Slums to Failed Estates? Evidence from a lottery for low-cost housing in Ethiopia

JOB MARKET PAPER

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Abstract

Nearly one billion people live in informal housing across the world. A common policy response is the construction of large-scale housing sites to replace slums, on the outskirts of cities. But should the state intervene to increase private housing consumption at all, and is moving people out of slums a good way to do so? Very little is known about preferences over location and housing consumption of the urban poor in developing countries, and even less is known about the effects of such mass-housing policies. This paper studies a lottery in Addis Ababa, Ethiopia, which randomly assigns the opportunity to buy an apartment in new state-built housing, and further randomizes the neighbourhood to which winning households are assigned. I find evidence that formal housing on the outskirts of cities is popular among slum dwellers; state intervention is welfare-enhancing. Households make substantial upgrades to their new units. The costs of moving to the outskirts of the city are negligible along a number of dimensions. Most crucially, labour supply and earnings are unaffected by moving to formal housing very far from the centre.

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1 Introduction

More than 60% of households in African cities live in slums, and rapid urbanization is compounding the problem even as economies grow. Relatively wealthy households still live without access to essential services in their homes, or in informal structures. Do households remain in slums because this reflects their preferences over consumption and location, or do they face constraints that limit their ability to consume their desired level housing? This question has important implications for the design of housing policies aimed at improving housing conditions for the poor. States all over the world intervene to provide low-cost housing that is affordable for the poor but might not otherwise be provided by the market. Particularly common policy response is mass state-built housing on the outskirts of cities. In developing countries this housing is delivered in the form of subsidised ownership schemes.[1] These policies are popular because they have the potential to move households out of slums into formal housing in great numbers and to engineer uncrowded, but high density, neighbourhoods instead of sprawl.

But it is far from obvious that the state should be intervening to increase housing consumption among the poor ahead of other priorities. Although states may justify the redevelopment or relocation of slums on the basis of negative health externalities (Rosen, 1985), or because central slum land is trapped into inefficient use (Henderson et al., 2016; Harari and Wong, 2018; Cai et al., 2018), economists have tended to be sceptical of arguments based on private consumption (Glaeser and Gyourko, 2008; Olsen and Zabel, 2014). In the absence of failures in the housing market, these mass housing policies are likely to be distortionary; they will subsidize higher levels of housing consumption than individuals would optimally choose, or push people to live in areas with worse economic opportunities (Collinson et al., 2015; Hunt, 2009).[2] Indeed, mass-housing sites are usually built on empty land on the outskirts of cities to lower land costs. If households live in slums because they enjoy cheap rents in good locations, or because they prefer to prioritise other consumption, they may suffer losses of income and social capital by moving to these new locations, and so will not move unless compensated for doing so. These relatively expensive policies could thus lead to the replication of slum-like conditions in drab estates far from city-centres.

This paper provides some of the first evidence on the effects of state-built formal housing in developing countries, by a using a lottery for government housing in Addis Ababa, Ethiopia. The policy is being scaled up rapidly after already more than doubling the

[1] Developed countries did this in the post-war era in the form of social tenancy housing. In many cases, policy-makers were responding to similar concerns about the living conditions of households in slums and tenements (Riis, 1890), and even calls for wholesale "slum clearance".

[2] States may also try to increase household consumption above households' optimal choice for paternalistic reasons.

existing formal housing stock over the last ten years.[3] I collect and analyse data in much the way one would for a randomised controlled trial, with a full pre-analysis plan, and working with a sample drawn from the large pool of program applicants, who are comparable to the population of the city as a whole.[4] My analysis proceeds in two steps. First, I use a detailed baseline and follow-up data on households who are entered into a housing lottery, to carefully unpack the location-housing decision, and the financial implications thereof, that households face when the win housing. Second, I use the winning of the lottery as a source of exogenous variation to study the effect of moving to formal housing. I find that households willingly trade their location in central slums for improved housing much further away, and invest heavily in complementary improvements to the units that they win. Moving to state housing comes with negligible costs along with a number of economic and social dimensions. These results suggest that households face enormous barriers to accessing housing and that the state can play a role in providing low-cost cost without substantial distorting effects.

Two main features of the Ethiopian housing program allow me to learn about households' preferences by studying the effects of the lottery. First, lottery winners own the homes, which they pay for with a subsidised mortgage. Crucially, they can rent the unit out legally. Market rents are, in most cases, similar to or above what they pay for slum housing in the centre. Therefore, moving into a new apartment that they own implies increased effective housing costs. In particular, a sub-group of slum-dwellers live rent-free in the centre on the state-owned land, and they lose these large implicit rent subsidies when they move. Therefore, moving in comes with some financial cost; rather than households being subsidised to move. Second, state-built housing sites have very high population density, but households that relocate are very unlikely to know anyone in their new neighbourhoods. Therefore, the move implies removal from ones' existing social network and relocation far from the city centre, but little change in the surrounding urban density. These features allow us to learn from revealed preference: do households voluntarily take up formal housing roughly 300% further from the centre without financial incentives to do so? And do they further upgrade these basic housing units, thereby forgoing future consumption for better housing now?

Different explanations for why households live in slums generate different theoretical predictions on these questions. Under one view, households face constraints to accessing their desired level of housing. The returns to upgrading an informal unit are lower than they are in formal housing, but upgrading to a formal unit requires a large fixed investment with mortgage finance. Coordination failures may prevent households from

[3] The state has delivered more than 200,000 housing units since the program started.

[4] A substantial proportion of the entire city has applied for the program, and in most ways, my sample resembles the population of the city as a whole (including the proportion that lives in informal housing), which allows me to make generalizable statements from this study.

moving together to cheaper neighbourhoods further away. In addition, slums themselves may constitute a poverty trap by preventing capital accumulation (Marx et al., 2013; Lilford et al., 2017). Under another view, households trade off location, housing quality and consumption optimally. Households live in crowded and unsanitary conditions because the economic returns of living in the centre outweigh the costs, and the marginal utility of non-housing consumption is higher than that of housing services. Residents may be aware of the adverse health and human capital effects of living slums, but the returns to investing in other things (for example, mobile phones or better schooling) may be higher than improved housing. Slums may be places of modernisation: households move to slums to access economic opportunity, but will move out of slums when they've accumulated the capital necessary to do so. The first view would predict that constrained households would invest in and move into formal housing on the outskirts, while the second view would not.

I survey 1,600 households, half of them who won a house, and follow up with them in early 2018, 18 months after the awarded housing was occupied. I find that roughly 50% of households move into the housing units that they own. That not all households move in is not surprising: the majority of households in the city applied for the program, and are likely to have heterogeneous preferences for housing and location. Households only move in, after all, if their willingness to pay for the new housing exceeds that of the market rent less some rental friction (such a brokerage fees). What is notable is how many households living in slum housing move to formal outskirts at higher costs, when they were previously living in informal housing and investing almost nothing in improving them.

Households make enormous investments in the housing that they win, in the form of large mortgage down-payments, and complementary investments to further improve the basic units that they win.[5] I find that almost all households make the down-payments, and complementary investments are remarkably large, roughly equivalent, on average, to the mortgage payments on the units (which are 20% of the total cost of the units). Households that move into the units that they own invest significantly more than those who rent the units out.I interpret these findings as evidence that households are constrained in their ability to access better housing prior to the intervention. The results from this paper show evidence for market failures in the housing market.[6]

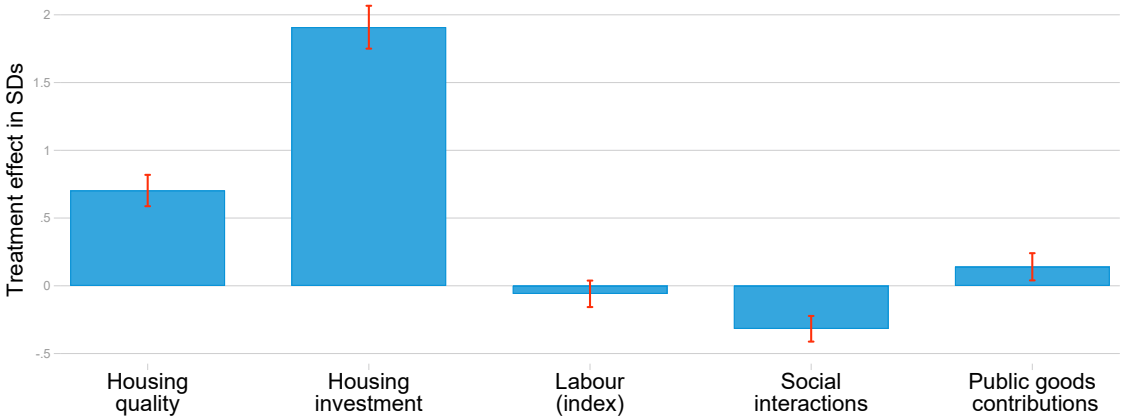
I turn to the second steps of the analysis. Does moving come with costs that must be weighed against the benefits of improved housing? I use the winning of the lottery as a source of exogenous variation to study the effect of moving to formal housing. I proceed with caution. Winners of the lottery do not experience increases in current income.

[5]The required mortgage down-payments constitute more than 50% of annual household income in most cases. This buys the household a basic unit with many key services that they did not have slums. But they can choose to add upgrades such as showers, sinks, plastering, painting, tiling, and electric fittings.

[6]I find less support for the idea of slums as poverty traps: households do not appear to face significant barriers to accruing the capital necessary to invest in housing when given the opportunity.

However, they do experience large wealth gains when they win a housing unit.[7] Therefore, I do not use winning the lottery as an instrument for moving to the outskirts, but rather estimate the intention-to-treat effect of winning the lottery, and then explore the extent to which I can attribute the estimated effect to either moving or the effect of the lottery itself. I then use random variation in the location of units that households win, which in turn induces different location-income trade-offs (and different rates of moving-in) to disentangle the effects of winning from moving in.[8] Figure 1 summarises the effects of winning the lottery across my five pre-registered primary outcomes.

Figure 1: Summary of main effects (ITT) on five pre-specified primary outcomes



First, I look at the labour market effects of the lottery. I find zero effects, precisely estimated, on a wide range of labour market outcomes of winning the lottery, of moving in and of winning but renting out the unit. Households that move adjust: some change their location of work, while others commute longer distances, without significant reductions in net income.[9] One notable exception to this is households who are assigned to state housing in the very centre of the city. They are very unlikely to move in, and their locations are not changed much at all, but they significantly reduce their labour supply because of the substantial rental income that they can earn.

I find reductions in the size of social networks and the regularity of interactions with neighbours due to winning the lottery, but see no effect on loneliness, dissatisfaction with neighbourhood interactions, dissatisfaction with their social lives, and small positive effects

[7] The new housing units are thought to be worth a considerable amount, and it will be legally possible to trade them in eight years' time. Non-winners expect to win a house in future lotteries.

[8] It is important to note that these results may be very different if households were forced to move, rather than being able to move voluntarily. I discuss this point in more detail in the conclusion of the paper.

[9] I find that households who move into formal housing experience reductions in their time spent during time-consuming home production tasks, and these time-gains more than compensate for increased commuting time.

on general mental health and anxiety. Households living in housing estates experience much lower conflict with their neighbours. They also report less reliance on social networks for economic affairs. Further, the results suggest that it is the effect of winning the housing asset, rather than moving, that leads to these changes in social interactions. Finally, I find no evidence of reductions in community cohesion or reduced willingness to invest in public goods, among households that win housing, and households that move in. In fact, I find small but significant increases in willingness to contribute both time and money towards upgrading and improving neighbourhood conditions and to helping out neighbours.

Do households moving out of their own neighbourhoods impose negative externalities on their old neighbours? If the most mobile or successful households move out, those left behind could (involuntarily) lose access to networks, or face higher risk of eviction.[10] To test for this I use variation in the number of winners of the lottery by urban district as a proportion of total population. Using a wide number of different sources of variation in this proportion, I find no evidence for negative spillover effects among untreated households.

My results contribute to an understanding of the economics of slums.[11] While an extensive literature shows a causal link between living in slums and number of negative health and investment outcomes, there is a relatively little work looking in the preferences of slum dwellers themselves. In other words, do households live in slums because they are poor, so that housing consumption would rise with income, or do they face other constraints? Do they remain in slums because slums are integral to their economic lives, or because they face constraints that prevent them from consuming their optimal level of consumption? A growing literature shows the importance of where households live on economic outcomes (Chetty et al., 2016; Chyn, 2018). It's not clear *ex ante*, whether new housing sites are "better locations": on the one hand, their location far away from jobs could be detrimental, on the other hand, better sanitation and reduced over crowding could improve health outcomes.

The paper closest to mine in this regard is Barnhardt et al. (2017), who study a housing program in India that provides formal housing at highly subsidised rents and find relatively low take-up rates and evidence of welfare losses due to social isolation. The policy I study induces a very different decision problem for lottery winners. First, households in my study pay to move into government housing, whereas in theirs, households loose rental subsidies when they move out of formal units. Seconds, in my setting households move to large high-density neighbourhoods where local economies have proliferated, whereas they

[10] Lower population density in a central area may make it more likely that slum households could be evicted by the state or a developer, who may sense that the communities bargaining power is weakened.

[11] There has been a growing interest in the causes and consequences of informal housing (Montgomery and Hewett, 2005; Brueckner and Selod, 2009; Cattaneo et al., 2009; Marx et al., 2013; Cavalcanti et al., 2013; Lall et al., 2007; Galiani et al., 2017). Henderson et al. (2016) focus on the distorting effects of slums on urban land use, even suggesting that slum-upgrading may further entrench these distortions (Harari and Wong, 2018). This evidence may provide motivation to redevelop or relocate slums.

study households who move to isolated neighbourhoods with low population density.[12] In this way, I can isolate the effects of trading central slums for peripheral formal housing, without the confounding effects of rent-subsidies or changes in local population density. I extend I extend their finding that social networks can be disrupted by moving, by showing a number of ways in which households may also prefer to reduce their social interactions: formality can substitute for informal risk-sharing (Banerjee et al., 2016).

I contribute to a related literature on the constraints to household investments in housing upgrades. A large literature looks at the effects of tenure insecurity and a lack of property rights on investment (Galiani and Schargrodsky, 2010).[13] My results suggest another mechanism, hinted at in (Marx et al., 2013), that the marginal costs of improving slum houses are high, but the cost of upgrading to a formal (concrete unit) is considerable and non-divisible. This result relates to a literature that shows strong complementarities between public investment spending and households investment (Michaels et al., 2017; Gonzalez-Navarro and Quintana-Domeque, 2016; McIntosh et al., 2017). I show that the combination of property rights, basic formal housing, and basic public planning leads to housing investments orders of magnitude larger than those induced by providing property rights alone. My study is one of the first, to the best of my knowledge, to measure, in fine detail, the actual cash investments made by households in proving their housing conditions.

My results have implications for policies aimed at providing housing for the poor in developing countries, and whether such policies can be justified at all. I show that households seem to lack access to good housing opportunities that they would very much like to pay for; state intervention appears to overcome market failures and improve welfare.

I fill a gap in the understanding of the economic effects of mass housing. Many commentators argue that the mass-housing approach that I study here will lead to distortions, and the replication of slum-conditions often associated with "failed estates" or "ghettos" in developed country public housing. I argue that these views dominate the discourse on housing policy and contribute to a view of slum-upgrading as best practice, despite relatively weak evidence on the benefits of slum upgrading (Turley et al., 2012; Lucci et al., 2015). Yet the evidence base is very thin. I identify and test for five main arguments commonly made to advance these predictions. I provide evidence on each of these channels and find little evidence for each. With the caveat that these are short-run results just two years after the housing was complete, I find no evidence for the hypothesis that public housing sites are becoming "failed estates".

[12] Indeed I find that access to small shops, markets, beauty-salons, transport (bus) depots, and even churches is unchanged in the new housing sites: these popped up over-night to service the new dense neighbourhoods.

[13] While some results have been promising, it now seems that land-titling is far from the panacea that it was once thought to be (Collin et al., 2015). Field (2007) shows that lack of property rights may constrain household labour supply.

2 Context

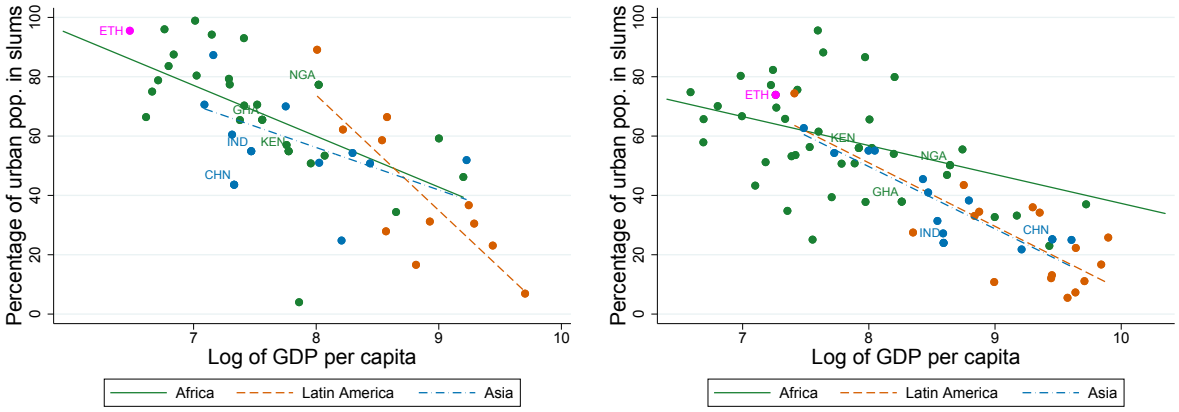
2.1 Slums and land markets in developing countries

This paper paper focuses on the problem of poor housing conditions: cramped spaces, informal building materials, and a lack of access to essential services such as water and sanitation. In many cases, these deprivations are accompanied by another depriviation: lack of secure tenure that means that households could be evicted from their homes at almost any time. Indeed the UN-Habitat defines a slum as any household lacking one or more of the five deprivations mentioned above. The UN SGDs included a target, under the seventh goal, of improving the lives at least 100 million slum dwellers.

Figure 2: **Addis Ababa population and housing sites**

(a) GDP and slums in 1990.

(b) GDP and slums in 2014.

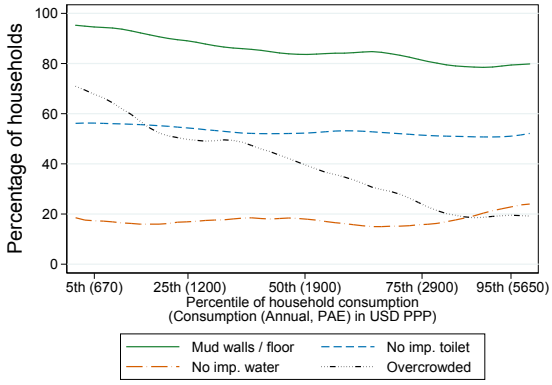


Cross-country correlations between GDP per capita and the proportion of urban households in slums from 1990 (Figure 2) suggest that economic growth would gradually go away, if Africa managed to generate sufficient growth. And indeed the proportion of of urban households living in slums has fallen from roughly 70% to 60% from 1900 to 2014. However, the rate of progress has not been as fast as one would expect given the economic growth experienced over this time period. Therefore the relationship between development and slum prevalence in 2016 is considerably weaker Africa that it is in the rest of the developing world (Panel B of Figure 2). I find that economic growth over the period 2005 to 2014 is not significantly correlated with changes in urban population living in slums. Although Marx et al. (2013) discuss the relationship between growth and slums, this paper is the first to test for cross-country correlation, to the best of my knowledge. Furthermore, rapid urbanization has meant that the both the absolute number, and the proportion of Africa's total population living in slums has grown over time. This may be because the pattern of African countries urbanization rapidly, without the industralization that has usually

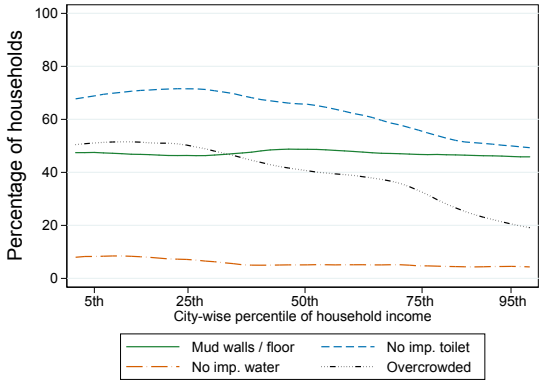
accompanied urbanization (Gollin et al., 2016; Glaeser, 2014).

Figure 3: **Household wealth and slums**

(a) Consumption & slums in Addis Ababa



(b) Income & slums in African primate cities



Next, I look at the evidence on who lives in slums within countries. I find that even relatively wealthy households live in very poor housing conditions, across Africa. Figure 3 shows data for Addis Ababa, Ethioipia, where this study is conducted. Here I plot four main deprivations of living in slums, as a function of expenditure per capita for representative micro-data for Addis Ababa taken for the 2011 Household Consumption and Expenditure Survey. Panel B of Figure 3 replicates the same anaylsis with hosuehold income per capita, this time for representative LSMS data from across ten countries in Africa, restricted to the primare city in each country.[14] Both Figures show a common pattern: levels of improved walls and floors, improved sanitation and private improved water, remain very low even among very wealthy households. Over-crowding declines rapidly with household wealth. It would seem that households are able to upgrade to larger housing units as they become wealthier, but they do not make expensive upgrades to their home: like adding a private toilets, and rebuilding their walls or floor. This suggests either that households simply value space over types of housing services, or that the costs of home-upgrading are lumpy and large, which prevents the kind of incremental upgrading that households would otherwise like to do.

These stylized facts provide the key motivation for this paper. Does the persistence of slums in Africa justify state intervention to improve the housing conditions of individual households? And is it plausible that poor housing conditions are simply the optimal choice of very poor households?

[14]This includes the cities Kampala, Blantyre, Addis Ababa, Dar-es-Salaam, and Accra. The results for Addis Ababa alone, using income data instead of expenditure, look very similar to the results in Panel A.

2.2 The Ethiopian housing program

I study the Ethiopian Integrated Housing Development Programme (IHDP), more popularly known as the Condominiums Programme, from the type of housing that is designed to deliver. The program was launched in 2004, and scaled up slowly, only reaching very large-scale deliver in the years that my study begins.[15]

The model is simple: the constructs new formal housing units, which then come under the ownership of individual households, who pay for costs of supplying the housing units with mortgages. The units are sold to households at subsidized rates: households entirely for the cost of building construction, and infrastructure provision, but receive the land for free. The state justifies this transfer of free on the grounds that the land is owned by state, after being nationalised under the previous socialist regime (1974-1991). However, the opportunity cost of giving away urban land is undoubtedly high, especially as the City currently sells vacant land via auction.

Therefore, to control the overall cost of the program, the state constructs the new housing on relatively cheap land, on the outskirts of the city.[16] The new housing is constructed at scale, and outsourced to private or state-owned construction companies. Connective infrastructure, including roads, sewers and water, are provided at the same time.[17] The average housing unit built between 2013 and 2016 is more than 15 kilometers from the city centre, and is situated in a site of over 500 housing blocks, with space for up to 60,000 residents. Figure 4 shows the location of the new housing relative to the population of the city and the main transport networks. Panel B shows where the applicant households come from: they are overwhelming drawn from the city centre of the city, where slums and government-owned slums in particular, are located.

Housing units are arranged in 5-storey walk up apartment blocks, with between 20 and 30 units in each block. Housing blocks are positioned around public common spaces between the blocks. Units come equipped with water, sewerage and electricity connections, as well as toilets, basins, and a shower, though these are rather basic. Public spaces are usually in fairly undeveloped condition: households are responsible for upgrading their own housing units as they see fit, and, collectively, for developing and maintaining public spaces. When construction of the housing is complete, the units are sold to applicants households all at once, so that all housing within a site becomes available for occupation at more or less the same time. Given the scale of the program, I find that it is extremely rare for anyone to know their new neighbours from before they moved. But they do not

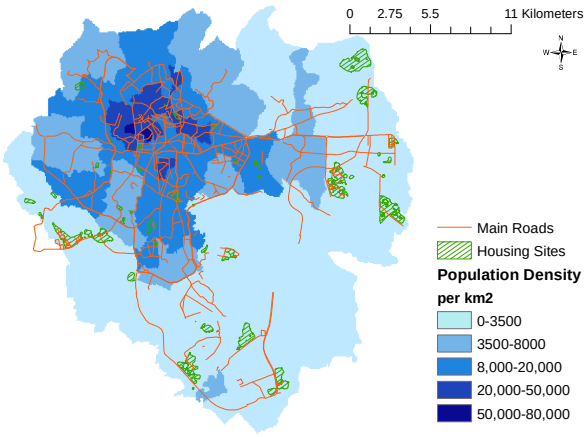
[15] This is a federal program, but has increasingly come under the control of the Addis Ababa city government, since the program is now only being rolled out in the Capital).

[16] The state also pursues a mixed-income neighbourhood policy in the city centre. I doing so it has constructed a few housing sites in more central areas, those these are relatively few.

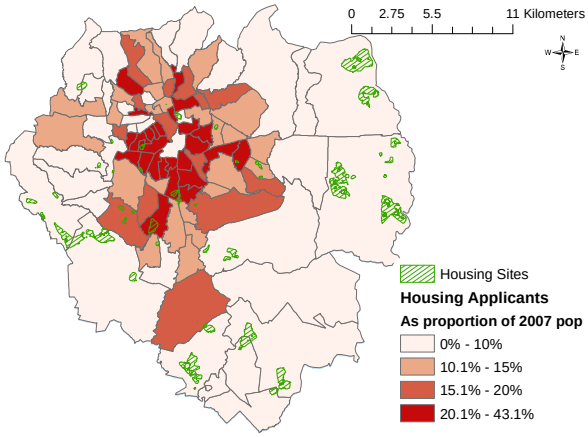
[17] Other public services such as schools and hospitals were not built at the same time, at least not in a planned fashion. These usually spring up in the years after housing is complete.

Figure 4: **Addis Ababa population and housing sites**

(a) Housing sites are located on the very outskirts.



(b) Applicants mostly live in the city centre



lack for new neighbours: the five- to eight-story buildings provide very high population densities, similar to those in slum areas. And informal transport systems, shops, services and churches quickly move into the sites access this new, large market. The design of the buildings explicitly allows for commercial units, sold on the ground-floor of housing blocks, which are sold at market rates in order to offset some of the program costs.

The housing project has different separate modalities, differentiated by the quality of the housing provided, and named for this proportion of the total sale cost that the beneficiary households must pay upfront. This program studies what is known as the 20/80 scheme, as beneficiary households must pay 20% of the total housing cost in the form of a down-payment. This studies focusses on the 20/80 scheme because this is the modality under which the largest number of units have been provided (nearly 100,000 when my study begins and over 60,000 in the two years hence), and because it targets poorer households, who are more likely to be slum dwellers, the second largest scheme- that required a 40% down-payment. After households make their down-payments, the remaining cost (after land subsidies) is taken out as a mortgage.

Mortgage finance is offered by the state to beneficiary households as part of the program. The state works with the Commercial Bank of Ethiopia to provide mortgages to households to be paid over 15 years at 9.5% per annum. Households are allowed to rent out the units, there is no legal restriction on this. However, they are not allowed to sell the units for five years from the data of taking ownership of the unit.

2.2.1 The beneficiaries

Opportunities to buy newly built housing are allocated by lottery, from a pool of applicant households. The lottery is computerized, and, as I show in Section 3, it is fair. Any

Table 1: Housing constructon and sale prices per unit (2015 USD)

	Studio	1-Bedroom	2-Bedroom
Floor surface area m^2	32	51	75
Construction	5,970	9,225	13,383
Land	3,551	5,487	7,960
Infrastructure	2,459	3,799	5,511
Total Cost	11,980	18,511	26,854
Total Sale Cost	3,880	8,300	15,390
Subsidy (excl infrastructure)	5,500	6,400	5,954
Down-payment	776	1,660	3,078
Monthly mortgage	31	64	136
Estimated value	20,000	25,000	35,000
by non-winners			32,000

household satisfying two criteria are eligible to apply for housing: they must not already own a property, and they must have lived in Addis Ababa for at least six months. There is no means-testing beyond this. Once registered households are required to make monthly savings contributions towards a dedicated account, which will be used to cover the mortgage down-payment in the event that they win the lottery. Households that did not make a required threshold of aggregate savings at the time of the lottery that I study were excluded from the lottery, but have a chance to save again for future rounds. These savings thresholds are relatively low: at the time of the lottery that I study, the average savings requirement was $318, or only three times the average required monthly mortgage repayment.

2.2.2 Lottery of 2015

This paper uses a lottery for housing that took place in March of 2015. This is known as the 10th round of the lottery, and constitutes the largest number of housing opportunities awarded at one time. In all, 33,000 housing units were awarded at this lottery. Relatively few housing units in remote sites had been delivered before the 9th round, just prior to the start of my study. So access to state-built formal housing on the city's outskirts was relatively new for applicant households.

According to the housing administration, over 700,000 households were registered for the program at the time of the lottery which I study. However, the state gave priority to households that had registered early in the scheme, and those that had reached minimum savings reuirements: in total 130,000 households were eligible for the lottery.The state priotisied female applicants, and government employees. Specifically, the lottery proceeds by randomly selecting 30% of total beneficiaries from the group of female applicants. Next

they select another 20% of the total beneficiaries from public employees. The remaining 50% are draw at random from remaining pool, regardless of gender orpublic employment. Given that 35% of the applicants were women, and 20% were public employees, this translates into a 37% chance of winning for the average woman applicant, a 21% chance for the average man, and a 42% chance of winning for public employees. This variation in the probability of women motivates my sampling strategy, outlined in detail in Section 3, in which I stratify my sample by the cells that were used for randomization, in order to oversample from the treatment group while keeping the average *ex-ante* probability of winning the same between my two samples.

The lottery assigned households to a variety of different sites. Conditional winning the lottery, assignment to site, block and housing unit is random. 97% of all beneficiaries in the lottery were allocated to 10 main sites (see Table A.1. Some of these units are in older sites (one or two years old from a previous round lottery). But the vaste majority (90%) were assigned to five main sites, that were completely new and scattered around the outskirts of the city.[18]

There were some considerable delays to the final construction on the housing, and on the devliery of electricity and sanitation services, which delayed the households from moving in until mid-2016, quite some time after they had won and sign ownership-agreements.

2.2.3 Costs and subsidies

Table 1 provides the key details on the costs of construction and delivery of the units. In all calculations, I estimate per unit costs by using financial statements on total costs per site provided by the urban ministry. I estimate average per unit construction, infrastucture and land costs by using unit floor surface area to distribute the total costs evenly by m^2. This method likely over-states the difference in the marginal cost of adding a larger unit versus a smaller unit, especially since all units incurr specific fixed costs, but not by much: estimated housing values are also roughly proportion of housing size. The land on which housing is built is relatively cheap, at \$100 per unit of floor space provided. Because the new buildings are 5-storey, but spaced relatively wide apart, this translates into an estimated land price, at the time of construction, of \$150 per m^2 . Construction costs are low by international standards.

To calculate the housing subsidy provided by the state to winning households, I simply subtract the total sales cost at which the unit is given to the household from the total construction costs, less the cost of providing the supportive infrastucture. Median household income in the sample of applicants is \$3,600 per annun. This means that the required downpayments and mortgage repayments are really quite sizeable. In Section 5, I discuss

[18] In Section 6.4 I return to this and look at different sites, including those located closer to the centre.

in more detail the financial implications of winning an apartment, and the implications of moving in or renting out a unit.

3 Data

3.1 Sampling

I draw my sample from government administrative records of households that had applied, and were eligible, for the housing scheme.[19] I drew my sample using administrative records on these households, as well as the results of the March 2015 lottery, the single lottery which generates the random variation studied throughout this paper.

Less than 30% of households in the waiting-list pool of applicants received a house in the lottery of 2015. Therefore, to maximize power, I sampled after the resutls of the lottery were known, so that I could ensure a larger proportion of my sample were treated. Second, the government conditioned winning probabilities on household characteristics, namely: female applicants, and applicants employed in the government sector, were prioritized. I did not know exactly how this prioritization worked in practice at the time of the baseline survey. Therefore, to ensure that each household included in the study had experienced identical *ex ante* odds of winning the lottery, I matched households one-to-one on adminstrative characteristics. Specifically, I divided treatment and control households into strata among which administrative characterstics were identical. The *ex ante* probably of winning the lottery was equal within these strata. I then took a completely random and representaitve sample of households of winning households, and for each winning household I sampled a single "matched" non-winning household from the sample strata, without replacement. In this way, each sampled winning household is matched uniquely to a control household. Therefore, an identical number of winning and non-winning households were originally listed, and these listed 'treated' and 'control' samples were identical on measureable administrative outcomes.

Note that this means that the sample is representative of households who won the lottery. As future lotteries are conducted, and the composition of the remaining applicant households changes, the composition of future winning samples is likely to change. Because the aim of this paper is to estimate the effects of the current lottery on households, I believe this sample is the correct one to use. Iin order to make predictions about how the effects of future lotteries may differ to this one, I reweight my sample to be representative of households in the applicant pool.[20] Since I find that my main results are hardly changed

[19] These lists came from the Ministry of Urban Development and Housing of the Government of Ethiopia.

[20] For example, my sample comprised proportionately more households with female applicants than female households remain in the applicant pool. Therefore to reweight my results I assign a higher weight a lower weight to households with female applicants to obtain average treatment effects representative for the applicant

by reweighting in this way, I include these results as robustness checks in the appendix.

The sample of households were interviewed for the first time in May 2015, immediately after the results of the lottery were announced. The only information available by which to contact people was a single phone number on record in the government administrative data.[21] Every household on applicant lists had a mobile phone number listed. This made it impossible to track households when these numbers had become dormant or been disconnected.[22] This problem of inactive phone numbers accounts for most of the non-response in the construction of the baseline sample. In total we reached 82% of listed households. Enumerator records show that more than 75% of this non-response came from inactive phone numbers. Importantly, whether a household had an inactive phone number or not was not affected by whether a household had won the lottery. This is unsuprising, as the lists were compiled before the lottery occurred. I find that treated households were no more likely to respond to the survey than those who were not treated. In total, the survey team reached 783 lottery winners and 781 non-winners, with a total baseline sample size of 1564.

3.2 Who applies and who wins?

Using the baseline data, I establish a set of key characteristics of my experimental sample.

First, I find clear evidence that the housing lottery is fair. Because of my strategy of sampling from the treatment and control group matching one-to-one on adminstrative observables, the probability of winning was equal *ex ante* among treated and control households, if the lottery was fair. For this reason, one should expect the sample to be balanced without conditioning the cells on which treatment itself was conditioned. Therefore, I conduct unconditional balance tests, shown in Table A.2, but the results are similar if I conditional on the strata used for matching. I conduct a joint F-test of the predictive power of fourteen main survey outcomes as well as administrative data. I fail to reject the coefficients of the effect on winning the lottery of my list of covariates are jointly equal to zero.[23]

My sampling strategy implies that the lottery outcome could already have affected household behaviour, since the baseline survey is actaully conducted shortly after the lottery results are announced. Not only do I find no signficant imbalance along imutable household and household head characteristics, but I find no evidence that winning the lottery has affected household labour supply, expenditure, income or even attitudes. This

pool.

[21] In very few cases administrative data on household addresses as also useful, but without a consistent address system in use in Addis Ababa, the house numbers provided by the administration were largely useless for tracking households.

[22] Furthermore, data entry mistakes by the administration lead to missing phone digits.

[23] This is not suprising in the case of the administrative data, since that data was used to match the households. The F-test fails to reject a joint null effect of only the survey data gathered in person.

is not suprising, given how recently these households had heard that they had won the lottery. Certainly no households would have had the oppurtunity to move into the new units yet: most of the apartments were still under construction and would remain vacant for at least another six to eight months.

Second, I show that winning households are comparable, along a number of measurable dimensions, to the population of Addis Ababa as a whole. That is not to say that the sample is entirely representative of the average household in the city, after all, they self-select into the program, possibly along unobservable dimensions. That said, the availabe evidence suggests that *most* households in Addis Ababa applied for the program. Government administrative records suggest that over 700,000 households registered for the housing scheme as a whole, when projectons from the 2007 Census forward to 2015 suggest that there are a little under a million households in the city as a whole. Households are required to prove residency to apply for the scheme, and while this may be possible to fake, and it may be possible for single households to have registered multiple times, it is still reasonable to assume that the majority of households in the city are registerd for the scheme.

Certainly the households in this study are not significantly more well off than the average household in the city, nor do they live in significantly better housing. Table A.3 shows a comparison between my sample and representative data from the Household Consumption and Expenditure Survey (HCES) conducted in 2011. [24] Inflation adjusted consumption per adult equivalent is similar, if slightly higher, than the average in the 2011 data. However, if I correct for the rapid rate of growth over this time period, using the national average, this suggests that my sample is in fact richer than the average household in the city. I have very recently acquired the latest HCES data, conducted in 2016, which shows, indeed that household consumption at the time of my survey was closer to 2103 Birr (roughly $78) per adult equivalent at 2015 prices, considerably higher than in my sample. Figure A.1 shows that distribution of household expenditure per adult equivalent is similar to that of the representative data. I use a proxy-means test model to predict household consumption using household demographics, assets and housing conditions, and find a very similar proportion of households in poverty in my sample. The most notable difference is the difference in ownership patterns in the data: households in my sample are less likely to own their own units. This is because the eligibility rules are intended to exclude households that own their own houses. While households in my sample have slightly more durable housing materials (notably, hard floors) they are considerably more over-crowded and have similar levels of access to private toilets and improved water. In this sense, I think the results from this paper not only teach us something about the beneficiaries of this program, but also about the preferences and constraints facing the representative household living in informal housing in Addis Ababa. Most importantly, fully 73% of households in my

[24] Conducted by the Ethiopian Statistical Agency (CSA).

sample live in housing that would be characteristized as slum conditions, which is higher than the average in the city as a whole. My resulst are robust to dropping all non-slum households from the sample.

3.3 Endline survey

The endline survey was conducted with the study sample from December to 2017 to February 2018.[25] Households that moved into the units have lived in the housing for roughly 16 months, on average, at the time of the endline survey.

The survey team were able to contact 91.18% of the sample, which is comparable to other studies in this literature, and is uncorrelated with treatment. See Table A.5. Relatively few covariates predict attrition, and the joint F-test on the effect of a set of pre-specified set of covariates on attrition is not significant. Even when I use a significantly expanded list of variables to predict attrition, I find no joint significant effect on attrition. It seems that what researchers should really be worried when it comes to attrition is that the pattern of attrition of attrition is significantly different between the treatment and control group, even if there is not significant difference is overall attrition between the two groups. I interact treatment with each of a my baseline covariates, and conduct a joint-F test of the hypothesis that they are jointly equal to zero. I find no evidence that different variables predict attrition in the treatment group (p=0.859).

Lastly, I want to be sure that the my main results are driven by changes in household composition: for example if winning the lottery increases the likelihood that a working age adult joins the households, thereby mechanically inflating the total income of the household. Using estimating equations outlined in my main empricial strategy section, I find no effect of the program on household size, and members joining or leaving the household (see Table A.6).

4 Identification

The analysis in this paper proceeds in two steps. In Section 5 I describe the financial implications of winning the housing lottery and the implications of moving the new housing. Here I want to understand how households adjust their consumption of housing, other consumption, and investment in response to winning the lottery. In the second stage, in Section 6, I study the effect of *moving* to mass-housing sites, using the results from Section 5 to shed light on whether these results could be driven by the direct effect of winning the lottery, rather than by moving to new housing.

[25] I track only the sample of households found at the baseline survey, having been convinced that the winning and loosing samples are comparable since the lottery is fair and that non-response at the baseline was not affected by winning the lottery.

Therefore, throughout the analysis my preferred estimator is an ITT estimate of the effect of winning the lottery on the household outcome of interest, averaging across households that move in and those that do not. I follow closely a pre-registered analysis plan, in which I define five main outcome families and outline my identifying equations.[26]. I use an intention-to-treat estimate of the effects of winning the lottery, estimated by T_i in Equation 1.[27] These are my preferred estimates. In each table of results, I report an index associated with each of the five primary outcome families. I control for a range of household baseline characteristics in all specifications, as well the baseline outcome of interest $y_{i,pre}$ in all regressions (Bruhn and McKenzie, 2009).[28]

$$y_i = \beta_0 + \beta_1 \cdot \mathtt{T}_i + \alpha \cdot y_{i,pre} + \boldsymbol{\delta} \cdot \boldsymbol{x}_{i,0} + \mu_i. \tag{1}$$

However, I want to unpack the extent to which particular effects (or lack of significant effects, as the case may be) are driven specifically by moving into the housing, and therefore what the implications of moving are. I estimate Equation 2 below, where β_2 estimates the difference in outcome y among those who move in relative to those that won the lottery but rented the unit out.

$$y_i = \beta_0 + \beta_1 \cdot \mathtt{T}_i + \beta_2 \cdot \mathtt{M}_i + \alpha \cdot y_{i,pre} + \boldsymbol{\delta} \cdot \boldsymbol{x}_{i,0} + \mu_i. \tag{2}$$

I proceed with caution throughout this analysis, acknowledging that the decision to move into the housing unit is not randomized, and so selection effects could be driving my results. First, I replace the set of pre-specified baseline covariates $\boldsymbol{x}_{i,0}$ used as controls with a set of a controls that predict the moving in decision $\mathtt{M}_i$, using machine learning techniques to select the right controls. Second, I check, for each outcome of interest y_i for whether the moving in decision is predicted by the baseline measure of the outcome of interest $y_{i,pre}$. Then I estimate Equation in first differences of y_i in order to be sure that selection on observables is not driving the results. While I cannot completely rule out the possbility that time invariant shocks are driven selection into the housing, and therefore

[26]https://www.socialscienceregistry.org/trials/2114

[27]I do not cluster my standard errors, since the unit of randomization is at the level of the individual (Abadie et al, 2017) and respondent households were scattered across the city at baseline, with no natural boundaries across different areas, and sampled at random without cluster-sampling.

[28]As pre-specified, I use the following baseline covariates x_{i0} are: total household earnings, total household size, number of working age members, number of school age members, dummy for rented a house privately at baseline, dummy for rented a house from the government at baseline, education level of household head, and data from the administrative data that was used to conditional the lottery winning probabilities: gender of the applicant, whether the household head works for the government, type of housing unit applied for (studio, 1-, 2- or 3- bedrooms).

the results, the consistent and clear pattern of In what follows, I am often able to show a very clear lack of evidence of any effect of winning the lottery independent of moving, with contrasting dramatic changes for those that move. I argue that this allows me to interpret the coefficient β_2 on the dummy varibale for having moved into the unit that the respondent owns as the *effect of moving*. And, in particular, when I estimate β_2 and β_1 very close to zero, both in first differences and in levels, I take this is as evdience that the effects of moving are likely very small.

4.1 Testing strategy and multiple hypothesis testing corrections

My pre-analysis plan outlines five outcome families, which comprise the primary outcomes of interest for this project. In fact, the analysis in this paper focusses almost exclusively on these five main outcome families, aside from specific tests used to illuminate mechanisms. These outcomes are: (1) Housing quality, (2) Housing Investment, (3) Labour market outcomes, (4) Social networks, (5) Community and public goods. My pre-analysis plan defines a index for each outcome (where appropriate), a list of outcomes that makes up that index, and (for some families) a further list of outcomes that do not enter the index, but are included in that family. I use the method of Anderson (2008) to calculate a standardized index for each main outcome.

Within each family I correct for the number of hypotheses across all of the members of that family. I use the method of (Benjamini et al., 2006) to control the false discovery rate. Then, using the five main indices I correct for the fact that I test for outcomes across five main families, using the same method. For the sake of narrative continuity, I discuss the main results in the paper family by family, but for an overview of the main results, I show the results for these five indices, taken together, and estimated with Equation 1 in Table 4 in Section 6. Column (5) provides the sharpened q-values, accounting for multiple hypothesis corrections. For each prespecified family of outcomes , I report False Discovery Rate q-values adjusted across outcomes within each family, in addition to reporting standard p-values.

4.2 Lottery since 2015

I make one deviation from my original pre-analysis plan. Since the lottery in 2015, the state ran another housing lottery very late in late 2016, in which households in my control group had the opportunity to win housing. In all 18% of households in my control group won housing in this lottery. At the time of the endline very few of them had moved into the units that they won, some were still finalizing the mortgage down-payments, while others had made significantly complementary investments and others had not. Because of these changes in my control group, I prefer to net these households out of my analysis, by including a dummy for being in the control group but winning housing in the 2016 lottery.

I do not report the coefficients on this dummy. These are my preferred estimates: while the results are qualitatively similar without this adjustments, the magnitudes of the coefficients are more reliable with it.

5 Do households move from slums to housing estates?

Winning households must decide whether to buy the house by paying a 20% down-payment and taking on a large-mortgage, which covers the construction costs of the unit. Second, they must then decide whether they will move into the unit or remain in the informal housing market. Third, households must decide how much to invest in further upgrades to their housing unit, regardless of whether they choose to live in it or not. I find that than 95% of households who win the lottery buy the house, and approximately 50% of households who win move in. Households who win invest heavily in further improvements to the units, and those that move in invest even more (13% and 17% of the initial construction costs, respectively).

In this section I describe the decision facing households who win a house in the Ethiopian housing lottery. What are the trade-offs when they face when making these decisions? What can these decisions tell us about households' preferences? Does revealed preference imply that made better off? To do this, I present descriptive estimates of the changes in financial status of households that win and move into the units. Table 2 estimates equation 2 for the separate effect of winning the lottery plus the effect of moving in relative to not moving. Although the decision to move in, is of course, endogeneous, these results give a good sense of the implications of the moving in decisions, particularly because the effect of winning the lottery without moving in is estimated close to zero on most outcomes.

(1) The housing units provide considerably better housing conditions and access to urban infrastructure. Moving into the housing leads to a 1.4 standard deviation increase in housing quality. This is an enourmous effect size, and reflects the wide-ranging advantages enjoyed in government housing over the housing conditions of individuals who do not move into the housing. Table A.8 in the appendix shows a decomposition of this main housing index, which was one of my five prespecified outcomes of interest for the paper with ITT estimates of winning the lottery. This shows that moving into government houses has significant effects on access to all of the main amenities that comprise the UN definition for slums, which include access to running water and sanitation as well as an improved durable structure. These effects are driven entirely by households who move into the government housing.Importantly, I selected the constitutent parts of this housing index to reflect the amenities provided by the state, and to exclude any upgrades to the unit that the household may have made to their housing unit. I return to those upgrades in the next sub section.

(2) Households that move live considerably further from the city centre, on average 8.8 kms further from the city-centre than those that do not move in.[29]

(3) Mortgage repayments for the government housing units are, on average, very similar the rents that households can earn from renting out these houses. There is some heterogeneity: because the state does not vary the price of new housing units by their location, the lucky households that receive housing very close to the centre are able to rent out their units for considerably more than the amount required for mortgage repayments. However, I have very few such households in my sample, implying that the average household who rents a house on the very outskirts receives rental income jus short of the required mortgage payments. This implies that, on average, that incomes of winning households are unaffected, on average, if they do not move into the housing units.

Table 2: The moving in decision

	Control		ITT Estimates			
			Lottery		Lottery + Moved in	
Outcome	mean	N	Coeff	Std. Err.	Coeff	Std. Err.
	(1)	(2)	(3)	(4)	(5)	(6)
Housing quality index	-0.0	1,426	0.1	0.2	1.5***	0.3
Distance from centre (km)	5.4	1,426	0.6	0.5	8.7***	0.5
Estimated housing cons.)	81.3	1,426	-3.4	3.0	10.1***	2.9
Net housing costs	49.3	1,426	0.8	3.8	23.4***	4.3
Rent income	2.9	1,426	68.4***	2.8	-66.1***	3.0
Mortgage repayments	3.5	1,426	74.3***	4.2	-3.6	4.3
Rent payments	48.2	1,426	-0.6	3.0	-43.2***	3.7
Housing subsidy received	32.0	1,426	2.9	4.0	-23.2***	4.0

(4) Condominium houses rent out for more than the average rent that households pay in their homes in more central informal settlements. As such, the market values larger, formal houses on the outskirts more than informal dwellings in the centre. As a result, moving into a condominium implies a significant financial cost, in the form of a net increase in spending on housing. Moving households lose access to rent from their condominiums that outways the gain in no longer paying rent for their old households. In this sense, moving households are paying more for better housing quality. This shows up clearly in household finances: row 3 of Table 2 shows that that moving households have higher housing consumption, but pay more for housing.

(4b) That said, lessor households pay broker fees that drive a wedge between the rent

[29]Here I estimate the distance from the city by direction Euclidean distance, but the results are similar when I calculate travel distances using the existing road network in the city.

that the receive for renting, and the rent that is paid. 62% of households that rent out their units do so through brokers, who charge a fee of 10% of the rental agreement on all exchanges, for at least one year of the lease agreement. In addition, lessors are required by law to pay taxes on rental income of 15%. While these are rarely enforced, many households suspect that they may be retrospectively, at some point in the future. These costs drive a wedge between the oppurtunity cost of moving in faced by the owner, and the market equilibrium value of living in the unit. So even if a household values their own condominium apartment at the same price as the market, the household will 'outbid the market' for their own unit, and will move in.

(5) There is heterogeneity in the financial costs of moving to a new housing unit, driven by heterogeneity in baseline tenure status. Many slum-dwellers receive large implicit housing subsidies, because they pay zero or very low rent. 35% of my sample live in informal housing units owned by the local government, which they rent out for, on average $0.75 per month. Another 10% live for free by squatting on public land. By contrast, households who live-in slum like conditions but rent on the private market, pay prices closer to $81 per month.

In the condominiums, 1-Bedroom units rent for $78, while 2-Bedroom units rent for $110 (on average, in my sample). So while moving from informal housing to condominiums is relatively cash neutral for some households, it is considerably more costly for other households. My data suggests that housing conditions in goverment-owned housing are roughly similar to informal units rented on the private market (in terms of access to key housing amenities, building materials, number of rooms, and location). Therefore, moving out of government housing implies losing free rent to the sum of roughly $81 per month.

5.1 Who moves?

I look for predictors of whether a household moves into the unit that they win among my full set of baseline covariates. Suprisingly few economic variables predict the move-in decision. Households of various wealth and earnings move in. Households who live rent-free (usually squatters on illegal land, or those that live for free in someone else's home) are slightly less likely to move in than those that rent out. This is not surprising, given that they lose large implicit rent subsidies when they move- still a surprisingly large fraction do move.

I employ a set of machine learning techniques, I extract the variables with the greatest explanatory power for whether a household moves into their own units or not. Employing a random forest classification model, with the optimal number of splits of five, on average, I find that outcomes related to social networks and community are the strongest predictors. Households that are not members of iddirs (large risk sharing groups with formal rules and structures) are more likely to move, and households with a large proportion of their

social network outside of their local neighbourhood are more likely to move.

5.2 Consumption and investment

The results in the previous section have shown that the average direct effect of winning the lottery on housing income is negative: lessors break even on their mortgage repayments, while those that move in pay more in mortgage than they paid in informal housing. But winning the housing has a sizeable wealth effect. Are households bringing forward their consumption of this wealth in the form of housing alone, or are they increasing their consumption of other goods too? Or are the increased costs of housing coming at the expense of other forms of household consumption, and therefore welfare?

Table 3: Expenditure and investment: Effect of winning the lottery

		ITT Estimate Lottery			
Outcome	Control mean (1)	N (2)	Coeff (3)	Std. Err. (4)	Adj q-value (5)
Expenditure, non-housing (monthly, USD)	166.1	1,426	76.8***	5.8	
Complementary housing investment	10.8	1,426	70.8***	2.7	0.001
Purchase of household durables	2.4	1,426	3.5***	0.7	0.001
Food Expenditure	71.7	1,426	2.6	2.0	0.237
Transport costs	12.8	1,426	2.8***	0.8	0.001
All other consumption	68.6	1,426	-3.2	2.9	0.262

Here I look at total household expenditure, net of all housing costs (rent, mortgage repyaments, or rental income). Further, following my pre-analysis plan, I break down these expenditures into housing investments, purchases of durables, transport costs, food and other consumption. Table 3 shows that total household expenditure rises enourmously, but this effect is driven almost entirely by increased housing investments, to which I will turn shortly. Household consumption, both on food and other goods, is unaffected, and the estimates are flat across the quantiles of household consumption (Figure A.3).[30] I exclude transport costs from these estimates: unsuprisingly, transport costs increase significantly for households that have moved to sites far from the centre, but it would misleading to think of these increases in spending as increasing household welfare. Similarly, investments in housing quality and durables are already likely to be captured in my measure of housing consumption. What is striking is that household consumption is not affected, in either, by winning formal housing, nor moving into it. Taken together with the results on housing quality and housing consumption, this suggests that households are consuming the entire

[30]The results are robust to looking at consumption per adult equivalent. I have 80% power to detect an effect of just $10 on the sum of food and other consumption, as effect of seven percent. Note that I find no significant impact on other sub-categories of spending, such as healthcare, education, clothing or entertainment.

housing subsidy in form of improved housing.

By constrast, the effects of winning the lottery on housing investments are enourmous. Here I measure housing investments as all money spent, over the last two years, on building, upgrading, or maintaining on any home that they own. This could include all fixed installations and permanent building, but excluded any moveable durables like furniture. I then average that number of the 24 month recall period to estiamte an I find that households spend on average $71 per month on housing investments after winning the lottery, off a control mean which is nil for the vast majority of households in the control group. This is equivalent to an average investment of $1700 per household in the new units, which is equivalent to 42% of all expenditure in the control mean, 30% of the total mortgage subsidy, 20% of the total construction costs of the units, and roughly 100% of the original down-payment made when taking out the mortgage. For winning households, these investments are made almost exclusively in the housing units that they have won. Investments in improving slum housing among in the control group are very well, but are, in fact, slightly higher as a percentage of total expenditure, than households in representative data from Addis Ababa.

With a random subset of households I conducted a longer form investment module to more closely investigate the types of investments that households had made, and to more closely verify that the investments had been made. This survey reveals that, in anything, the numbers are slight under-estimates of the size of the investments made by winning households. Households in the more detailed survey report a median investment in the housing of $2300 each. Further, I break down the investments into 32 different sub-categories of upgrades, from a list compiled from qualitative work.

The investments made do not directly contribute to the housing quality index. Figure A.2 in the Appendix shows a break-down of the most regularly reported types of investments made by households. A quick comparison with Table A.8 shows that very few of these of these investments are captured in the main housing index, such as the formal building materials, taps and flushing toilets. Rather the upgrades are made to tile the floors, particularly in bathrooms, plaster and paint walls,

Most importantly, these investments are, in the vast majority of cases, improvements or amenities that the lottery winners did not enjoy in their old informal homes. For many other items, for example: doors betewen adjoining rooms, they reported having the item in their old house, but that the new item in the housing unit was as significant improvement on what they had before. Using the detailed disaggregated data on upgrades and whether the household reports having had that upgrade before, I estimate that 93% of upgrades were completely new amenities, for the median household.

By contrast, households in slums invest almost nothing into their homes or properties. This holds true in my data at baseline, my control group, and representative household

expenditure surveys, in which households invest less than 0.5% of total consumption in home improvements.[31]

Why do households make these large investments in their new homes? In the case of lessor households the motive is clear- they earn a higher return when renting out when they make these improvements to their units. The data shows a strong correlation between housing investment levels and the rent that condominiums fetch on the market.[32] However, households that*live* in the units that they own invest significantly more than those that do not, even though they are any wealthier, nor did they live in better housing at baseline, than those households that do not move in. They consume those housing upgrades. And we know that winning the lottery and moving in does not increase household income. If households are able to dissave from their future wealth, which has increased as a result to winning the lottery, then it is striking that they consume all of this in the form of improved housing now, with no effect on other forms consumption. By contrast, households who do not move into the housing and rent it out, do not invest anything in upgrading the informal housing that they live in.

I argue that these results could be driven by two mechanisms. First, security of tenure could make households willing to make investments without fear that they'll loose these investments if they are forced to move out the units that they don't earn. Still, this would not explain why, in the private rental market in the rest of Addis Ababa land-lords do not make significant improvements to informal housing units. A second explaination is that the returns are higher returns to investment (whether those returns are privately consumed or rented) in formal housing relative to informal housing. For example, plastering and painting the inside of a house made of wood and mud is likely to be more expensive to do, and considerably more expensive to maintain. Similarly, certain other investments in improving housing are likely to be almost infiniitely expensive without actaully constructing a formal housing unit: such as installing a proper shower in a house without a formal connection to the water mains. Therefore, upgrades that can be made to informal houses have much smaller amenity value, dollar-for-dollar, than they do in the new condominiums, which would explain why housing investment increases so much in the new apartments.

6 Impacts of winning the lottery

Table 4 shows the results for impacts on my five main outcomes. Some of these results have already been disucssed in great detail in the previous section: namely the effects of

[31] They spent more, in fact, on repair and maintenance of their homes after their homes are damaged.

[32] A small minority of households report that they were unable to afford the costs of investing and so are waiting to make those investments before renting out the unit.

Table 4: Summary of main effects on five primary outcomes

Outcome	Control mean (1)	ITT Estimate Lottery N (2)	Coeff (3)	Std. Err. (4)	Adj q-value (5)
Housing quality index	0.000	1,426	0.703***	0.058	0.001
Expenditure, non-housing (monthly, USD)	166.064	1,426	76.769***	5.764	0.001
Household labour market index	0.000	1,420	-0.059	0.049	0.227
Intensity of social interactions (index)	0.000	1,426	-0.317***	0.049	0.001
Community and public goods index	0.000	1,413	0.140***	0.053	0.010

winning the lottery on housing quality and housing investments. I argue that the effects on housing quality shown in Table A.8 reflect entirely the improved housing provided by the state and enjoyed by those households that move in. Households that do not move into the housing do not experience an increase in housing quality, and baseline housing charactersitics are not correlated with whether households move into their units. The additional investments made by households into the units provide additional amenities, over and above improvements in housing quality, for those that move in.

Thus, the results thus far suggest an overall welfare gain in the form improved housing consumption for winning hosueholds. Would these households have been better off receiving the housing subsidy in cash, instead of the large illquid asset that the housing lottery provides? The results suggest that at least for some households, they would not: to the extend that they can consume the housing subsidy in the form non-housing consumption by renting out the unit and dissaving against increased future wealth, I find that households chose to forgo increased consumption now, firstly by moving into the condominium units that they own, and secondly, by investing heavily in the units that they live in.

But does moving come with significant costs or disamenities that I have not yet discussed? And could it be that households that have been made wealthier by the housing subisidies are enjoyed increased housing consumption only by moving to locatiosn where they will suffer lower incomes, thereby off-setting their increased wealth in the future? And is there any evidence for the claim that the new neighbourhoods that they live in will suffer longer term decline in quality, as result of the lower social capital? In this section I turn to the effects of winning the lottery on non-consumption outcomes. I look at labour supply, time-use, social networks and community.

6.1 Labour market outcomes

I document the effect of winning housing on household labour supply. I look for evidence that individuals in households that relocate far away from their original locations have

worse labour market outcomes, reflected in lower total earnings, hours worked or overall employment. The results show no effect of winning the lottery on housing on labour market outcomes. Table Panel A of Table 5 shows the reults for household level averages per working-age member. I am able to rule out even modest impacts of winning the lottery on total hours, employment or total households earnings.[33] I start with my main index of household labour market outcomes, prespecified as one of five primary outcomes for the analysis, and below show the results for the three constituent parts: employment, hours worked and earnings. The null results at the household level are mirrorred in the individual-level results in Panel B. The results are robust to either including, or excluding, adult household members who were both present and working age in the baseline survey. There is some evidence that winners are significantly more likely to be working in a white-collar job (a professional job, in an office), although this result is not robust to correcting for number of hypotheses related to employment outcomes that I tested. These results do not appear to hiding significant heterogeneity in treatment effects among workers. Figure 5 plots the estimates for quantile regressions across the distribution of household earnings hours per working age adult, and the labour market index. The profiles of effects is relatively flat across quantiles, with only a mild (insignificant) dip around the median of hours worked.

6.1.1 Could the lack of impacts be driven by the wealth effects of the program?

Standard economic theory, and a growing body of evidence (see, for example, Cesarini et al. (2017)) would suggest that any increase in wealth due to the effects of winning the lottery should reduce household labour supply. This makes it unlikely that the null effects on labour supply are due to some large effect of moving being counter-acted by a positive labour supply response to the wealth effect of the lottery. Still I check for evidence that this could be the case.

First I show that baseline labour market outcomes have little predictive power over who moves into the housing, and who does not. Second, I show that the effects of winning the lottery are estimated to be close to zero, both among those who move in and those that do not move in. Furthermore, when I estimate the effects of moving separately from the effects of winning, in first differences between endline and baseline labour market outcomes, I find no effects. Table A.9 shows these findings. In the first set of columns I estimate the average treatment effect of winning the lottery among those that win, while the second set of columns shows the additive effect on moving into the housing, on top of the effect of the lottery. Finally, Column (7) shows the p-value for the joint test that the combined effect of the lottery plus moving is equal to zero.

[33] I have 80% power to detect a treatment effect of 1.578 hours of work per working age adult, over a mean of 30 hours per working age adult, with $\alpha = 0.1$.

Table 5: Effects of winning the lottery on labour market outcomes (household and invidudal)

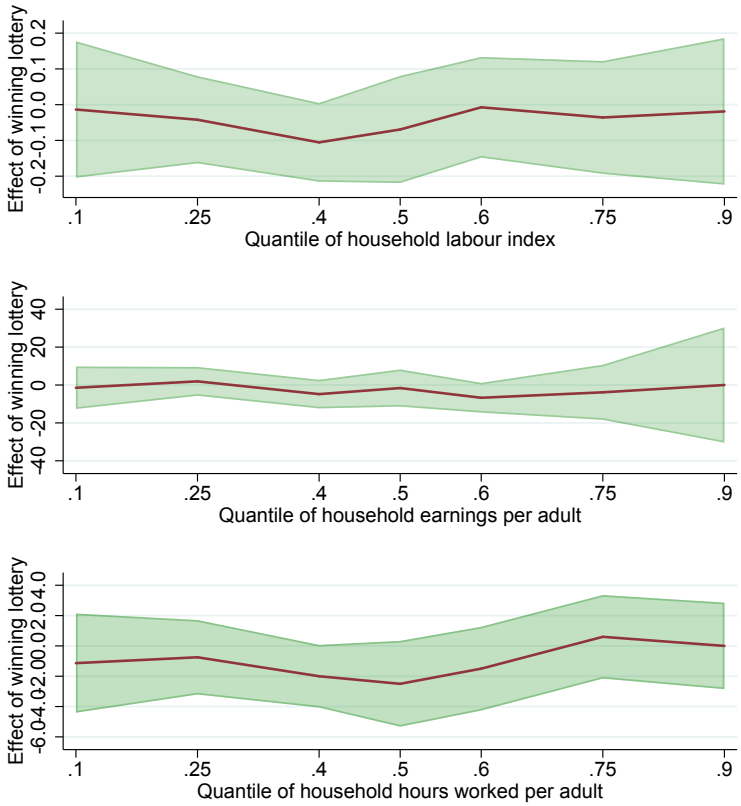
Outcome	Control mean (1)	ITT Estimate Lottery N (2)	Coeff (3)	Std. Err. (4)	Adj q-value (5)
Panel A: Household level regressions					
Household labour market index	0.000	1,420	-0.059	0.049	
Earnings per working age adult (pm, USD)	88.6	1,426	-2.311	3.980	0.562
Total employed per working age adult	0.663	1,415	-0.018	0.016	0.391
Hours worked per working age adult	29.17	1,415	-1.105	0.860	0.391
Panel B: Individual labour market outcomes					
Individual monthly earnings (USD)	83.63	3,692	-2.159	3.297	0.821
Individual hours worked in the last 7 days	29.81	3,692	-0.835	0.742	0.695
Respondent did any work in the last 7 days	0.630	3,692	-0.011	0.014	0.821
Self-employed work in the last 7 days	0.120	3,692	-0.001	0.010	0.914
Wage-employed work in the last 7 days	0.449	3,692	-0.006	0.015	0.866
Out of work and education (Youth: 16-29)	0.232	1,274	-0.007	0.023	0.866
Permanent work	0.295	3,692	0.017	0.012	0.664
White collar-work	0.196	3,692	0.028**	0.012	0.131
Panel C: Worker labour market churn					
Switched between self/wage employment	0.098	1,631	0.035**	0.017	0.090
Moved from self to wage employment	0.196	440	0.032	0.042	0.600
Moved from wage to self employment	0.047	1,501	0.030**	0.013	0.082
Switched occupations (40 main occupations)	0.379	1,527	0.001	0.025	0.956
Stopped working (working at baseline)	0.157	1,971	-0.013	0.016	0.600
Works in areas near housing sites	0.109	2,286	0.079***	0.017	0.001
Works within walking distance of home	0.282	2,286	-0.025	0.019	0.375
Works from home	0.059	2,286	-0.003	0.009	0.838

In all, I take this as suggestive evidence that in this setting, increasing household permanent income (wealth) without increasing their access to cash has no effects, or very small effects on labour supply and earnings. Similarly, moving to public housing appears to have no effect on aggregate labour outcomes.

6.1.2 Labour market adjustments

How do households manage to maintain their labour supply and earnings, despite moving, on average 8.8 kilometres (2.6 times) further from the city centre than those who did not win housing? The evidence, presented in Table 5, Panel C, suggests that some workers are able to adjust their place of work, while most others endure longer commuting times. Winning

Figure 5: Quantile regression: effect of lottery on household labour market outcomes



leads to slightly more churn in place of work, and sector of work. Members of winning households are significantly more likely to have switched their form of employemnt, either from self-employment to wage-employment or in the opposite direction. There is no effect, however, on the probability that a respondent has switched the occupation in which they work. Most importantly, winning households are almost twice as likely to work in the same neighbourhood as one of the two public housing sites. This difference was not present at baseline, suggesting that they managed to switch their place of work to somewhere more convinient. I do not find a significant impact of the lottery on the probability that individuals work in a location that is within twenty minutes walk from their home. This is partly driven by the fact that some small fraction of individuals work at home and seem to be able to move these from-home enterprises to the condominiums. Relatively few people work in the actual housing site in which they live, but not from home (only 3% of employed individuals), but a substantial fraction do seem to be travel relatively short distances to the new urban centres developing close to these new sites.[34] Taken together,

[34]This result is perhaps testament to the rapid development of economic activity that sprung up near to new housing sites, often specifically to service the new demands of consumers living there, but also residents of

Table 6: Effects of winning the lottery on daily time use in minutes

Outcome	Control mean (1)	ITT Estimate Lottery N (2)	Coeff (3)	Std. Err. (4)	q-value (5)
Time on all domestic tasks	167.4	4,579	-12.2**	4.9	0.023
Time cleaning and cooking	121.9	4,579	-9.1***	3.4	0.017
Time sleeping	485.6	4,579	-0.8	2.7	0.782
Time commuting to work	30.8	4,579	8.0***	1.6	0.001
Time commuting (cond. on work)	61.5	2,249	17.9***	2.9	0.001
Time working plus commuting	536.7	2,249	11.1	7.3	0.177
Leisure	388.9	4,579	6.5	7.9	0.485

the results suggest that households moving to new neighbours do so by adjusting their place of work and their employer, some choosing to move to self-employment perhaps for it's increased work flexibility, but remain in their same occupations, and experience no loss of income as a result.

6.1.3 Commuting and time use

Winning the lottery leads to considerably longer commutes, driven entirely by individuals who move out to the public housing. I find that winning the lottery leads to an increase in commuting time per person of eight minutes, which is driven entirely by an increase in commuting time per day per working adult of seventeen minutes over a mean of roughly one hour per day. Assuming that the effects on commuting driven entirely by households that moved to the new housing, this suggests that moving to public housing has the effect of increasing commuting times by 34 minutes per day per working, more than doubling commute times. This effect is slightly smaller than the effect that would be implied by the mechanical increase in travel times from the new sites to central locations, reflecting the adjustment in place of work outlined in the paragraph above. Winning the lottery leads to an increase in individual commuting costs of roughly $2.4 per month, which is consistent with the effects of the lottery on household expenditures reported in Table 3 above. Although coefficient is negative, the effect on earnings less commuting costs per worker is not significant. Similarly there is no significant effect on the sum hours work and commuting time.

On net, there is no evidence that households that win the housing lottery reduce their labour supply, nor that those that move to housing reduce their labour supply as a result. Households seem to be able to adjust their employment in response to changing location,

new privately developed housing nearby.

with no corresponding loss in earnings. Although they face longer commutes to work, these time costs appear to be offset completely by reduced time spent doing domestic labour tasks, with no net effect on total leisure time or time sleeping. This implies that net welfare welfare costs in terms of time-use are likely quite small. I test whether treatment effects are heterogeneous by gender: if women benefit more than men from reduced domestic-work burdens, they may experience (more) positive labour market outcomes. I do find that the effect of the lottery on women's labour supply is positive, while the effect on men is negative, but neither coefficent is quite significant and they are not quite statistically different from one another.

It is possible that the time freed up by reduced domestic burdens, and the off-setting effect that has against commute times, is what is driving the null effects on total labour supply. Indeed it may be the case that if households were relocated to the outskirts of cities without corresponding improvements in their housing conditions, that total labour supply would contract. Such a test is beyond the scope of this paper, but perhaps provides another reason for why households do not move to the outskirts of the city into informal housing: the costs of moving may be higher in informal housing.

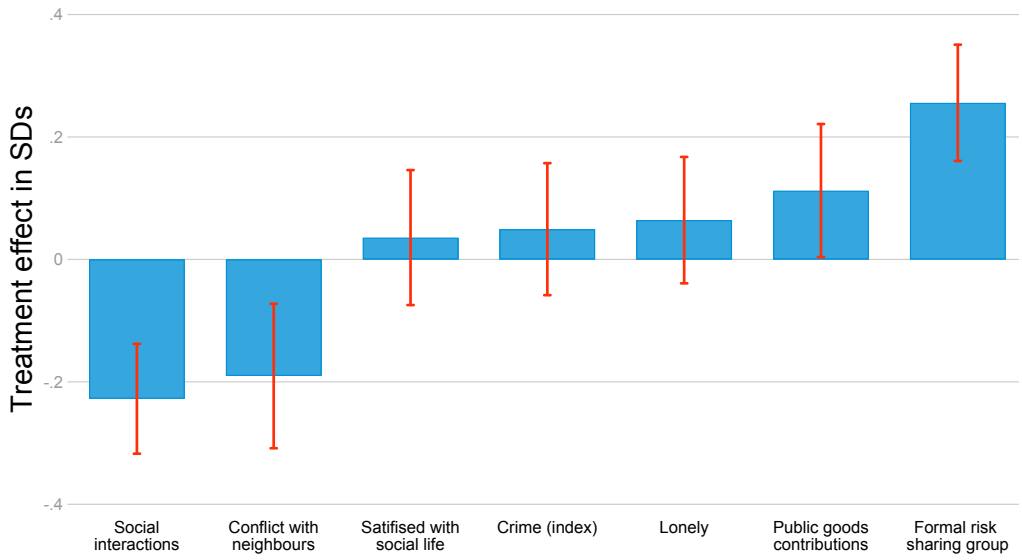
6.2 Social networks and community

Next, I turn to the social effects of the policy. Figure 6 summarizes the main effects of the policy on social and community outcomes. The tables are the online appendix. I find a large reduction in the size of total social networks and the regularity of interactions with neighbours due to winning the lottery.However, the welfare implications of these reduced social networks do not seem to be so obviously harmful. Households living in housing estates experience much lower conflict with their neighbours. This includes reductions in disagreement with neighbours, including verbal and physical fights, and reductions in envy among neighbourhods. They also report less reliance on social networks for economic affairs. I find no effect on loneliness, dissatisfaction with neighbourhood interactions, and small positive effects on general mental health and anxiety. When asked about their satisfaction with their social networks household who won the lottery were more likely to report that they "have relatively few social interactions, and I am happy with that" rather than "I have many social interactions, and I am happy with that", but no more likely to say that they are dissatisfied with their social lives.

Taken to together, the results suggest that households may rely less on informal social networks precisely because of the precarious nature of economic life in slums and that these become less important once households move out of slums. This result is consistent with the view that informal economic relationships arise as a response to a lack of formality of living in slums, and the particular burdens on economic life that this implies. When households win formal housing they become less reliant on informal networks for their

prosperity. In addition, the results suggest that informal relationships in these contexts can be a burden as well as a benefit, at least for some households. Households may resent the demands made on them by some of their neighbours, as well as the intrusion of local government officials into their daily lives. This result is related to recent work by Banerjee et al. (2016).

Figure 6: Summary of main effects (ITT) on main social networks outcomes



Finally I turn to the effects of winning the lottery on public goods and community. I find that lottery winners experience increases in their willingness to contribute both time and money to investments in public goods in their new housing sites than households in the slums report among their neighbours. I find that this is driven by households that move in, not those that do not move. These improvements reflect not only a desire to improve their physical surroundings Furthermore, I find evidence that households that move increase their participation in neighbourhood risk sharing groups that have formal rules of association and regular payment requirements. In qualitative work with households, I found that households that moved said that they were not in local risk-sharing groups in their old neighbourhoods because they were excluded from those groups, either because the groups were closed to membership at the time that they moved to the city, or because membership was determined by political connections that they did not have. Moving to new neighbourhoods allowed them to more freely associate with their neighbours and set up risk-sharing groups on their own terms. This story is consistent with the quantitative data: I find that the main predictor of whether a household moves into the housing is their attachment to local social networks and risk sharing groups before they moved: it is the

households that had the weakest ties to their old neighbourhoods who were more likely to move.

6.3 Heterogeneity by treatment site

The majority of housing studied in this paper is located in a few sites, a certain distance from the city. Rents in these units are similar to private sector slum housing in the centre, and similar to the morgage repayments on the units. These specific characteristics of the units allow me to draw lessons from households' decisions to move or not move into the units. The program might operate differently if the housing units were located elsewhere. I do have data on households that were relocated to a few different sites, at different distances from the city. Indeed, households that win a house in the very centre face a different location, expenditure trade off. They may be more likely to move in if they have strong preferences for a central location, but less likely to move in because the implied loss of rental income is so much higher. Therefore, take up rates might not only differ by site, but the baseline covariates correlated with program take-up may differ too given the different trade-offs that households face.

The random assignment of households to housing sites, conditional on winning, gives me causal identification of the effect of a winning in a different site. I returned to the field to collect additional data from households randomly sampled only from smaller housing sites in different locations in the city. Table A.1 shows the 10 different sites in the data, with sample sizes and average distance from the city centre by site.

I assign a travel time to the centre of the city, using google maps traffic data. For the very lagest housing sites I estimate the time taken to walk from the edge of housing site to the main tranpsort route, to generate hetergoneous travel distances within housing sites. I then look at the affect of the (randomly assigned) distance of the housing unit from the centre, and estimate differential treatment effects by distance. Because the distrubtion of apartment distances is highly non-uniform I group households by distance to the city into four distance categories. I denote each category $\mathtt{T}_i^{\{d_1,d_2\}}$ where d_1 (d_2) is minimum (maxium) distance from the centre of the housing, then estimate the following equation:

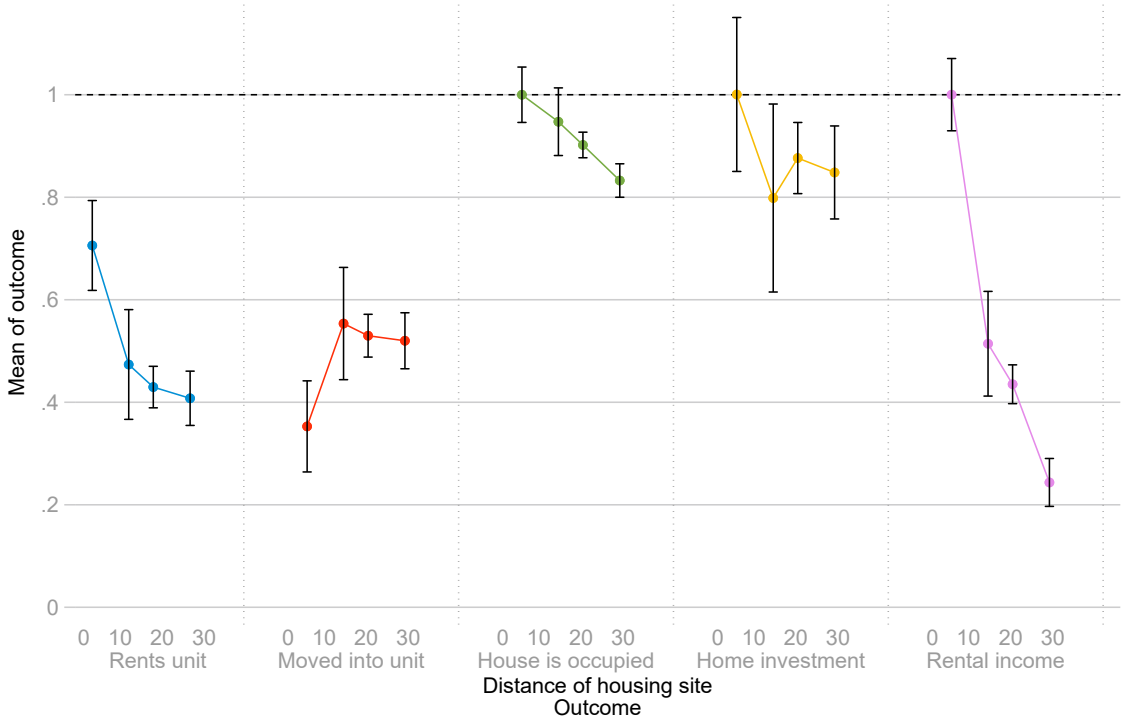
$$y_i = \beta_0 + \beta_1 \cdot \mathtt{T}_i^{\{0,4\}} + \beta_2 \cdot \mathtt{T}_i^{\{4,10\}} + \beta_3 \cdot \mathtt{T}_i^{\{10,20\}} + \beta_4 \cdot \mathtt{T}_i^{\{20,30\}} + \alpha \cdot y_{i,pre} + \boldsymbol{\delta} \cdot \boldsymbol{x}_{i,0} + \mu_i. \quad (3)$$

The market rent for houses that are rented out in the centre are orders of magnitude larger than the households in the far away sites, and way above the mortgage repayment requirements. This implies a large income effect winning such a housing unit, and also implies a high oppurtunity cost of moving in relative to moving out. In this sense households winning central apartments are offered the choice between increased housing consump-

tion or increased income, with no accompanying change in their location. This is in stark contrast to overwhelming majority of hosueholds who face housing-location trade-off with mostly no implications for their income. By constrast, I have a sample of housheods that win housing unusually far from the city centre, in a very remote location with commuting distance 50% further than the average housing site.

My most important finding is that the proportion of households renting out the housing units falls dramatically with distance, while the proportion renting out the units rises (as does the proportion of households that are left unocciped by the owners). These results reflect the trade-offs faced by households: as the opportunity cost of moving grows, households are more likely to rent out the unit, and less likely to live in the unit that they own. Rents (conditional on renting out) are considerably higher in the central sites, roughly twice the median and three times the rent in the most distance sites. Therefore, households who win housing less than four kms from the centre are very likely to rent out and earn a lot from doing so. There are made substantially richer. On the other hand, those with units nearly 30 kms away are made poorer: renting out the units does not quite cover the mortgage repayments.

Figure 7: Description of occupation, renting and rental income by site distance



These location and rent differences have implications for the impacts of the housing. I find that households that win housing in the centre reduce their labour supply after wining, despite not moving into the units. When I split households into those who move, and those that do not, the results seem clearly driven by households who do not. The rent they earn allows them to reduce their labour supply,which is consistent with the evidence on lotteries in developed countries Cesarini et al. (2017). By constrast, households that do move into their homes in the do not experience changes in labour supply, or commuting costs. By constrast, I find some suggestive evidence that households that win households very far away, do suffer some negative consequences. All none of the results are quite significant, I find that consumption falls for households that win more distance sites. This result is driven primarily by households that do not move into their units, and find the mortgage repayments burdensome.

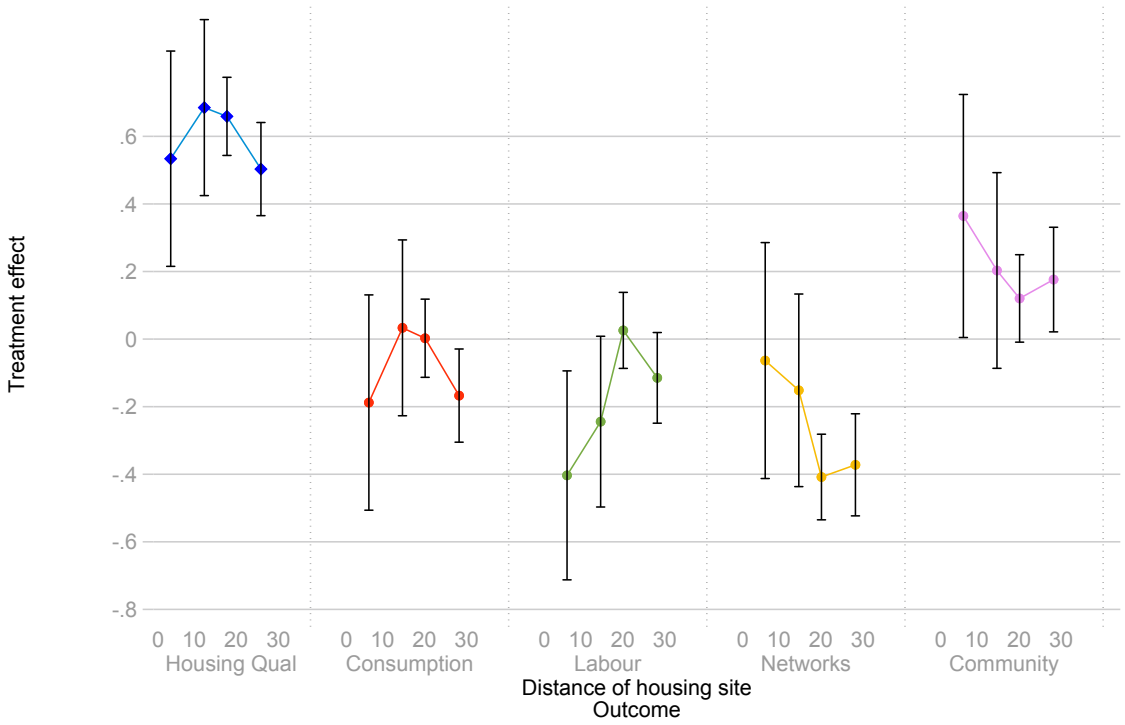
The results on social networks are particularly revealing: I find that winning housing has significantly negative effects on my social networks interaction index across all sites. This is true even for households that win housing in sites close to the city centre, and even though relatively few of these households move in. I cannot reject the hypothesis that the treatment effects are equal across all four sites (p= 0.25). I take this as further evidence, together with the earlier finding that even households that do not move into their units experience reductions in social networks, that it is not relocation to more distance sites that is driving these changes in social networks.

6.4 Spillovers and SUTVA

Winning households are selected from the population of applicants at random. This means that, in many cases, households that win the housing live in close proximity to households that do not win. Could it be that households are affected by not winning the lottery, but living next to a lottery winner, who is then likely to move out of the neighbourhood? This possibility has serious implications for the interpretation of my results. First, are the welfare gains from the program that accrue to winners and residents offset by negative spillovers onto the households that remain living in slum areas? Second, if households in my sample are negatively impacted by spillovers from their neighbours winning, this could be biasing my estimates. In other words, this would constitute a violation of the stable unit treatment value assumption (SUTVA), since the potential outcomes of both treated and treated respondents could be affected by the treatment status of other individuals in the population. For example, with regards to my main results on labour market outcomes, if non-winning households are negatively effected by loosing their social networks, this could be biasing my estimates of the impact of winning upwards, towards zero.[35]

[35]It is possible that both moving and non-moving households are negatively effected by moving, and that these two effects cancel each other out in the estimation.

Figure 8: Main treatment effects, by distance of site from city centre



This a real concen, since, in some areas of the city, up to 10% of households won the recent housing lottery. On average 7% of households in a district win the program, with a standard deviation of 3% As the program continues to expand, the cumulative of number of households who win will continue to grow.

I am able to test for the effect of having winning households in ones' neighbourhood. I use data on the universe of winners of the housing lottery in 2015, with administrative data on the place of residence of households, within 116 administrative units within the city. Similarly, I am able estimate the number of applicants in each administrative area. I match these data to census and other survey data on populations in each adminstrative unit, as well poverty rates, and the proportion of households living in slums.

Then, for both winning and non-winning households in my sample separately, I estimate the effect of the proportion of households who won the lottery in that area. I find no effect on either winning or control households across a range of outcomes. In Table 7 I show the results for the five main indices used throughout this paper, with additional checks on social networks and community outcomes. In addition I check for an effect of neighbours' winning on tenure security, measured by whether a houseold has been evicted in the last

Table 7: Effects of proportion of neighbours winning on control group outcomes)

Outcome	Control mean	ITT Estimate Lottery			
		N	Coeff	Std. Err.	Adj q-value
	(1)	(2)	(3)	(4)	(5)
Housing quality index	0.00	711	0.06	0.06	0.702
Expenditure, non-housing (monthly, USD)	165.82	711	0.88	5.92	0.883
Household labour market index	0.00	708	-0.05	0.05	0.721
Intensity of social interactions (index)	0.00	711	-0.07	0.07	0.702
Total number of social ties	11.41	706	0.39	0.66	0.781
Conflict among neighbours (index)	0.00	474	-0.07	0.09	0.721
Community and public goods index	0.00	709	0.12*	0.06	0.351
Household is a member of at least one iddir	0.54	711	-0.01	0.03	0.819
Household fears eviction in next 5 years	0.36	711	0.01	0.03	0.781
Household has been evicted in last 2 years	0.09	711	0.03*	0.02	0.351

two years, or expects to be evicted in the next five years. I express effect sizes a function of treatment proportions in standard deviations.

The number of households who win the lottery in each district is not random: it is directly correlated with the number of applicants in the district.[36] Next, I test for the effect the proportion of winners in the district while also controlling for the proportion of applicants. By law of large numbers there is very little variation in the proportion of *applicants* that win the lottery. As a result, any variation in the proportion of winners after controling for the the proportion of applicants is likely to be driven by the proportion of female public servants applicants (since these households receive priority in the lottery). This variation is also non-random, but is plausibly unncorrelated with my main outcomes of interest, or at least, less correlated than the raw proportion of applicants. Still, I add controls for the proportion of female applicants, the proportion of public-sector applicants, and an interaction between the two, and use those as controls too. Adding these controls does soak up a considerably amount of the variation in the proportion of winners, but some random variation does remain.[37] I show these results in Tables A.10. Even after adding these controls for the size and characteristics of the applicant pool, I find similar results to those in Table 7. This makes me confident that spillovers are not driving my main results.

The previous section showed that the households that moved out to the new apartments from their central locations were those that were less embedded in their neighbourhood

[36] As Figure 4 shows, areas in the centre of the city have a higher proportion of their residents as applicants. Therefore, in the results in Table 7 I control for distance from the city centre, and include ten division fixed-effects.

[37] The r-squared on a regression of the proportion of winners in a district on the proportion of applicants, female applicants, public sector and the interaction of a female and public is over 0.8.

social networks and community groups. This could explain, in part, why there are no negative spillovers: households with the weakest social ties, and the least to lose by moving, are also those who are least integral to the community, and whose absence is less consequential than other households.

7 Conclusion

I show that households living in informal housing move to formal housing on the outskirts of the city when they have the chance. Moving in immediately improves the quality of the house that they live in, and households make significant complementary investments in their new houses, adding many amenities that they lacked in their previous slum housing. Many households pay significantly more to live in these units while others give up land that they lived on free before winning the housing. This trade-off appears to come with relatively minor costs: households face longer, and slightly more expensive commutes, but see on reduction in their labour supply or earnings.

The results in this paper have implications for policies to address the problem of slums in developing countries. In this paper identify, and test for, five main arguments that are regularly made against mass public housing of the kind that I study here. First that the one-size-fits-all nature of a housing provided is likely to be relatively too good for most households living in slums, and they will sublet these units to wealthier households. Second, that they cause economic deprivation by placing households far away from jobs. Three, they will cause households to lose important social networks. Four, they will lead to high concentrations of poverty in new housing sites. And five, stemming from three and four, lack of social and economic capital will undermine maintenance of provision of public goods. Underpinning these arguments are understandings of why households continue to live in slums and the question of whether they do so because slums provide an essential economic function or whether households have little choice but to live in slums.

I find that households do choose more improved housing, even when this is financially costly, and I find no evidence of negative effects on labour market outcomes. The results on social networks suggest that households' reliance on informal networks in slums may be less important to their well-being, at least among those that choose to move. On point four, the nature of selection into the program, and the sheer number of slum dwellers in Africa's cities, means that neighbourhood diversity in the new housing sites is considerably higher than it is in the centre of the city. In a companion paper to this one, I study the effects of that diversity on neighbourhood outcomes. I find no evidence that public goods investments and commmunity cooperation in the new neighbourhoods will be significantly weaker than they are in slum neighbourhoods.

Important caveats apply to these results. First, these are short-run results. Evidence from

public housing in developed countries suggested that government built housing estates remained relatively pleasant neighbourhoods for many years before experiencing decline: in the form of mismanagement, the rise of delinquency, and every increasing concentration of poverty, as only the poorest of the poor remain in these areas. My results on the Ethiopian program are encouraging in this regard, but longer run work is required to understand the long-run effects of these policies.

Second, this policy allows households to voluntarily move to new formal housing. Many households choose not, preferring to rent to other private households, not in my sample, who have a higher willingness to pay for formal housing on the outskirts. The intention-to-treat results estimated in this paper are in no way interpreted as the average treatment effects of moving. The results could be considerably different if households that do not choose to move were forced to move.

References

Anderson, M. L. (2008). Multiple inference and gender differences in the effects of early intervention: A reevaluation of the abecedarian, perry preschool, and early training projects. *Journal of the American statistical Association 103*(484).

Banerjee, A., A. Chandrasekhar, E. Duflo, and M. O. Jackson (2016). Changes in social network structure in response to exposure to formal credit markets.

Barnhardt, S., E. Field, and R. Pande (2017). Moving to opportunity or isolation? network effects of a randomized housing lottery in urban india. *American Economic Journal: Applied Economics 9*(1), 1–32.

Benjamini, Y., A. M. Krieger, and D. Yekutieli (2006). Adaptive Linear Step-up Procedures that Control the False Discovery Rate. *Biometrika 93*(3), 491–507.

Brueckner, J. K. and H. Selod (2009). A theory of urban squatting and land-tenure formalization in developing countries. *American Economic Journal: Economic Policy 1*(1), 28–51.

Bruhn, M. and D. McKenzie (2009). In pursuit of balance: Randomization in practice in development field experiments. *American Economic Journal: Applied Economics 1*(4), 200–232.

Cai, Y., H. Selod, and J. Steinbuks (2018). Urbanization and land property rights. *Regional Science and Urban Economics 70*, 246–257.

Cattaneo, M. D., S. Galiani, P. J. Gertler, S. Martinez, and R. Titiunik (2009). Housing, health, and happiness. *American Economic Journal: Economic Policy 1*(1), 75–105.

Cavalcanti, T., D. Da Mata, and M. Santos (2013). On the determinants of slum formation. *The Economic Journal*.

Cesarini, D., E. Lindqvist, M. J. Notowidigdo, and R. Östling (2017). The effect of wealth on individual and household labor supply: evidence from swedish lotteries. *American Economic Review 107*(12), 3917–46.

Chetty, R., N. Hendren, and L. F. Katz (2016). The effects of exposure to better neighborhoods on children: New evidence from the moving to opportunity experiment. *American Economic Review 106*(4), 855–902.

Chyn, E. (2018). Moved to opportunity: The long-run effect of public housing demolition on labor market outcomes of children. *American Economic Review forthcoming*.

Collin, M., J. Sandefur, A. Zeitlin, et al. (2015). Falling off the map: The impact of formalizing (some) informal settlements in tanzania. *Centre for the Study of African Economies Working Paper, University of Oxford*.

Collinson, R., I. G. Ellen, and J. Ludwig (2015). Low-income housing policy. Technical report, National Bureau of Economic Research.

Field, E. (2007). Entitled to work: Urban property rights and labor supply in Peru. *Quarterly Journal of Economics 122*(November), 1561–1602.

Galiani, S., P. J. Gertler, R. Undurraga, R. Cooper, S. Martínez, and A. Ross (2017). Shelter from the storm: Upgrading housing infrastructure in latin american slums. *Journal of urban economics 98*, 187–213.

Galiani, S. and E. Schargrodsky (2010). Property rights for the poor: Effects of land titling. *Journal of Public Economics 94*(9-10), 700–729.

Glaeser, E. L. (2014). A world of cities: The causes and consequences of urbanization in poorer countries. *Journal of the European Economic Association 12*(5), 1154–1199.

Glaeser, E. L. and J. E. Gyourko (2008). *Rethinking federal housing policy: How to make housing plentiful and affordable*. Aei Pr.

Gollin, D., R. Jedwab, and D. Vollrath (2016). Urbanization with and without industrialization. *Journal of Economic Growth 21*(1), 35–70.

Gonzalez-Navarro, M. and C. Quintana-Domeque (2016). Paving streets for the poor: Experimental analysis of infrastructure effects. *Review of Economics and Statistics 98*(2), 254–267.

Harari, M. and M. Wong (2018). The economics of slums in the developing world. *mimeo*.

Henderson, J. V., A. J. Venables, T. Regan, and I. Samsonov (2016). Building functional cities. *Science 352*(6288), 946–947.

Hunt, D. B. (2009). *Blueprint for disaster: The unraveling of Chicago public housing*. University of Chicago Press.

Lall, S. V., H. G. Wang, D. Da Mata, et al. (2007). Do urban land regulations influence slum formation? evidence from brazilian cities. *Brazilian Association of Graduate Programs in Economics*.

Lilford, R. J., O. Oyebode, D. Satterthwaite, G. Melendez-Torres, Y.-F. Chen, B. Mberu, S. I. Watson, J. Sartori, R. Ndugwa, W. Caiaffa, et al. (2017). Improving the health and welfare of people who live in slums. *The lancet 389*(10068), 559–570.

Lucci, P., T. Bhatkal, A. Khan, and T. Berliner (2015). What works in improving the living conditions of slum dwellers. *ODI Dimenstion Paper 4*.

Marx, B., T. Stoker, and T. Suri (2013). The economics of slums in the developing world. *Journal of Economic Perspectives 27*(4), 187–210.

McIntosh, C., T. Alegría, G. Ordóñez, and R. Zenteno (2017). The neighborhood impacts of local infrastructure investment: Evidence from urban mexico. *American Economic Journal: Applied Economics*.

Michaels, G., D. Nigmatulina, F. Rauch, T. Regan, N. Baruah, and A. Dahlstrand-Rudin (2017). Planning ahead for better neighborhoods: Long run evidence from tanzania.

Montgomery, M. R. and P. C. Hewett (2005). Urban poverty and health in developing countries: Household and neighborhood effects. *Demography 42*(3), 397–425.

Olsen, E. O. and J. E. Zabel (2014). United states housing policy. *HandBook of Regional & Urban Economics*.

Riis, J. A. (1890). How the other half lives: studies among the tenements of new york.

Rosen, H. S. (1985). Housing subsidies: Effects on housing decisions, efficiency, and equity. In *Handbook of public economics*, Volume 1, pp. 375–420. Elsevier.

Turley, R., R. Saith, N. Bhan, E. Rehfuess, and B. Carter (2012). Slum upgrading strategies involving physical environment and infrastructure interventions and their effects on health and socio-economic outcomes. *Cochrane Database Syst Rev 1*.

Figure A.1: Kernel density: household consumption among housing applicants and representative data from the Ethiopian household consumption and expenditure survey from 2011 (2015 Birr, adjusted for economic growth

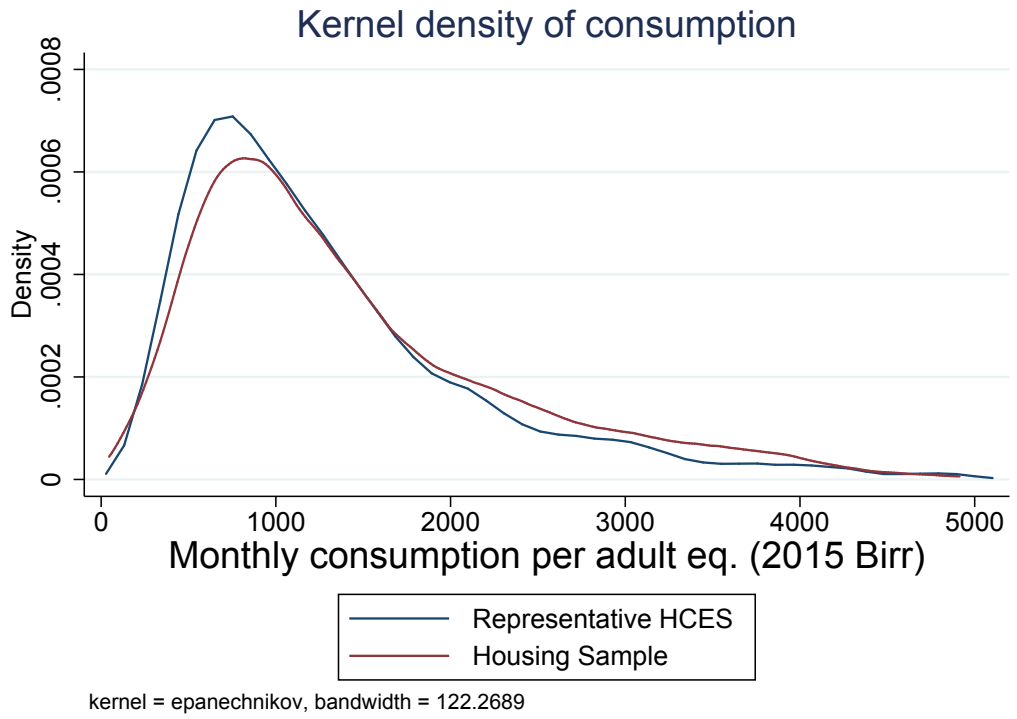


Figure A.2: **Detail on upgrading investments made by households**

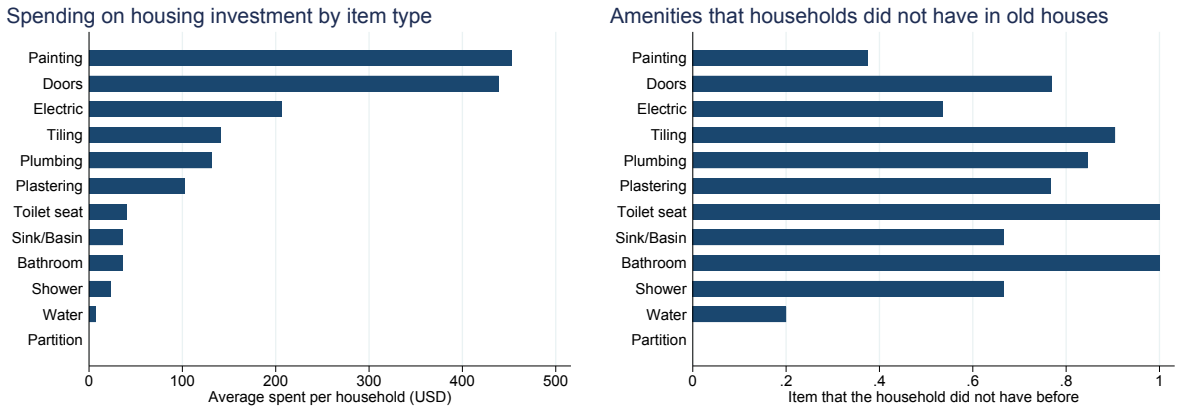


Table A.1: Housing sites and number of units awarded

Site	Number of Units	Distance
Yeka Abado	12501	19
Tulu Dimtu	12272	28
Yeka ayat	2865	17
Gelan	1272	18
Genet Menafesha	1212	15
Summit	750	15
Basha Wolde Chilot	535	2
Karakore	495	14
Lideta Redevelopmnt	393	3
Mekanisa Kotari	352	6
Total (main 10 sites)	32647	
Total (all sites)	33585	

Figure A.3: Quantile regression: effect of lottery on household non-housing consumption

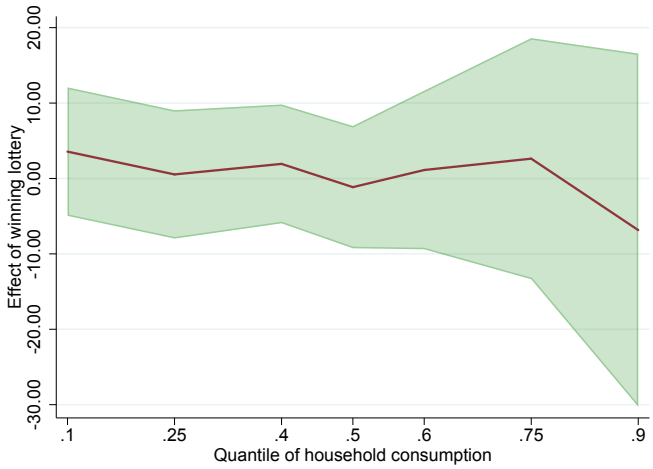


Table A.2: Balance- treatment and control

Outcome	N	Control Mean	Std Dev.	Coeff	p (F-test)
Administrative data					
Scheme contributions (pre-lottery, 1000s ETB)	1564	11.23	11.26	-0.17	0.77
Female registered	1564	0.46	0.50	-0.01	0.76
Applied for 1-Bedroom	1564	0.12	0.32	-0.00	0.92
Survey data					
Household size	1564	3.52	1.93	-0.15	0.13
Number of children 6-18	1564	0.83	1.00	-0.07	0.15
Age of household head	1563	43.25	11.20	-0.38	0.51
Female household head	1563	0.36	0.48	-0.00	0.86
HH head migrant (born out of Addis)	1564	0.70	0.46	0.01	0.72
Number of working age members (16-64)	1564	2.47	1.44	-0.12	0.11
Tenure: rents on private market	1564	0.55	0.50	-0.03	0.22
Lives in slum (UN-Habitat)	1564	0.73	0.44	0.02	0.26
Housing assets index	1564	0.09	7.93	-0.50	0.21
Hours worked in last 7 days(per WA adult)	1552	32.92	19.51	-0.93	0.35
Earnings per working age adult (ETB, monthly)	1564	4223.71	3907.72	-221.76	0.26
Consumption per capita (monthly, ETB)	1564	1502.83	1257.31	-99.09	0.12

Joint F-test of predictive power: all above predictors on treatment status

Predictor variables	F-stat	p-value
All variables above	0.93	0.5812
All variables, partial F-test of survey outcomes	1.04	0.4132
Excluding administrative variables	0.94	0.5510

Table A.3: How does the sample compare to the Addis Ababa population?

Outcome	Sample Means	
	Housing Sample (2015)	HCES (2011)
Household size given	3.52	3.98
HH member under 18	1.16	0.67
Female headed HH	0.36	0.40
Monthly consumption (per adult equivalent, 2015 ETB)	1,502.83	1,363.58
Growth adjusted consumption (2011-2015, 8% p.a.)	1,502.83	1,855.14
Household below urban poverty line as defined in 2011	0.22	0.22
Total number of working age adults in HH	2.47	2.88
Self employed members (per WA adult)	0.16	0.20
Wage employed members (per WA adult)	0.55	0.44
Household head age	43.25	43.88
Household head marital status	0.50	0.52
People per room	3.18	2.16
Floors made of hard/solid material	0.74	0.59
Cemented walls	0.24	0.15
Roof is mode of correguated iron sheet	0.87	0.92
HH has a private toilet	0.26	0.29
Access to improved sanitation facility	0.57	0.47
Tenure: lives free or owns home	0.19	0.38
Tenure: rents government owned home	0.26	0.31
Tenure: rents on private market	0.55	0.31
Total number of rooms in household	2.01	2.29
HH has access to an improved water source	0.90	0.82
HH owns a mobile/wireless phone	0.85	0.83
HH owns a commercial vehicle/car	0.09	0.02
Housing deprivations (UN definition, max=4)	1.23	1.30
Slum housing (UN definition using only floors)	0.73	0.70
Slum housing (UN definition with inadequates walls and floors)	0.87	0.89
Head education - highschool only	0.24	0.12
Head education - degree or diploma	0.34	0.29

Table A.4: Predictors of attrition

Dependent Variable: No-response or refused	Only Treatment		All Covariates	
	Coeff	Std. error	Coeff	Std. error
	(1)	(2)	(3)	(4)
Won Housing Lottery	-0.003	0.014	-0.004	0.014
Household size			-0.006	0.004
Earnings per working age adult (1000s, ETB, monthly)			0.004	0.002*
Tenure: rents government owned home			-0.030	0.022
Tenure: rents on private market			-0.015	0.020
Head finished highschool			0.025	0.019
Head completed tertiary education			-0.013	0.018
Registrant is female			-0.019	0.015
Registrant is public employee			-0.003	0.017
Applied for 1 Bedroom			0.014	0.021
Applied for 2 Bedrooms			0.038	0.024
Applied for 3 Bedrooms			0.080	0.087
P-value of F-test	0.8463		0.0785	
N	1,564		1,564	

Table A.5: Predictors of attrition

Dependent Variable: No-response or refused	Only Treatment		All Covariates	
	Coeff	Std. error	Coeff	Std. error
	(1)	(2)	(3)	(4)
Won Housing Lottery	-0.003	0.014	-0.004	0.015
Household size			-0.000	0.008
Number female members			0.010	0.009
Number of small children (<6)			-0.006	0.014
Number of children 6-18			-0.023	0.010**
Age of household head			0.001	0.001
Female household head			-0.019	0.019
HH head migrant (born out of Addis)			0.002	0.017
Years living in current home			-0.000	0.000
Tenure: lives free or owns home			0.030	0.022
Tenure: rents government owned home			0.000	0.000
Tenure: rents on private market			0.017	0.018
Housing quality index			0.001	0.002
Lives in slum (UN-Habitat)			-0.004	0.020
Housing assets index			-0.001	0.001
Member of an iddir			0.002	0.016
Number of close social ties (hh head)			-0.000	0.001
Head finished highschool			0.035	0.020*
Head completed tertiary education			-0.010	0.019
Head ethnicity: amhara			-0.022	0.015
Head religion: orthodox			-0.010	0.020
Head is married			-0.012	0.020
Working members (per WA adult)			0.035	0.037
Hours worked in last 7 days(per WA adult)			-0.001	0.001**
Earnings per working age adult (ETB, monthly)			0.000	0.000**
Consumption per adult equivalent			0.000	0.000
P-value of F-test	0.8463		0.1165	
N	1,564		1,539	

Table A.6: Effects of the lottery on household composition

Outcome	Control mean (1)	ITT Estimate Lottery N (2)	Coeff (3)	Std. Err. (4)	Adj q-value (5)
Current household size	3.886	1,426	-0.062	0.075	0.964
Current number of working age adults	3.052	1,426	-0.041	0.051	0.964
New people joined this household since baseline	1.569	1,345	0.008	0.029	0.964
Number of newly joined members (incl. children born)	0.650	1,426	-0.003	0.058	0.964
Number of newly joined adult household members	0.401	1,426	-0.013	0.043	0.964
Original members who left the household	0.529	1,426	0.052	0.051	0.964
Origianl members who remained in household	3.132	1,426	-0.007	0.057	0.964

Table A.7: The financial effects of winning

Outcome	Control mean (1)	ITT Estimate Lottery N (2)	Coeff (3)	Std. Err. (4)
Housing quality index	0.0	1,426	0.8***	0.1
Distance from the city centre (km)	5.5	1,426	4.9***	0.3
Estimated housing consumption (market)	83.1	1,426	1.5	2.4
Net housing costs	52.1	1,426	11.4***	2.9
Rent income	3.9	1,426	36.0***	2.1
Mortgage repayments	11.8	1,426	72.5***	2.7
Rent payments	44.5	1,426	-22.6***	2.6
Housing subsidy received	31.0	1,426	-8.4***	3.1

Table A.8: Housing Quality: Effect of winning the lottery

Outcome	Control mean (1)	ITT Estimate Lottery N (2)	Coeff (3)	Std. Err. (4)	Adj q-value (5)
Housing quality index	0.000	1,426	0.703***	0.058	
Formal wall	0.311	1,426	0.290***	0.024	0.001
Formal floor	0.788	1,426	0.085***	0.020	0.001
Formal water source in home	0.179	1,426	0.304***	0.023	0.001
Improved toilet (shared $<$ 5 others)	0.243	1,426	0.313***	0.024	0.001
Cooks with electricity	0.769	1,426	0.050**	0.022	0.024
Cooks indoors	0.845	1,426	0.043**	0.019	0.026
Number of people per room	3.877	1,355	-0.340***	0.116	0.005

Table A.9: Wealth effects versus moving effects in first differences: household labour

Outcome	Control mean (1)	N (2)	ITT Estimates Lottery Coeff (3)	Lottery Std. Err. (4)	Lottery + Moved in Coeff (5)	Lottery + Moved in Std. Err. (6)	(3)+(5)=0 P-value (7)
Household labour market index	0.000	1,420	0.027	0.117	0.085	0.136	0.365
Earnings per adult	88.601	1,426	-2.859	4.505	1.273	5.369	0.758
Total employed per adult	0.663	1,415	-0.005	0.023	-0.004	0.027	0.700
Hours worked per adult	29.174	1,415	1.115	1.483	-1.856	1.675	0.626

Table A.10: Effects of proportion of neighbours winning on control group outcomes (with controls for number of applicants))

Outcome	Control mean (1)	Effect of neighbour winners N (2)	Coeff (3)	Std. Err. (4)	Adj q-value (5)
Housing quality index	0.00	711	0.12	0.13	0.595
Expenditure, non-housing (monthly, USD)	165.82	711	5.65	13.20	0.869
Household labour market index	0.00	708	0.02	0.14	0.869
Intensity of social interactions (index)	0.00	711	-0.14	0.14	0.595
Total number of social ties	11.41	706	1.38	1.39	0.595
Conflict among neighbours (index)	0.00	474	-0.16	0.18	0.595
Community and public goods index	0.00	709	-0.02	0.14	0.869
Household is a member of at least one iddir	0.54	711	0.02	0.06	0.869
Household fears eviction in next 5 years	0.36	711	0.08	0.07	0.595
Household has been evicted in last 2 years	0.09	711	0.05	0.04	0.595

Table A.11: Impacts on total social interactions (Main outcome family 4)

Outcome	Control mean (1)	ITT Estimate Lottery N (2)	Coeff (3)	Std. Err. (4)	Adj q-value (5)
Intensity of social interactions (index)	0.000	1,426	-0.317***	0.049	
Total number of social ties (talk more than once a week)	11.409	1,414	-2.178***	0.435	0.001
Participation in community events (index)	0.000	1,374	-0.157***	0.054	0.005
Supportive interactions among neighbours (index)	0.000	1,350	-0.061	0.054	0.255
Negative (conflict) interactions among neighbours (index)	0.000	1,141	-0.190***	0.063	0.005
Interactions with local government (index)	0.000	1,352	-0.230***	0.050	0.001

Table A.12: Effects on community and public goods (Main outcome family 5)

Outcome	Control mean (1)	ITT Estimate Lottery N (2)	Coeff (3)	Std. Err. (4)	Adj q-value (5)
Community and public goods index	0.000	1,413	0.140***	0.053	
Tenure security (index)	0.000	1,239	0.123**	0.055	0.095
Willingness to contribute to public goods (index)	0.000	1,297	0.112**	0.057	0.095
Beliefs- neighbours' willingness to contribute to PGs (index)	0.000	1,207	0.096	0.059	0.138
Security and crime (index)	0.000	1,293	0.049	0.058	0.392
Index of community and public goods excluding tenure security	-0.024	1,413	0.115**	0.058	
Index of access to local services and markets	-0.049	1,426	0.107*	0.056	
Time to reach nearest public green space	15.691	1,426	-2.081**	0.835	
Time to reach nearest clinic	16.647	1,426	1.248**	0.573	
Time to reach the centre of the city	33.996	1,426	13.088***	1.629	
Neighbourhood has working streetlights	0.394	1,426	-0.128***	0.026	
Neighbourhood has the smell of drains or sewerage	0.000	1,375	-0.092	0.058	
Condition of piping and sewerage system	-0.000	1,362	-0.052	0.060	