

# Reducing Debt Improves Psychological Functioning and Changes Decision Making in the Poor\*

Qiyang Ong<sup>a\*\*</sup>, Walter Theseira<sup>b</sup>, Irene Y.H Ng<sup>c</sup>

<sup>a</sup> Social Service Research Centre, National University of Singapore, Singapore

<sup>b</sup> School of Business, Singapore University of Social Sciences, Singapore

<sup>c</sup> Department of Social Work, National University of Singapore, Singapore

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PRELIMINARY

Abstract

We study how changes in indebtedness and resources affect psychological functioning and decision making. Highly indebted low-income households in Singapore benefited from a one-off, unanticipated debt relief program worth several months' household income. We measured household finances, anxiety, cognitive functioning, and economic decision making pre- and post- debt relief. Debt relief significantly improved cognitive functioning and reduced anxiety, risk aversion, and present bias. We test the hypothesis that poverty-induced impairments in psychological functioning alter economic decision making. Reducing cognitive bandwidth taxes by eliminating debt accounts significantly reduces present bias, but changes in absolute scarcity, performance in inhibitory control tasks and anxiety are unrelated to economic decision making. Interventions targeting cognitive bandwidth taxes could be more effective at alleviating poverty than providing untargeted transfers.

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\* Preliminary. Please do not circulate, but kindly refer interested parties to the corresponding author. We apologize in advance to the many parties who have contributed to our project for not including acknowledgements in this draft.

\*\* *Corresponding Author:* Qiyang Ong, Social Service Research Centre, National University of Singapore, Ventus, 8 Kent Ridge Drive, #03-01, S(119246), Tel.: +65 66013430. Email: qiyangong@gmail.com

## 1 Introduction

Conventional policy on poverty often targets material scarcity, especially in the developing world. Efforts to provide access to food, clean water, and basic healthcare have helped achieved several targets in the Millennium Development Goals (United Nations 2000), although much work remains. But building the capacity of the poor to escape poverty has proven much harder, even in the developed world, where poverty often remains entrenched despite considerable resources being devoted to welfare programs. Recent studies have proposed a novel explanation for the persistence of poverty traps: poverty itself impairs the quality of decision making, by sapping cognitive resources and causing stress and anxiety (Bertrand et al., 2004; Baer et al., 2012; Shah et al., 2012; Mani et al., 2013; Haushofer and Fehr, 2014; Carvalho et al., 2016; Dean et al., 2017). Poverty may adversely affect decision making and psychological functioning directly, as when deprivation through inadequate food and shelter harms physiological functioning. But poverty may also affect behaviour because the poor spend considerable time and attention simply managing the day-to-day demands of life under scarcity, and have little mental ‘bandwidth’ remaining to make better decisions on health, education, investment, and employment. Under this view, the risky and impatient decisions made by the poor may be rooted in scarcity-driven deficits in cognitive and psychological functioning (Lawrance, 1991).

Understanding whether and how scarcity harms psychological functioning is important for informing interventions designed to alleviate poverty. However, the current evidence is mixed. While the rural poor in India experience significant impairment to cognitive functioning over the annual harvest cycle (Mani et al. 2013), no such effects are found in the urban poor in the United States over the payday cycle (Carvalho et al. 2016). This raises questions on whether the impact of scarcity on functioning is generalizable – especially to developed contexts where material scarcity is less severe – and whether material scarcity, or bandwidth deficits, matter more.

We address this question by studying the effects of a significant and unanticipated positive wealth shock provided by a one-off debt relief program targeted at highly indebted low-income households in Singapore. Low-income households often owe extensive debts for daily living expenses such as rent and utilities; the average household in our study owed more than two months’ household income in arrears. Debt relief generated a sharp quasi-experimental change in financial resources worth several months’ household income, which allows us to identify the causal relationship between poverty, psychological functioning and decision-making.

We find that participants exhibit improved cognitive functioning, and reduced anxiety, risk aversion, and present bias after receiving debt relief. This supports the hypothesis that scarcity causes significant harms to psychological functioning and alters decision making, and also demonstrates realistic interventions can remedy these deficiencies. Our results also reconcile contrasting evidence from the literature, and suggest that significant shocks to scarcity are required to produce detectable impacts on cognitive functioning (Mani et al. 2013), particularly in developed economies where social safety nets may render the effects of small payday cycles on the urban poor less significant (Carvalho et al. 2016).

To further understand why some scarcity shocks may produce functional changes in the poor, and others do not, we conduct two additional analyses. First, we study how the extent and structure of the scarcity shock matters, distinguishing between the effects of bandwidth taxes, and that of material scarcity. Previous studies generally examine aggregate changes in financial resources (Mani et al. 2013; Carvalho et al. 2016), potentially conflating the effects

of material scarcity with that of bandwidth taxes. The design of the debt relief program provides exogenous variation in financial resources, as well as variation in a novel direct measure of bandwidth taxes: debt accounts, which vary with the number of creditors that the participant owes money to. Each creditor requires costly management to forestall legal action or the loss of key services such as electricity. Eliminating a debt account also eliminates any bandwidth taxes associated with having to manage that particular creditor – allowing us to directly test for the importance of bandwidth taxes while controlling for the absolute change in debt levels.

Second, we examine the causal chain between poverty, psychological functioning and economic decision making in the field. Substantial laboratory and observational evidence suggests poverty changes psychological functioning, which in turn alters economic decision making, leading to greater risk aversion and present bias (Raghunathan and Pham, 1999; Dohmen et al., 2010; Haushofer et al., 2014). However, these studies either rely on simulating poverty in the lab, or on comparing poor and non-poor populations. Our field study has a poor population experiencing a financial shock that directly improves psychological functioning, allowing us to test whether the induced change in psychological functioning alters economic decision making.

We find strong evidence that cognitive bandwidth taxes are a key mechanism explaining why poverty reduces cognitive functioning, increases anxiety, and ameliorates present bias. In contrast, changes in resource scarcity have muted effects, and poverty-induced impairments in psychological functioning – specifically, in inhibition control and anxiety – do not alter economic decision making. To give a sense of the significance of bandwidth taxes, eliminating one debt account improves cognitive functioning by a comparable amount to reducing aggregate debt by SGD1238. Eliminating a debt account significantly reduces anxiety, whereas the amount of aggregate relief has no impact on negative affect whatsoever. While these results strongly support the bandwidth tax mechanism, they also indicate further work is needed to understand whether other aspects of impaired psychological functioning are the direct causes of changes in economic decision making in the poor.

The remaining paper is structured as follows. Section 2 provides the details of our field study. Results of our study are provided in sections 3 and 4. Section 3 presents the causal evidence on the impact of debt relief and compares our findings with the other field studies of Mani et al. (2013) and Carvalho et al. (2016). Section 4 will focus on the mechanics of how poverty affects psychological functioning and economic decision-making. The final section concludes.

## **2 Field Study**

### **2.1 Debt relief program**

In 2015, a Singapore-based charity, Methodist Welfare Services, administered a one-off debt relief program targeted at chronically indebted low-income Singapore resident households.<sup>1</sup> Participation was restricted to households with monthly per capita incomes of less than

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<sup>1</sup> Although the charity is affiliated with the Methodist Church, charitable institutions in Singapore are required to serve the general public to qualify for tax-exempt status. Program recipients were representative of low-income households in Singapore.

SGD1500, and who had outstanding eligible chronic debts of at least six months' duration.<sup>2</sup> Eligible debts included housing arrears (mortgage or rental), utilities arrears, town council arrears, telco arrears and hire purchase arrears. Other types of debt were considered on a case by case basis. In particular, unsecured consumer debts were generally excluded because such debts are rare amongst low-income households in Singapore due to income-based restrictions on credit access, and because the charity targeted debts attributable to non-discretionary spending.

The program was administered through a network of Family Service Centres, which provide local social services to vulnerable families throughout Singapore. Family Service Centres are operated by charities and are financially supported by the Singapore Government, which assigns centres to serve specific geographic areas.<sup>3</sup> While Family Service Centres provide ad-hoc financial assistance, major welfare programmes are administered directly by Government agencies.

Family Service Centre social workers had broad discretion to identify and endorse eligible clients and specific debts for relief. No direct applications from clients were accepted, and all endorsed applications were approved by the charity's headquarters before relief was granted. Thus, while clients with greater outstanding debts generally received more relief (up to the program limit of SGD5000), there is extensive idiosyncratic variation in both the amount of relief granted, and in the number of debt accounts paid off.

The debt relief program attracted 656 applications, of which 94% were approved. Program payouts were consistent with the eligible debt guidelines, with 593 beneficiaries (95% of all approved applications) receiving debt reduction in at least one eligible debt type. We study only clients who received all relief dollars in eligible debts, as other relief granted suggests circumstances were exceptional for reasons we do not observe.

The three most common debt types paid were utilities (52%), housing (43%) and telco (33%). Beneficiaries received debt relief ranging from SGD75.50 to SGD5000; the average was SGD2394, and the median SGD1994. Twenty one percent of beneficiaries received the maximum debt relief of SGD5000. Beneficiaries did not receive cash transfers, as the charity paid creditors directly. Program administrators generally paid off entire debt accounts if possible, instead of spreading relief evenly across all outstanding accounts.<sup>4</sup> Approximately 45% of beneficiaries had two or more debt accounts paid off.

## 2.2 Survey sample

Due to personal data protection laws, we were unable to directly solicit study participation from a master list of all applicants to the debt relief program. Instead, we worked with Family Service Centres to refer applicants to our study.<sup>5</sup> At the time of recruitment and referral,

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<sup>2</sup> The per-capita income limit of SGD1500 means households in the lowest three deciles of the income distribution in Singapore would qualify for the program. Household per-capita income in the third decile in 2015 was SGD1446. (Department of Statistics Singapore 2016)

<sup>3</sup> As Family Service Centres serve a specific geographic area, clients are generally not permitted to 'shop around' to receive services from a Centre serving a neighbouring region.

<sup>4</sup> A debt account is defined as one specific account in arrears owed to one creditor. For instance, arrears owed to two separate phone companies are considered two debt accounts. For more details on how debt account data was constructed from program administrative records and the survey, please see the appendix.

<sup>5</sup> The referral process follows: Methodist Welfare Services (the program administrator) requested that participating Family Service Centres and social workers obtain consent from clients to be referred to the study. Social workers were told that consent to be referred to the study was voluntary and would not affect program

beneficiaries knew that they had applied for the debt relief program, but were unaware of program approval.<sup>6</sup> Several months had elapsed between program application and the study recruitment date.

Our study design consists of a comprehensive household financial survey, augmented with measures of psychological and cognitive functioning. Study participants were provided with compensation for their time, and economic decision making tasks were incentivized. The study's first wave was designed to capture data pre-debt relief, while the second wave captured data three months post-debt relief.

Our first wave captured data on 241 debt relief program participants; the second wave successfully followed-up with 238 participants. However, our analysis excludes participants with incomplete data on household finances, psychological functioning, or economic decision making.<sup>7</sup> We also excluded 29 participants who received relief for 'non-eligible' debts, as their debts are unrepresentative of typical low-income household finances, and because their circumstances must have been exceptional for program administrators to approve relief. As the distribution of household debt is skewed with a few participants reporting very large debts, we exclude those with pre-relief debt levels above the 95<sup>th</sup> percentile. Our analysis sample consists of a balanced panel of 175 participants.

Table 1 reports income and debt characteristics of our sample. In general, our sample is representative of very low-income, vulnerable households in Singapore. Prior to debt relief, average household income per capita conditional on employment income was SGD359, compared to SGD541 for the first income decile in Singapore.<sup>8</sup> 17% reported zero household income from work, although such households typically receive some public assistance.<sup>9</sup> Income characteristics three months after debt relief are similar.

Pre-debt relief, the average debt was SGD3780, and the median SGD2949. The median household (conditional on having positive income) owed approximately 1.77 times total monthly household income in debts. On average, households had 3.17 debt accounts outstanding. Participants received an average debt relief of SGD2319, with 19% receiving the maximum debt reduction of SGD5000. Participants' debt relief amounts are broadly comparable to those received by program beneficiaries in general.<sup>10</sup>

Our survey shows that debt relief provides an effective wealth shock and significantly alleviates scarcity. Three months post-debt relief, the average debt level fell from SGD3782

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eligibility or program benefits. We then contacted these referred clients and obtained informed consent to participate in the study. We had no direct contact with family service centres and their social workers throughout the referral process.

<sup>6</sup> At the time of study recruitment, we were informed by the program administrator that all valid applications with eligible debts would be approved up to the per-beneficiary relief cap of SGD 5,000. As far as we know, applicants were not told prior to the official announcement of results that their applications were highly likely to be approved.

<sup>7</sup> As is standard for household surveys, participants could refuse to answer questions without penalty. We included participants with missing data, as long as the participant answered all questions on household finances, psychological and cognitive functioning, and economic decision making.

<sup>8</sup> Department of Statistics Singapore, 1<sup>st</sup> to 10<sup>th</sup> Decile, Average Monthly Household Income from Work Per Household Member Among Resident Employed Households, 2015.

<sup>9</sup> While our survey asked about income from various sources, the table reports only income from work. In general, households in Singapore have more difficulty recalling and reporting income from Government transfers and non-work sources, compared to work income.

<sup>10</sup> The program administrator provided us with administrative data on the debt amounts, types, and relief granted for all beneficiaries.

to SGD1944, while 90% of participants reported holding less debt. Average outstanding debt accounts fell from 3.17 to 1.30<sup>11</sup>. The data suggest partial conversion of debt relief transfers into consumption, as there is an average net difference of SGD483 between the debt relief amount, and the actual change in debt held three months after relief.

**Table 1. Summary Statistics of Study Participants Pre- and Post-Debt Relief**

Variables	Statistics	Pre Debt Relief	Post Debt relief
Total debt (SGD)	Mean	3782	1944
	SD	2938	2668
Number of debt accounts outstanding	Mean	3.17	1.30
	SD	1.34	1.29
Debt relief amount (SGD)	Mean		2319
	SD		1587
Debt relief accounts paid off in full	Mean		1.68
	SD		0.91
Proportion of participants with zero household income per capita	%	17%	15%
Household income per capita (SGD) (for households with at least one working member)	Mean	359	371
	SD	204	222
Household Size <sup>1</sup>	Mean	4.91	4.86
	SD	1.98	2.00
Employed (participants)	%	53%	60%
Female (participants)	%	78%	78%
Number of id		175	175

### 2.3 Identification

Because debt relief is capped by the lower of eligible debts or SGD5000, households with greater debt at program application receive more relief on average. This potentially affects our analysis if household debt is endogenous with respect to psychological functioning and economic decision making – that is, if individuals with low self-control and greater present bias hold more debt. While this would pose a challenge to any cross-sectional study of debt and functioning, we are less concerned in our context because our study relies on exploiting the quasi-experimental exogenous change in household debt from the debt relief intervention.

The first part of our analysis produces an internally valid estimate because it compares psychological functioning and decision making in the same individual, before and after debt relief. External validity is in our view also high, because our study participants are similar to non-participant debt relief beneficiaries, in terms of debt levels. Moreover, poverty goes hand in hand with debt: worldwide, a substantial fraction of extremely poor households owe outstanding debts (Banerjee and Duflo 2007).

<sup>11</sup> Our study’s main results hold even if we exclude from the analysis participants who reported a net aggregate increase in debt after the intervention.

The second part of analysis considers the effect of the amount and type of debt relief granted on psychological functioning and decision making. The analysis does not use participants' actual debt levels, which may be endogenous, but uses debt relief granted instead. There is considerable residual variation in debt relief amounts even after accounting for the fact that granted debt relief tracks eligible debt. Social workers and program administrators made decisions independently on which eligible debts to apply for relief, and how much relief to grant, respectively. The correlation coefficient between debt relief and eligible debts is moderate at 0.63, even when considering only participants whom in principle could have received full debt relief because their total eligible debts were worth less than SGD5000. In fact, more than two-thirds of our analysis sample received debt relief amounts that differed by more than 10% from their eligible debt: the average difference between eligible debts, and the amount of debt relief granted, was SGD1463, and the standard deviation of the difference was SGD2168. Robustness checks show that our results all hold even if the one-third of participants who received practically the same amount of relief as eligible debts, representing the most endogenous part of our sample, were excluded from the analysis. While we acknowledge that a randomized debt relief intervention would avoid these concerns, we were not able to implement such a design.

### **3 Causal impacts of debt relief**

We measure cognitive and affective aspects of psychological functioning, as previous studies argue that these aspects may independently affect decision making of the poor (Shah et al., 2012; Mani et al., 2013 and Haushofer and Fehr, 2016). To measure economic decision making, we use incentivized risk aversion and time discounting tasks, following on findings that the poor are more likely to be risk averse and present biased (Lawrence, 1991; Guiso et al., 2008; Tanaka et al., 2010).

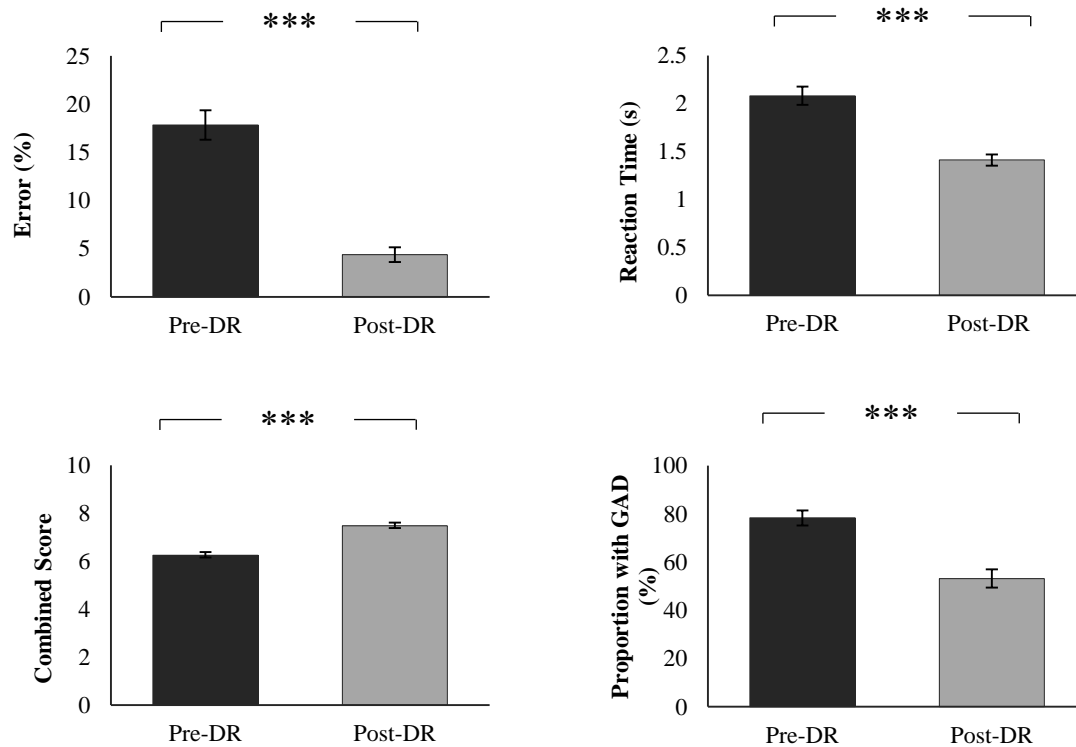
#### **3.1 Psychological functioning**

We measured cognitive functioning using the Eriksen Flanker test, a standard inhibition control task incorporated in the NIH toolbox (Zelazo et al. 2013), and also used in Carvalho et al. (2016). In each test trial, a central stimulus is presented, together with potentially distracting surrounding stimuli ("Flankers"). The participant must consciously ignore the distracting stimuli to identify the central stimulus quickly and accurately. Each Flanker test consisted of 20 trials. Following Zelazo et al. 2013, we constructed a combined cognitive functioning score based on the combination of speed (median reaction time for each decision) as well as accuracy (proportion of errors) of the participants' responses.<sup>12</sup>

Our measure of negative affect is a battery of eight questions used in the DSM-IV criteria for Generalized Anxiety Disorder (GAD) (Liebowitz 1996). Previous studies have established that GAD symptoms often arise in the poor, and that these symptoms are quantitatively distinct from the background stresses of poverty (Baer et al., 2012). This property makes GAD (symptoms) appropriate as a measure of psychological affect that may be impacted by scarcity.

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<sup>12</sup> Participants who score high on speed but low on accuracy exhibit poor inhibition and executive control. Hence, the combined measure only gives participants who have high accuracy scores (at least 80% correct answers) additional score for speed. See Zelazo et al. 2013 for details.



**Figure 1. Psychological Functioning Measures Pre and Post Debt Relief. Flanker Task Error Rate (Top left); Flanker Task Trial Median Reaction Time (Top right); Flanker Task Combined Score (Bottom left); Generalized Anxiety Disorder Symptoms (Bottom right).** 175 participants. Error bars reflect  $\pm 1$ SEM. Top horizontal bars show statistical significance. \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

Figure 1 reports the psychological functioning measures before and after debt relief. The first three panels describe the error rate, the median reaction time and the combined score for the cognitive functioning task. Cognitive functioning significantly improves post-debt relief. The average proportion of errors fell from 18% pre-relief to 4% post-relief (Two-sample Wilcoxon rank-sum test,  $z=6.557$ ,  $p < 0.000$ ,  $n = 175$  participants). The median reaction time improved from 2.08 seconds pre-relief to 1.41 seconds post-relief (Two-sample Wilcoxon rank-sum test,  $z=5.443$ ,  $p < 0.000$ ,  $n = 175$  participants). The combined score confirms a significant increase in cognitive functioning, rising from 6.25 to 7.48 post-relief (Two-sample Wilcoxon rank-sum test,  $z=6.174$ ,  $p < 0.000$ ,  $n = 175$  participants).

Debt relief significantly reduces the incidence of GAD symptoms. The last panel in Figure 1 reports that the proportion of participants exhibiting GAD fell from 78% to 53% post-relief (Two-sample proportions, two-tailed test:  $z= 4.955$ ,  $p < 0.000$ ). This change is driven almost entirely by a reduction in GAD symptoms among those identified with GAD pre-relief: 37% of participants with GAD pre-relief stopped exhibiting symptoms post-relief, contributing to a 29 percentage point reduction in the GAD proportion. Only 6 participants acquired GAD symptoms post-relief.



### 3.2 Economic decision-making

We used the incentivized risk choice task designed by Eckel and Grossman (2002) to measure risk aversion. The task requires participants to choose one of six lotteries: (SGD28/SGD28), (SGD36/SGD24), (SGD44/SGD20), (SGD52/SGD16), (SGD60/SGD12), and (SGD70/SGD2), each with a 50-50 chance of winning the higher or the lower reward. The six lotteries are ordered by decreasing Constant Relative Risk Aversion parameters.<sup>13</sup> While the risk choice task is relatively simple, it is easily understood, especially by participants with poorer math skills, and is less likely to elicit random responses (Dave et al. 2010). We use the CRRA parameter intervals implied by the participant's lottery choice as the variable of analysis.

Time discounting is measured using two incentivized multiple price lists (Harrison et al., 2002; Meier and Sprenger 2015). Each price list requires participants to trade-off receiving a varying smaller payoff sooner, versus a larger fixed payoff of SGD50 at a later date. The first price list offers a choice between payoffs today versus one month later, while the second offers payoffs at six months versus seven months later. A participant with a lower discount factor ('impatient') prefers smaller, sooner payoffs to waiting for larger fixed payoffs. Present bias is characterized by dynamically inconsistent choices, that is, favouring smaller sooner payoffs only when the payoff is immediate, but not when the payoff occurs in the future.<sup>14</sup>

In common with earlier studies, a proportion of participants (24%) made inconsistent choices, switching multiple times between a smaller, sooner payoff and the larger fixed payoff. We exclude these participants from this analysis. Of the remaining participants, on average 72% do not switch at all between the smaller payoff and the larger fixed payoff in any given price list.<sup>15</sup> Thus, the discount factor for at least one price list can only be broadly bounded for a significant proportion of participants.<sup>16</sup> As the bounded discount factor is sufficient to identify present bias, we restrict our analysis to a binary indicator of whether the participant's choices reflect present bias.<sup>17</sup>

Figure 2 presents the distribution of risk lottery choices pre- and post-relief. We find a significant shift towards more risky lotteries post-relief (Two-sample Wilcoxon rank-sum test:  $z=-2.862$ ,  $p < 0.004$ ). Notably, the proportion of participants choosing the most risk averse option (28, 28) fell from 33% to 22% post debt relief.

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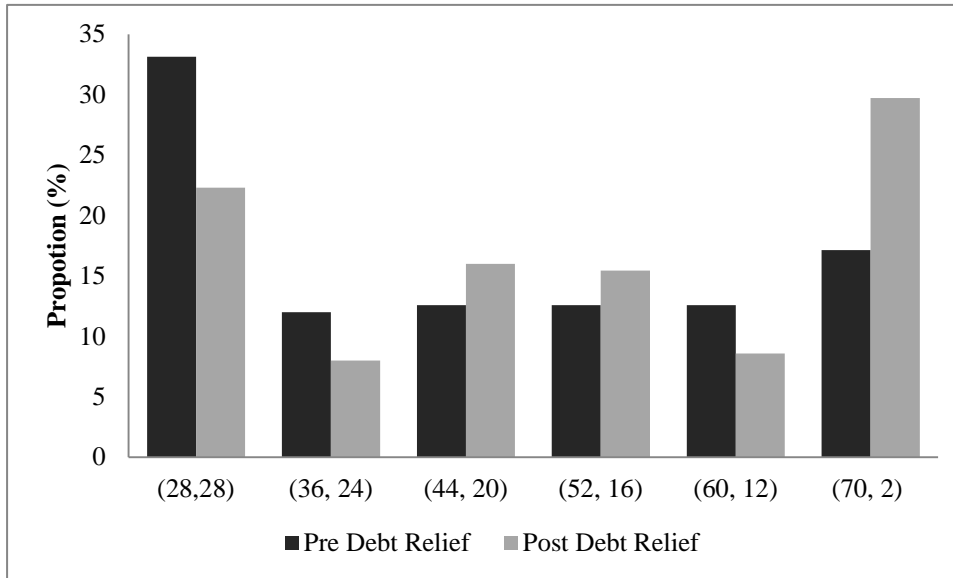
<sup>13</sup> The list of participant choices and implied CRRA parameter intervals follows: (Participant Choice):(CRRA Parameter Intervals). (SGD28/SGD28):(3.46,+∞); (SGD36/SGD24):(1.16,3.46); (SGD44/SGD20):(0.71,1.16); (SGD52/SGD16):(0.50,0.71); (SGD60/SGD12):(0,0.5); (SGD70/SGD2):(-∞,0)

<sup>14</sup> Consider a participant who chooses SGD38 today instead of SGD50 in one month, and SGD48 in 6 months instead of SGD 50 in 7 months. This participant has a lower discount factor for the near-term choice compared to the longer-term choice. This means the participant is more 'impatient' the closer at hand the payoff is, and exhibits present bias.

<sup>15</sup> The high rate of non-switching between payoffs is not unusual. In Meier and Sprenger's (2015) large-scale study, 40% of subjects did not switch between payoffs in any given price list. While this suggests a wider range of payoffs should be offered, the implied discount factor of choosing the lowest possible payoff of SGD30 is extremely low and implies very high impatience.

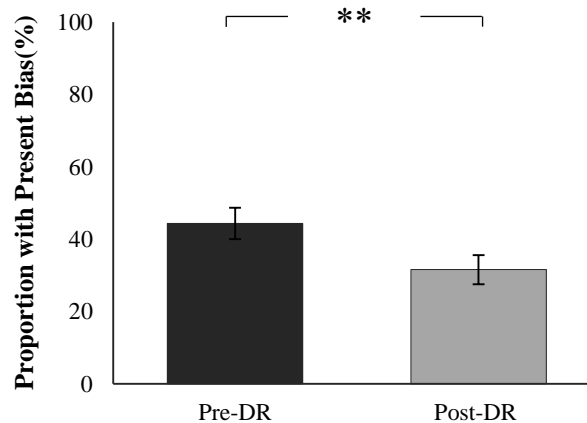
<sup>16</sup> Discount factors can still be bounded even if the participant reports no switches within a price list. For example, a participant who always chooses a smaller sooner payoff, and never switches to the later larger fixed payoff of SGD50, should have a discount factor less than that implied by a switch at the lowest smaller payoff of SGD30.

<sup>17</sup> Present bias can be imputed reliably even if a participant reports no switches within a price list. For example, a participant who switches at SGD38 today versus SGD50 in one month, but who always chooses SGD50 in 7 months instead of a smaller sum at 6 months, is present biased. The discount factor from the first price list is lower than the bounded discount factor from the second price list.



**Figure 2. Risk Choices Pre and Post Debt Relief.** 175 participants.

Present bias is also significantly reduced post-debt relief, as shown in Figure 3. The proportion of participants with present bias fell from 44% pre-debt relief to 32% post-debt relief (Two-sample proportions, two-tailed test:  $z=2.147$ ,  $p < 0.032$ ).<sup>18</sup>



**Figure 3. Proportion with Present Bias Pre and Post Debt Relief.** Restricted to 133 participants who made consistent time discounting choices in both survey waves. Error bars reflect  $\pm 1\text{SEM}$ . Top horizontal bars show statistical significance. \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

<sup>18</sup> Including the 24% of participants who made inconsistent choices provides similar results. Assuming that inconsistent participants' 'real' discount factors are captured by their first switching point, we find that the proportion of present biased participants fell from 47% to 34% post-debt relief (Two-sample proportions, two-tailed test:  $z=2.394$ ,  $p < 0.016$ ).

### 3.3 Comparison with previous studies

To put our results in perspective, we compare our results to the two closest studies of the effects of poverty on psychological functioning and decision making: Mani et al. (2013) and Carvalho et al. (2016). Our comparison is restricted to cognitive function and risk aversion, as the measures of psychological affect and time discounting are not directly comparable across studies.

The first two columns in Table 2 show that the debt relief induced change in cognitive function is larger in magnitude than Mani et al. (2013), and similar in precision. Although we use the Eriksen Flanker task, while Mani et al. (2013) use the Stroop task, both tasks measure the inhibition control component of executive cognitive function (Diamond 2013; Dean et al. 2017). The results confirm that significant changes in resource constraints can improve cognitive functioning across different contexts of poverty. In contrast, even though we use the same Flanker task measure as Carvalho et al. (2016), our changes in cognitive functioning are more than ten times larger in magnitude than theirs. The differences persist regardless whether the data is analysed using their econometric model – based on the individual Flanker trial – or our model, based on the log of total task response time.

The last two columns of Table 2 compare changes in CRRA in our study and Carvalho et al. (2016). Debt relief significantly reduces CRRA, making participants less risk-averse. In contrast, Carvalho et al. (2016) find no payday effect on risk aversion. The CRRA results are directly comparable because we use the same elicitation method as Carvalho et al. (2016), down to the same value of lottery payments in nominal terms.<sup>19</sup>

Together, these results suggest the timing and magnitude of resource shocks matter for the mechanism linking poverty and functioning. Our study and Mani et al. (2013) feature a resource shock large enough to allow households to ‘reset’ their household finances through paying off loans and relieving financial stress. In contrast, the payday cycle studied in Carvalho et al. (2016), while having a measurable impact on expenditures, is less likely to allow households to change important aspects of household finances.

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<sup>19</sup> The values provided in the risk elicitation lottery were identical between Carvalho et. al (2016) and our study in nominal terms. That is, while we used SGD28, Carvalho et al (2016) used USD28, following Eckel and Grossman (2002). While the USD was worth about SGD1.40 at the time of study, the value of the incentive is comparable as price levels for domestically oriented goods and services are lower in Singapore. A basic purchased cooked meal costs, for example, about SGD3.

**Table 2. Comparison of Results Across Studies**

	Cognitive Functioning Response Time			CRRRA Parameter	
	Our study	Mani et al.	Carvalho et al.	Our study	Carvalho et al.
Before Debt Relief	0.256*** (0.046)			0.916*** (0.303)	
Before Harvest		0.19*** (0.036)			
Before Payday			0.020 (0.029)		-0.10 (0.152)
Constant	3.399*** (0.023)	7.49*** (0.011)	8.06*** (0.031)	1.919*** (0.222)	1.66*** (0.110)
Observations	350	902	20206	350	1064
Number of id	175	451	1056	175	532

Cognitive Functioning Response Time analysis: “Our study” dependent variable is the log of Flanker task total response time in seconds; fixed effects model with no control variables. “Mani et al.” dependent variable is the log of the numerical Stroop task total response time in seconds; uses re-analysis in Carvalho et al (2016) with a fixed effects model with controls for calendar month.<sup>20</sup> “Carvalho et al.” dependent variable is log of individual Flanker trial response time in seconds from Study 1 in Carvalho et al. (2016); OLS model with controls for trial order. CRRRA Parameter analysis: “Our study” and “Carvalho et al.” dependent variable is the CRRRA parameter interval; interval regression model with no control variables.

#### **4 Mechanisms linking poverty to psychological functioning and decision making**

We now explore the mechanisms that link poverty to impaired psychological functioning and altered economic decision making. First, we differentiate between the effects of material scarcity, and the cognitive bandwidth taxes of managing consumption under scarcity. Second, we examine whether poverty-induced changes in psychological functioning are linked to changes in economic decision making.

Material scarcity may directly affect functioning because the poor consume insufficient calories, have inadequate shelter, and are more exposed to environmental hazards, directly impairing psychological functioning and decision making (Schofield 2014; Schilbach et al., 2016; Dean et al., 2017). But scarcity may also impose cognitive bandwidth taxes, from managing limited income carefully to meet basic consumption needs. While the rich and poor alike have limited mental bandwidth to process information and make decisions, the poor are especially vulnerable to demands on their attention and time because they lack access to bandwidth-saving devices, such as automatic deposits and payments and affordable credit (Mullainathan and Shafir, 2013; Mani et al., 2013; Schilbach et al., 2016). We propose that

<sup>20</sup> Our study’s model omits time-based controls because our participants should not be affected by weather-related seasonal effects. Singapore is a city with no meaningful agricultural sector and as an equatorial city the weather is fairly constant year-round. While religious and cultural holidays might affect participants, our surveys were always conducted outside significant holiday periods in Singapore.

debt accounts, in particular, may tax cognitive bandwidth heavily because mental accounting may lead the poor to view each debt as a separate stressor, rather than take a consolidated view of finances (Thaler 1999). Laboratory evidence shows a preference for paying off debt accounts rather than minimizing borrowing costs (Amar et al., 2011) – suggesting bandwidth costs of debt accounts are substantial. Apart from mental accounting effects, each additional debt account means one more creditor requiring time and attention, to avoid sanctions such as losing access to utilities, phone services, or legal action. As such, the bandwidth taxes of poverty may affect psychological functioning and economic decision-making separately from material deprivation.

If poverty changes psychological functioning, those changes in functioning could then have a chain effect on economic decision making. Laboratory experiments show exogenous shocks to fear, anxiety, and cognitive ability increase risk aversion and present bias (Hinson et al., 2003, Whitney et al., 2008, Benjamin et al., 2013, Haushofer and Fehr, 2014), while observational studies find lower cognitive ability is linked with greater risk aversion and present bias (Dohmen et al. 2010; Benjamin et al. 2013; James et al. 2015). Testing the role of cognition and psychological affect on decision making simultaneously is important, in line with dual process theories proposing decisions result from the combination of the patient, risk neutral deliberative system, as well as the impulsive, risk-averse emotional system (Dohmen et al. 2010). However, the laboratory setting cannot fully replicate the constraints faced by low-income households in the field. Our study's debt relief intervention, in contrast, generates exogenous variation in absolute scarcity, in bandwidth taxes, and in psychological functioning in the field. This allows us to study the relative impact of both changes in scarcity and psychological functioning on economic decision-making; we are not aware of other studies that study both channels jointly.

We first examine the effect of scarcity, in absolute terms, as well as through bandwidth taxes, on psychological functioning. Absolute scarcity is measured by the amount of debt relief received, while bandwidth taxes are measured by the number of debt accounts paid off. We then examine the effect of scarcity and psychological functioning on economic decision making. The measures of psychological functioning and economic decision making are described earlier.

#### **4.1 Psychological functioning**

The first three panels in Table 3 report results from fixed effects regressions on cognitive functioning. The absolute amount of debt relief is positively associated with larger improvements in cognitive functioning, reducing both error rates and median response times, and improving the composite score. But the number of debt accounts fully paid off also significantly and independently affects cognitive functioning. The point estimates suggest that clearing one debt account has an effect on cognitive functioning comparable to providing approximately SGD1006 – SGD1904 of debt relief.

**Table 3. Fixed effects regressions on Cognitive Functioning and Generalized Anxiety Disorder Scores**

	Cognitive Functioning			GAD
	Error Rate	Log Median Response Time	Combined Score	
Debt Relief Amount	-0.0315*** (0.007)	-0.0492** (0.022)	0.256*** (0.062)	-0.00544 (0.019)
Debt Accounts Paid Off	-0.0317*** (0.012)	-0.0937*** (0.029)	0.317*** (0.098)	-0.133*** (0.027)
Constant	0.174*** (0.008)	0.544*** (0.024)	6.298*** (0.068)	0.775*** (0.018)
Observations	350	350	350	350
R-squared	0.299	0.179	0.291	0.217
Number of id	175	175	175	175

Debt Relief Amount is in SGD Thousands. For Cognitive Functioning: The Error Rate dependent variable is the proportion of incorrect Flanker Task trials, where 1.0 = all trials incorrect. The Log Median Response Time dependent variable is the log of median response time in seconds over all Flanker Task trials. The Combined Score dependent variable is a scale of 0 to 10, comprising the accuracy score (the inverse of the error rate, rescaled to a maximum score of 5) plus the bonus time score (maximum score of 5) for participants with at least 80% accuracy. For GAD: The dependent variable is equal to 1 if the participant has GAD symptoms and 0 otherwise. Robust standard errors are in parentheses. \*Significant at 10%; \*\*significant at 5%; \*\*\*significant at 1%.

Column 4 of Table 3 reports results from fixed effects regressions on the incidence of GAD symptoms. While there is no relationship between debt relief amount and GAD, having a greater number of debt accounts paid off significantly reduces the likelihood of exhibiting GAD symptoms post-relief. The point estimate of debt relief amount is so small it suggests thousands of dollars of relief are equivalent to only one debt account clearance. Overall, the results suggest that cognitive bandwidth taxes matter much more than the absolute amount of resources.

#### 4.2 Economic decision-making

Table 4 reports results from interval regressions on the debt relief induced change in CRRA parameters<sup>21</sup>. We find no effect of the magnitude of debt relief or debt accounts repaid on risk aversion. We also find no statistically significant relationship between debt relief-induced changes in cognitive functioning and negative affect on risk aversion.

<sup>21</sup> We obtained first differences of the change in CRRA based on participant choices between the first and second waves. Because CRRA intervals are bounded by infinity for extreme choices, the difference in CRRA intervals is effectively unbounded  $(-\infty, +\infty)$  when participants choose the same extreme choice between waves. This forces us to omit participants who chose the lottery (SGD28/SG28) or (SGD72/2) in both waves from the analysis. For consistency, we also dropped all participants who kept the exact same lottery choice between waves from the analysis. The results are broadly similar if we include those participants. The results are also similar if we assume that CRRA intervals for the extreme choices are bounded at an arbitrary value less than infinity, which allows us to use the entire sample.

**Table 4. Interval Regression on Changes in CRRA Parameters Pre and Post Debt Relief**

	1	2	3
Debt Relief Amount	0.274 (0.405)		0.253 (0.413)
Debt Accounts Paid Off	0.275 (0.605)		0.293 (0.630)
Change in Cognitive Functioning		0.458 (0.329)	0.446 (0.330)
Lose GAD =1, 0 otherwise (Base group: no change in GAD)		-0.49 (1.396)	-0.586 (1.408)
Gain GAD =1, 0 otherwise (Base group: no change in GAD)		-2.293 (2.342)	-2.297 (2.546)
Constant	-3.008* (1.729)	-2.330** (0.926)	-3.340* (1.834)
Observations	139	139	139
Number of id	139	139	139

Debt Relief Amount is in SGD Thousands. The dependent variable is the change in the CRRA parameter interval pre and post debt relief. The Change in Cognitive Functioning is measured based on the combined score scale described earlier. Robust standard errors are in parentheses. \*Significant at 10%; \*\*significant at 5%; \*\*\*significant at 1%.

There is evidence, however, suggesting that cognitive bandwidth taxes increase present bias. Table 5 reports fixed effects regressions on the incidence of present bias. In columns (1) and (3), the number of debt accounts paid off significantly reduces present bias.<sup>22</sup> On the other hand, there is no statistically significant effect of the amount of debt relief, or of changes in cognitive functioning and negative affect, on present bias.

<sup>22</sup> While liquidity constraints are an alternate explanation for changes in present bias (Dean et al. 2014; Epper 2015), we believe this plays a smaller role than bandwidth taxes in our study, because the debt relief amount – which proxies for liquidity constraints in addition to material scarcity – has no effect on present bias.

**Table 5. Fixed Effects Regressions on Present Bias**

	1	2	3
Debt Relief Amount	0.0123 (0.018)		0.0106 (0.020)
Debt Accounts Paid Off	-0.0878** (0.035)		-0.0932** (0.041)
Cognitive Functioning		-0.0163 (0.023)	0.00685 (0.028)
GAD		0.0912 (0.093)	-0.0179 (0.102)
Constant	0.437*** (0.026)	0.433** (0.175)	0.408** (0.189)
Observations	266	266	266
R-squared	0.05	0.013	0.051
Number of id	133	133	133

Debt Relief Amount is in SGD Thousands. The dependent variable is equal to 1 if the participant has present bias and 0 otherwise. The Change in Cognitive Functioning is measured based on the combined score scale described earlier. Robust standard errors are in parentheses. \*Significant at 10%; \*\*significant at 5%; \*\*\*significant at 1%.

Overall, the evidence is mixed and only partially supports the hypothesis that scarcity induces impairments in psychological functioning which contributes to risk aversion and present bias in the poor. While we find cutting bandwidth taxes reduces present bias, there is no support for the link between the inhibition control component of executive functioning, and risk aversion and present bias. Moreover, changes in psychological affect do not appear linked to risk aversion or present bias. The results suggest the cognitive effects of bandwidth taxes in the poor extend beyond the inhibition control component of executive functioning.

## 5 Discussion

Our study suggests cognitive bandwidth taxes contribute to impeding psychological functioning and decision making of the poor. The cognitive bandwidth tax mechanism helps to reconcile the contrasting literature: When financial shocks are sufficiently large, they allow households to ‘reset’ finances and cut bandwidth taxes, thus improving functioning (Mani et al. 2013). In contrast, anticipated and modest income shocks do little to alter finances and have little impact on functioning (Carvalho et al. 2016). The effects of poverty on psychological functioning and decision making exist even among the poor in a highly developed country, and do not require basic material deprivation, as the present contrasting literature may imply.

There are important policy implications, particularly in developed countries, which face persistent intergenerational poverty rather than widespread absolute poverty. Conventional anti-poverty policy is often guided by neoclassical economic principles, addressing material deprivation through cash transfers and in-kind support, while debt problems are managed through financial education. Although welfare programs have reduced deprivation, such programs may have ceiling effects, and may have limited reach, if they fail to target and



reduce bandwidth taxes by easing the complex decision constraints faced by the poor (Gennetian and Shafir 2015). Cash transfer policies should be rigorously compared in the field to targeted assistance that resolves specific cognitive ‘pain points’. Moreover, financial education should also account for the psychological costs of managing household finances. While debt mental accounting behaviours have traditionally been seen as costly (Amar et al. 2011) because people often prioritize paying off accounts rather than minimizing borrowing costs, the reality may be that the mental dividends from clearing debt accounts are worth more than saving a few dollars of interest.

While we show that cognitive bandwidth taxes are a significant cause of impaired functioning and decision making, we also find little support for the hypothesis that shock-driven improvements in inhibition control and anxiety explain changes in risk attitudes and present bias. However, we do not reject a link between psychological functioning and decision making in the poor. Rather, our findings suggest more work in field settings is needed to test whether changes in other psychological functions – such as working memory, cognitive flexibility, and higher order skills in reasoning and problem solving (Diamond 2013; Dean et al. 2017) – directly alter decision making among the poor. The search for psychological mechanisms may be challenging, as the poor have endured the cognitive burdens of poverty for years, and may have developed strategies for decision making that rely less on conventionally studied cognitive channels. Beyond mechanisms, future work should explore whether these changes in cognitive functioning and economic decision making are persistent, and whether they meaningfully contribute to behaviours that allow upward mobility.

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