at the value of R526 per month, and "COG & CSG+" (pink) is a simultaneous increase in the CSG of R318 per month and the introduction of a Co-G at R263 per month. See notes to Table 4 for additional details on the income-support subgroups. Poverty impacts are simulated by imposing a lockdown shock of 75% loss of income from informal work, and then applying the various interventions. Panel (a) presents the headcount ratio (FGT0) for the Upper-bound Poverty Line (light shade) and Food Poverty Line (dark shade). Panel (b) presents the Poverty Gap (FGT1, light shade) and Squared Poverty Gap (FGT2, dark shade), using the Upper-Bound Poverty Line. Informal-worker households are households which include an informal worker. Poverty is evaluated using per capita household income. Authors' calculations using NIDS Wave 5 and post-stratified weight. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Appendix E. Coverage of combined OAP and Co-G, by decile

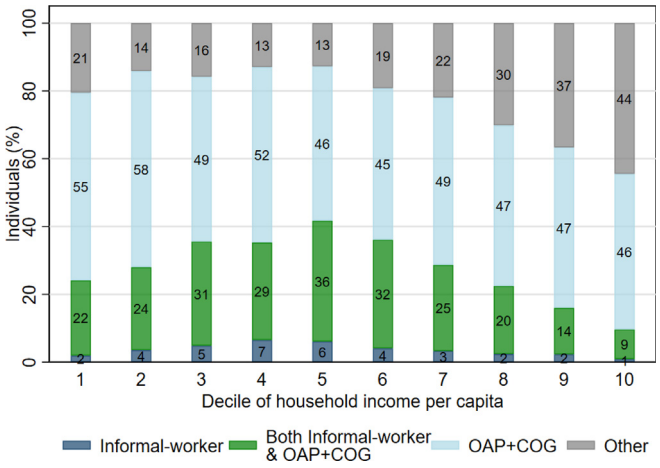


Fig. E1. Coverage of OAP + Co-G, by decile. *Notes*: Figure shows coverage of by at least one of the OAP or the Co-G grants, for all individuals by decile of per capita household income. Particular attention is placed on coverage of informal-worker household members. Informal-worker households are households which include an informal worker. Each bar consists of four exhaustive and mutually exclusive sets of individuals: those in informal-worker households which do not have a co-resident grant recipient (blue), those in informal-worker households which do have a co-resident grant recipient (green), those in households which have a co-resident grant recipient but no informal worker (various colours), and those in households with neither informal workers nor grant recipients (grey). Authors' calculations using NIDS Wave 5 and post-stratified weight. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

References

Abel, M. (2019). Unintended Labor Supply Effects of Cash Transfer Programs: New Evidence from South Africa's Pension. *Journal of African Economies, 28*(5), 558–581.

Adams-Prassl, A., Boneva, T., Golin, M., & Rauh, C., 2020. Inequality in the Impact of the Coronavirus Shock: Evidence from Real Time Surveys. Working Paper 13183. IZA Institute of Labour Economics.

Aguero, J., Carter, M., & Woolard, I. (2007). The impact of unconditional cash transfers on nutrition: The South African Child Support Grant. *SALDRU Working Paper Series, 39*.

Aizer, A. (2010). The gender wage gap and domestic violence. *American Economic Review, 100*(4), 1847–1859.

Alon, T., Doepke, M., Olmstead-Rumsey, J., & Tertilt, M., 2020. The Impact of COVID-19 on Gender Equality. Working Paper 26947. National Bureau of Economic Research, Apr. 2020.

Anderson, S., & Eswaran, M. (2009). What determines female autonomy? Evidence from Bangladesh. *Journal of Development Economics, 90*(2), 179–191.

Ardington, C., Case, A., & Hosegood, V. (2009). Labor supply responses to large social transfers: Lon-gitudinal evidence from South Africa. *American Economic Journal: Applied Economics, 1*(1), 22–48.

Arnall, A., Furtado, J., Ghazoul, J., & De Swardt, C. (2004). Perceptions of informal safety nets: A case study from a South African informal settlement. *Development Southern Africa, 21*(3), 443–460.

Attanasio, O., & Lechene, V. (2002). Tests of the income pooling in household decisions. *Review of Economic Dynamics, 5*(4), 720–748.

Bartik, A., Bertrand, M., Cullen, Z., Glaeser, E., Luca, M., & Stanton, C., 2020. How Are Small Busi-nesses Adjusting to COVID-19? Early Evidence From a Survey. Working Paper 26989. National Bureau of Economic Research.

Bassier, I., Budlender, J., Leibbrandt, M., Ranchhod, V., & Zizzamia, R. (2020). South Africa can - and should - top up child support grants to avoid a humanitarian crisis. *The Conversation*.

Bertrand, M., Mullainathan, S., & Miller, D. (2003). Public policy and extended families: Evidence from pensions in South Africa. *The World Bank Economic Review, 17*(1), 27–50.
Besley, T., & Kanbur, R. (1991). The Principles of Targeting. In *Current Issues in Development Economics* (pp. 69–90). Springer.
Bibi, S., & Duclos, J. (2007). Equity and policy effectiveness with imperfect targeting. *Journal of Development Economics, 83*(1), 109–140.
Branson, N., 2019. Adding a Top-Up Sample to the National Income Dynamics Study in South Africa. Technical Note no. 8. Cape Town: Southern African Labour and Development Research Unit. URL: https://www.datafirst.uct.ac.za/dataportal/index.php/catalog/712/download/ 10139.
Branson, N. & Wittenberg, M., 2019. Longitudinal and Cross-Sectional Weights in the NIDS Data 1–5. Technical Note no. 9. Cape Town: Southern African Labour and Development Research Unit. URL: https://www.datafirst.uct.ac.za/dataportal/index.php/catalog/712/download/ 10140.
Brophy, T., Branson, N., Daniels, R., Leibbrandt, M., Mlatsheni, C., & Woolard, I., 2018. National Income Dynamics Study Panel User Manual. Technical Note Release 2018. Version 1. Southern Africa Labour and Development Research Unit. URL: https://www.datafirst.uct.ac.za/dataportal/index.php/catalog/712.
Browning, M., Bourguignon, F., Chiappori, P., & Lechene, V. (1994). Income and outcomes: A structural model of intrahousehold allocation. *Journal of Political Economy, 102*(6), 1067–1096.
Carter, M., & May, J. (2001). One kind of freedom: Poverty dynamics in post-apartheid South Africa. *World Development, 29*(12), 1987–2006.
Case, A., & Deaton, A. (1998). Large cash transfers to the elderly in South Africa. *The Economic Journal, 108*(450), 1330–1361.
Chatterjee, A., Czajka, L., & Gethin, A., 2020. Estimating The Distribution Of Household Wealth In South Africa. Working Paper 2020/45. UNU-WIDER.
Coibion, O., Gorodnichenko, Y., & Weber, M., 2020. Labor Markets During the COVID-19 Crisis: A Preliminary View. Working Paper 27017. National Bureau of Economic Research.
Deaton, A., & Muellbauer, J. (1986). On measuring child costs: With applications to poor countries. *Journal of Political Economy, 94*(4), 720–744.
Deaton, A., & Paxson, C. (1998). Economies of scale, household size, and the demand for food. *Journal of Political Economy, 106*(5), 897–930.
Department of Labour, Republic of South Africa, 2020. COVID-19 Temporary Employee/Employer Relief Scheme (C19 TERS). Notice 215 of 2020. Policy Document. Mar. 26, 2020. url: https://www.gov.za/sites/default/files/gcis_document/202003/43161gen215.pdf (visited on 04/25/2020).
Dercon, S. (2002). Income risk, coping strategies, and safety nets. *The World Bank Research Observer, 17*(2), 141–166.
Devereux, S., 2016. Social protection for the poor: lessons from recent international experience. Working Paper 142. Institute of Development Studies.
Di Falco, S., & Bulte, E. (2011). A dark side of social capital? Kinship, consumption, and savings. *Journal of Development Studies, 47*(8), 1128–1151.
Dominic Brown, 2020. "Universal basic income – an idea whose time has come. In: Daily Maverick (May 25, 2020). url: https://www.dailymaverick.co.za/article/2020-05-25-universal-basic-income-an-idea-whose-time-has-come/ (visited on 10/11/2020).
Doss, C. (2013). Intrahousehold bargaining and resource allocation in developing countries. *The World Bank Research Observer, 28*(1), 52–78.
Dufo, E. (2003). Grandmothers and granddaughters: old-age pensions and intrahousehold allocation in South Africa. *The World Bank Economic Review, 17*(1), 1–25.
Du Toit, A. & Neves, D., 2007. In search of South Africa's 'second economy': Chronic poverty, economic marginalization, and adverse incorporation in Mt Frere and Khayelitsha. Working Paper 102. Cape Town: Programme for Land and Agrarian Studies., 2007. url: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1629206.
Ebrahim, A., 2020. Covid-19 And Socioeconomic Impact In Africa: The Case Of South Africa. Background Note 2. UNU-WIDER.
Eyal, K. & Woolard, I., 2013. School enrolment and the child support grant: Evidence from South Africa. Working Paper 125. Southern Africa Labour and Development Research Unit, 2013.
Ferguson, J. (2015). *Give a man a fish: Reflections on the new politics of distribution*. Duke University Press.
Fields, G., 1990. Labour market modelling and the urban informal sector: Theory and evidence. Tech. rep. Paris: Organisation for Economic Co-operation and Development, pp. 49–69. url: https://digitalcommons.ilr.cornell.edu/articles/464/.
Finn, A. & Leibbrandt, M., 2017. The dynamics of poverty in South Africa (updated, version 3). In: SALDRU Working Paper Series 174 (2017).
Foster, J., Greer, J., & Thorbecke, E. (1984). A Class of Decomposable Poverty Measures. *Econo-metrica, 52*(3), 761–766.
Gentilini, U., Almenfi, M., Dale, P., Blomquist, J., Natarajan, H., Galicia, G., Palacios, R., & Desai, V., 2020. Social Protection and Jobs Responses to COVID-19: A Real-Time Review of Country Measures (May 22 version). Live Document. World Bank, Washington, DC. URL: https://www.ugogentilini.net/.
Gentilini, U., Almenfi, M., Dale, P., Demarco, G., Blomquist, J., Palacios, R., Desai, V., & Moreira, V., 2020. Social Protection and Jobs Responses to COVID-19: A Real-Time Review of Country Measures (May 15 version). Live Document. World Bank, Washington, DC. URL: https://www.ugogentilini.net/wp- content/uploads/2020/05/Country- SP- COVID- responses_May15.pdf.
Gentilini, U., Almenfi, M., Dale, P., Demarco, G., & Santos, I., 2020. Social Protection and Jobs Responses to COVID-19: A Real-Time Review of Country Measures (May 1 version). Live Document. World Bank, Washington, DC. URL: https://www.ugogentilini.net/wp-content/uploads/2020/05/Country-SP-COVID-responses_May1.pdf (visited on 05/01/2020).
Gerard, F., Imbert, C., & Orkin, K., 2020 Social Protection Response to the COVID-19 Crisis: Options for Developing Countries. Policy Brief. Economics for Inclusive Prosperity. URL: https://econfip.org/policy- brief/social- protection- response-to- the- covid- 19- crisis-options-for-developing-countries/.
Greiner, C. (2010). Patterns of translocality: Migration, livelihoods and identities in Northwest Namibia. *Sociologus*, 131–161.
Grosh, M. & Baker, J., 1995. Proxy means tests for targeting social programs: simulations and speculation. Working Paper. World Bank, Washington, DC. url: https://elibrary.worldbank.org/doi/pdf/10.1596/0-8213-3313-5.
Gustafsson, M., 2020. How does South Africa's Covid-19 response compare globally? A preliminary analysis using the new OxCGRT dataset. Working Paper. ReSEP, University of Stellenbosch.
Hamoudi, A., & Thomas, D. (2014). Endogenous coresidence and program incidence: South Africa's old age pension. *Journal of Development Economics, 109*, 30–37.
Hussmanns, R., 2004. Measuring the informal economy: From employment in the informal sector to informal employment. Working Paper 53. Policy Integration Department, Bureau of Statistics. Geneva, International Labour Organisation. URL: https://www.ilo.org/wcmsp5/groups/public/—dgreports/—integration/documents/publication/wcms_079142.pdf.
International Labour Organisation, 2003. Guidelines concerning a statistical definition of informal employment. In: (2003). url: https://www.ilo.org/wcmsp5/groups/public/—dgreports/—stat/documents/normativeinstrument/wcms_087622.pdf (visited on 04/21/2020).
International Labour Organisation, 2018. Women and men in the informal economy: A statistical picture. Third edition. Tech. rep. 2018. url: https://www.ilo.org/wcmsp5/groups/public/—dgreports/—dcomm/documents/publication/wcms_626831.pdf.
International Labour Organisation, 2020. COVID-19 crisis and the informal economy: Immediate responses and policy challenges. Brief. URL: https://www.ilo.org/wcmsp5/groups/public/@ed_protect/@protrav/@travail/documents/briefingnote/wcms_743623.pdf.
International Labour Organisation, 2020. ILO Monitor: COVID-19 and the world of work. Third edition. Report. URL: https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/documents/briefingnote/wcms_743146.pdf.
Kanbur, R., 2016. Intra-Household Inequality and Overall Inequality. Discussion Paper DP11719. CEPR. URL: https://ssrn.com/abstract=2893072.
Kerr, A. (2018). Job flows, worker flows and churning in South Africa. *South African Journal of Economics, 86*, 141–166.
Klasen, S. (2000). Measuring poverty and deprivation in South Africa. *Review of Income and Wealth, 46*(1), 33–58.
Lanjouw, P., & Ravallion, M. (1995). Poverty and household size. *The Economic Journal, 105*(433), 1415–1434.
La Porta, R., & Shleifer, A. (2014). Informality and development. *Journal of Economic Perspectives, 28*(3), 109–126.
Leibbrandt, M., Woolard, I., Finn, A., & Argent, J., 2010 Trends in South African Income Distribution and Poverty since the Fall of Apartheid. In: Working Paper Series 101.
Mahler, D., Laknner, C., Aguilar, A., & Wu, H., 2020. The impact of COVID-19 (Coronavirus) on global poverty: Why Sub-Saharan Africa might be the region hardest hit. Blog. The World Bank. URL: https://blogs.worldbank.org/opendata/impact-covid-19-coronavirus-global-poverty-why-sub-saharan-africa-might-be-region-hardest.
Makiwane, M. (2010). The child support grant and teenage childbearing in South Africa. *Development Southern Africa, 27*(2), 193–204.
Mary Burton. "Why all South Africans should back a basic income grant. In: Business Day (Apr. 16, 2020). url: https://www.businesslive.co.za/bd/opinion/2020- 09-13- why-all-south-africans-should-back-a-basic-income-grant/ (visited on 10/11/2020).
Ministry of Finance of the Republic of Namibia, 2020. LAUNCH STATEMENT: Emergency Income Grant of the Economic Stimulus and Relief Package, issued by Ipumbu Shiimi, MP. Policy Document. URL: https://mof.gov.na/documents/35641/36580/Launch+Statement+EIG+of+the+COVID-19+Economic+Stimulus+Package.pdf.pdf/1c4c320b-efae-72f4-6cb6-2942923fdc12.
Naudé Malan, 2020. A basic income grant will transform the South African social security system. In: Daily Maverick (Aug. 19, 2020). url: https://www.dailymaverick.co.za/article/2020-08-19-a-basic-income-grant-will-transform-the-south-african-social-security-system/(visited on 10/11/2020).
Neves, D., & Du Toit, A. (2013). Rural Livelihoods in South Africa: Complexity, Vulnerability and Differentiation. *Journal of Agrarian Change, 13*(1), 93–115.
Philip, K., 2020. Support for jobs in the informal sector: The case for a special Covid-19 grant. In: Daily Maverick (Mar. 22, 2020). url: https://www.dailymaverick.co.za/article/2020-03-22-support-to-jobs-in-the-informal-sector-the-case-for-a-special-covid-19-grant/(visited on 03/25/2020).
Posel, D. (2001). How do households work? Migration, the household and remittance behaviour in South Africa. *Social Dynamics, 27*(1), 165–189.
Posel, D., Fairburn, J., & Lund, F. (2006). Labour migration and households: A reconsideration of the effects of the social pension on labour supply in South Africa. *Economic Modelling, 23*(5), 836–853.
Ranchhod, V. (2006). The effect of the South African old age pension on labour supply of the elderly. *South African Journal of Economics, 74*(4), 725–744.
Ravallion, M., 1998. Poverty Lines in Theory and Practice. The World Bank.
Rogan, M. & Skinner, C., 2017. Employment in the South African informal sector: Interrogating trends, identifying opportunities. In: Tackling Unemployment and Poverty in South Africa: The Contribution of the Informal Sector. Cape Town: HSRC (2017).

Sanchez-Paramo, C., 2020. COVID-19 will hit the poor hardest. Here's what we can do about it. Blog. The World Bank. URL: https://blogs.worldbank.org/voices/covid-19-will-hit-poor-hardest-heres-what-we-can-do-about-it.

Schotte, S., Zizzamia, R., & Leibbrandt, M. (2018). A poverty dynamics approach to social stratification: The South African case. *World Development, 110*, 88–103.

Seekings, J., & Nattrass, N. (2015). Policy, Politics and Poverty in South Africa. *Palgrave MacMillan*.

South African Social Security Agency, 2018. SASSA Annual Performance Report. 2018/19. Annual Report. URL: https://www.sassa.gov.za/annual%5C%20reports/Documents/SASSA%5C%20Annual%5C%20Report%5C%202018-2019.pdf (visited on 04/20/2020).

Special Covid Grant Working group, 2020. Economic Mitigation and Relief Measures for COVID-19: A Proposal for a Special COVID Grant, url = URL: https://covid19economicideas.org/wp-content/uploads/2020/04/Special-Covid-19-Grant-Proposal-full-version-17-April-2020.pdf.

Statistics South Africa, 2019. National Poverty Lines. Statistical Release P0310.1. Statistics South Africa.

Strauss, J., & Thomas, D. (1998). Health, nutrition, and economic development. *Journal of Economic Literature, 36*(2), 766–817.

Sumner, A., Hoy, C., & Ortiz-Juarez, E., 2020. Estimates Of The Impact Of Covid-19 On Global Poverty. Working Paper 43. UNU-WIDER.

The Presidency, Republic of South Africa, 2020. Statement by President Cyril Ramaphosa on further economic and social measures in response to the COVID-19 epidemic. Apr. 21, 2020. url: http://www.thepresidency.gov.za/speeches/statement-president-cyril-ramaphosa-further-economic-and-social-measures-response-covid-19 (visited on 04/25/2020).

Theron, J. (2010). Informalization from above, informalization from below: The options for organization. *African Studies Quarterly, 11*(2-3), 87–105.

Triegaardt, J. (2005). The Child Support Grant in South Africa: A social policy for poverty alleviation? *International Journal of Social Welfare, 14*(4), 249–255.

Van deWalle, D. (1998). Targeting revisited. *The World Bank Research Observer, 13*(2), 231–248.

Woolard, I., & Klasen, S. (2005). Determinants of income mobility and household poverty dynamics in South Africa. *Journal of Development Studies, 41*(5), 865–897.

Woolard, I., & Leibbrandt, M. (2013). The evolution and impact of unconditional cash transfers in South Africa. In L. Harrison, J. Lin, & C. Sepulveda (Eds.), *Development Challenges in a Postcrisis World*. Washington DC: World Bank.

Zizzamia, R., 2020. Is employment a panacea for poverty? A mixed-methods investigation of employment decisions in South Africa. In: World Development 130 (2020) 104938. doi: 10.1016/j.worlddev.2020.104938.

Zizzamia, R., Schotte, S., & Leibbrandt, M., 2020. Snakes and ladders and loaded dice: Poverty dynamics and inequality in South Africa, 2008–2017. Working Paper 33. UNU-WIDER, Apr. 2020.