The demand for government housing: Evidence from lotteries for 200,000 homes in Ethiopia

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Abstract

Can the state improve the lives of slum dwellers by supplying formal housing otherwise not provided by the market? Or will state-built housing, priced at the cost of production, be beyond the willingness to pay of poor households or built in the wrong location? To answer these questions, I study a lottery for large-scale government housing in Ethiopia. Winners of the lottery are sold apartments on the outskirts of the city. They then have the choice to move in or rent out these units. By moving in, they pay a high implicit price in forgone rent determined by the market, which I show to exceed the cost to the state of producing the housing. I find that nearly half of lottery winners trade slum housing in the city centre for improved housing on the outskirts of cities. In addition, they make upgrades to their apartments, adding a number of amenities that they did not enjoy in their slum housing. I argue that this reveals unmet demand for improved housing and suggests that informal housing is a sub-optimal outcome for a large proportion of slum-dwellers in this setting. Moving to sites far from the city centre does not negatively affect labour supply or earnings. Although social lives are less vibrant in the new housing estates, lottery winners report significant reductions in conflict with neighbours and increased willingness to contribute to public goods.

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1 INTRODUCTION

Nearly one billion people throughout cities in the developing world live in slum housing, built from informal materials like wood and mud, and lacking access to essential services liked piped water. A common government policy response is to intervene directly in the supply of low-cost affordable housing. This was true of today's rich countries until at least the 1980s, and is increasingly common in developing countries today. But do slum-dwellers want to move to new formal housing, often located in large estates far from where they live? If poor households are unwilling to pay for this housing at the market rate, or indeed, above the costs of production, then the state provision of a private good like housing is likely to be inefficient (Rosen, 1985).

A simple explanation for the prevalence of slums is that poor households value improved housing less than they do other forms of consumption and investment (Glaeser, 2011). In particular, slums provide low-cost housing in locations close to the centre of the city. Improved housing built on cheap land further away from the city may be affordable to poor households, but moving there would cause them to lose access to jobs within walking distance (Glaeser et al., 2008) and valuable social networks (Munshi and Rosenzweig, 2016). According to this view, state-built formal apartments will be beyond the willingness to pay of slum households. When governments endow poor households with access to affordable housing they will either try to sell or rent these homes to wealthier households, or will leave them vacant.[1] If this is the case, demand-side subsidies or cash-transfer programs are more appropriate interventions than government-supplied housing.

Instead, the justification for state-supply of housing requires an alternative view: that slums are a sub-optimal outcome for many households (Marx et al., 2013). Households would be willing to pay for formal housing further away from the city, but this demand is not met by the private sector, for many possible reasons. For example, mortgages are unavailable to poor households in these settings. Alternatively, it may be impossible for private developers to finance new settlements with connective infrastructure on the edge of cities, at the scale required to make these settlements viable.[2] In the presence of pent-up demand, state intervention can provide a large enough supply-shock of formal housing that its market price will be affordable to households in slums, but will still exceed the costs of production.

In this paper, I study a large-scale government housing scheme in Addis Ababa, Ethiopia. Ethiopia is following the example of middle-income countries that have built millions of government houses in recent decades, but is leading the way among lower-income countries for whom this is an increasingly popular policy response.[3] The state builds housing in new settlements on cheap

[1] Subsidized home-ownership for the poor may only create a class of absentee landlords. The costs of acting as a landlord mean that poor households would prefer the cash equivalent of subsidies.

[2] Government regulation of land markets could also limit the supply of new housing. In this paper I do not present evidence on the binding constraints on the supply of new housing, but discuss some possibilities in Section 4.1.

[3] The largest housing programs in the world are in Brazil and South Africa, which have delivered three and four

land on the outskirts of the city. The housing is then sold with mortgages to poor households at partially subsidized rates. I study a lottery for 34,000 apartments, by collecting detailed panel data on a random sample of 1,600 households entered into this lottery. I follow them for three years after some randomly win the opportunity to purchase a new formal apartment.

I learn about the demand for government housing by studying the decision to occupy this housing among lottery winners. I provide a simple theoretical framework to show that their decision to move in reveals demand for housing at a price determined by the foregone rent that they could earn by renting on the market. Lottery winners have something that non-winners do not: access to a formal home that they own on the outskirts of the city. However, they do not receive direct incentives to move into the new housing, nor are they required to move to benefit from the program. Instead, they are free to rent out their apartments at rates determined by the market. This provides a unique opportunity to observe market prices for government housing, which is not possible to do for social housing schemes for which rents are directly subsidized.[4] I characterise the price of moving in by estimating the rental value of each apartment, compare that price to the costs of producing the housing, and estimate the fraction of lottery winners who move at this price.

I find that 46% of lottery winners move into their apartments. Rents in government housing are considerably higher than the rents households pay in slums. Therefore, by moving in they pay more in net housing costs: moving in is not a way to save money on rent. Furthermore, I show that the value of new apartments implied by the market rent exceeds the total cost of production by the state. Owners also make significant upgrades to their new apartments, to roughly the equivalent of 18% of units' total production cost.[5] They add amenities that they did not have in slums, such as tiling, showers, painting, kitchen sinks, and electric lighting. I argue that this shows a willingness to pay to consume a level of housing quality not just above slum levels, but above the level provided by the state.[6]

I interpret these findings as showing that households would have liked to have consumed this improved housing but did not have access to the opportunity to purchase it in the absence of the program. Under this interpretation, my results provide an argument for state intervention in the supply of housing. The key challenge to this argument is that winning the lottery may have increased households' purchasing power. Could income effects have led to increased housing consumption even in the absence of state-supplied housing? I show that, because of the costs

million houses, respectively. There are similar programs in Mexico, Chile, and Nigeria. See Table A.2.

[4]While waiting lists suggest that people want to live in social housing at the subsidized price, it is difficult to tell whether their willingness to pay is above the costs of production (Rosen, 1985; Glaeser and Luttmer, 2003).

[5]Those who move in consume those investments in the form of better housing, whereas those who rent-out earn a rate of return. Households who moved in invested significantly more than those who did not move in.

[6]I suggest two reasons why households make these upgrades to their government homes, but not to their slum homes. First, they enjoy significantly improved tenure security in government housing. Second, the costs of making incremental upgrades to a basic formal structure may be significantly lower than the equivalent upgrades to a wood and mud structure.

of mortgage repayment, the direct effect of winning the lottery on current income is negative, but to close zero, on average. Still, households may experience the lottery as a positive wealth shock, if they anticipate that the value of their apartments will exceed the state-subsidized purchase price. They may be bringing this future income forward in the form of increased housing consumption. To rule this out, I estimate the size of the increase in wealth experienced by each winning household by using random variation in the location and amenities of the apartment to which they were randomly assigned. I find that households who win more valuable homes are not more likely to move into their units nor do they experience an increase in housing consumption if they remain in slums. A subset of households that experience a wealth shock from the lottery that is close to zero is not significantly less likely to move in.

In the second half of the paper, I ask: is it a mistake to build new government housing in such remote locations? Even if households move voluntarily, this might come with costs, and revealed preference may not be a reliable guide to household welfare. Household decision-makers may misjudge the costs of moving, either for themselves or other members of their family. Households that move could do so expecting a large number of households to move with them, but find that this is not the case and that they lack neighbours, shops, or regular transport to the centre.

First, I look at whether moving far from the centre distorts labour market outcomes. I find zero effects, precisely estimated, on earnings and a wide range of employment outcomes of winning the lottery. Households that move adjust: some change their location of work, while others commute longer distances, without significant reductions in income. I find no evidence that households move to the new sites in order to guard their new investments: winners report significantly increased tenure security, and spend significantly less time in their homes. Living in formal housing leads to significantly less time dedicated to domestic tasks in the home, a finding that is consistent with Devoto et al. (2012) and Franklin (2016).

Second, I consider that moving households out of informal settlements to places where they are unlikely to know any of their neighbours may cause disruption to social networks that could harm welfare. I find that social life in government housing does differ from life in slums. Lottery winners have fewer active interactions with their neighbours. But this is a trade-off that they seem willing to make. Winning households experience significant reductions in conflict with neighbours. Qualitative work suggests that shared facilities in slums, such as toilets and cooking space, caused a great deal of conflict. Lottery winners report significantly lower levels of anxiety and are no more likely to report feelings of loneliness. Regardless of this, if social connections are instrumental in the maintenance of local public goods (Bowles and Gintis, 2002), the lack of social capital among neighbours could quickly lead to dysfunction of communities, and the deterioration of public goods. Instead, residents have formed active community management associations, and report significantly higher willingness to contribute time and money to the provision of local public goods.

I am careful to point out that the results could be very different in households were forced to move out of slums rather than moving voluntarily, as they do in my study. I examine the determinants of the decision to move to show that households that move to government housing are those who appear to have the lowest costs of living further away. Those that chose not to move may well face large costs were they forced or incentivized to move.

My contributions are threefold. First, I contribute to the literature on the economics of slums.[7] There is a growing body of literature showing positive effects of slum-upgrading interventions, but there is very little work assessing the willingness to pay for better housing among people living in slums.[8] Devoto et al. (2012) show that households in slums exhibit willingness to pay for tapped water in their homes, when given access to credit to finance these investments. Low levels of housing investment in slums have been linked to a lack of property rights (Galiani and Schargrodsky, 2010; Collin et al., 2015), and a lack of access to finance for fixed investments (McIntosh et al., 2011). But households may face multiple constraints that leave them "trapped" in slums (Marx et al., 2013). My results suggest that slums are sub-optimal outcomes for a substantial fraction of households, who would move out if they have the opportunity. [9] By studying a policy on this scale, I learn about the preferences of millions of people were previously living in slums: I estimate that roughly between 50 and 70 percent of the population of the city has applied to the program. In this way I provide evidence for the proposition that poorly functioning housing and land markets are be a big part of why cities in Africa have such high numbers of people living in slums (Collier and Venables, 2014).[10]

Second, by evaluating one of the first randomized studies of mass housing programs at scale, I contribute to an understanding of the effects of moving households to new neighbourhoods built by the state. Evidence from the US suggests that government housing has generally induced housings to live in worse neighbourhoods that harmed long-term outcomes (Chyn, 2018; Eerola and Saarimaa, 2015). Moving from poorer to observably better neighbourhoods has large economic benefits (Kling et al., 2007; Chetty et al., 2016; Chetty and Hendren, 2018). It's not clear, *ex ante*, whether new housing sites in my setting are "better locations". It is often argued

[7]For other perspectives on slums see Montgomery and Hewett (2005); Brueckner and Selod (2009); Glaeser (2014); Cavalcanti et al. (2013); Lall et al. (2007); Henderson et al. (2016) and Cai et al. (2018). For how slums are affected by neighbourhood-level programs such as infrastructure, planning and slum-upgrading see Michaels et al. (2017); McIntosh et al. (2017); Turley et al. (2012) and Harari and Wong (2018).

[8]See, for example, the impacts of free home upgrades such as providing cement floors or tapped water infrastructure (Cattaneo et al., 2009; Devoto et al., 2012; Galiani et al., 2017).

[9]Barnhardt et al. (2017) find that households in India do not move from slums to formal housing on the outskirts, because of the social isolation implied by living far away. In their study, families lose deep rental subsidies if they do not live in the new sites. Similarly, South Africa's program legally obliges owners to live in their houses (Franklin, 2016; Picarelli, 2018). This makes it impossible to estimate households' willingness to pay for formal housing. My results may differ because of the scale of the estates I study: in Ethiopia, households move to large high-density neighbourhoods where local economies have proliferated.

[10]It is also thought that slums impose negative externalities on neighbouring residents to the city. Indeed, one policy of government housing programs may be to move households out of slums, in order to reduce the perceived negative externalities of slums. Assessing whether these projects achieve that aim is beyond the scope of this paper.

that the mass-housing approach will create dysfunctional neighbourhoods and the replication of slum-conditions. 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". The rates at which households move to new government housing are similar to those in the Moving to Opportunity experiment, and I find similar short-run improvements in adult mental health (Katz et al., 2001).

Third, I contribute to a literature on the economics of government housing programs. Millions of government houses were built throughout in the 20th century, and are being built in developing countries today.[11] Standard economic theory suggests that the production of new housing can only improve social welfare if there exists untapped demand for this kind of housing. This point has been made by many economists (Glaeser and Gyourko, 2008) but not assessed empirically, to the best of my knowledge. In the United States, there is evidence against the existence of widespread housing market failure: the housing construction sector, as well as mortgage markets, appear to be more or less competitive. It is believed that the cost of producing housing in the early public projects was often high, above the willingness to pay of the poor, which would suggest that the states' intervention on the supply side may have been distortionary (Collinson et al., 2015).[12] The evidence is divided on whether low-income housing in the US increased housing affordability or simply crowded private sector supply of housing of a similar quality (Baum-Snow and Marion, 2009). I study a setting where the evidence for a failure in the housing sector is much stronger (Collier and Venables, 2014; Henderson et al., 2016). In the conclusion to the paper, I discuss conditions under which government supplied housing may be a second-best response to the challenge of dysfunctional housing markets in developing countries.

2 Context & Program

2.1 Housing and slums in developing countries

I focus on the problem of poor housing conditions: over-crowded spaces, informal building materials, a lack of access to tapped water and a lack of access to decent sanitation. UN-Habitat defines a household as living in a slum if they any of these four key deprivations, *or* if they lack secure tenure. In most large African cities, more than 50% of households live in slums, according to this definition. Before considering possible market or government failures that may be causing poor housing conditions, it is worth considering the evidence for the view that slums are simply the symptom of low incomes, and a temporary step in the process of urbanisation that comes with development (Marx et al., 2013; Glaeser, 2011).

[11] For example, between 1945 and 1980 the government of the United Kingdom built over 6 million dwellings, 50% more than were delivered by the private sector (this is based on my own calculations using data from DCLG, Live tables on house building, Table 244.

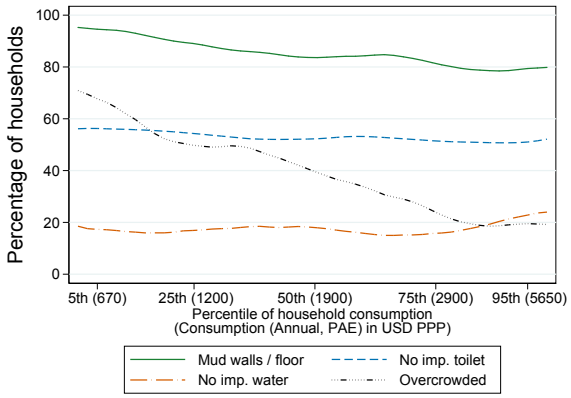
[12] See Apgar (1990) for an alternative viewpoint.

If slums will eventually go away with economic development, Africa is lagging beyond the rest of the world. In the online Appendix (part A.1) I show cross-country correlations between GDP growth and slum prevalence.[13] Rapid urbanization in Africa has meant that both the absolute number and the proportion of people living in slums has grown over time. This lack of progress on housing is perhaps symptomatic of the phenomenon of urbanization without industrialization said to be taking place in Africa (Gollin et al., 2016; Glaeser, 2014).

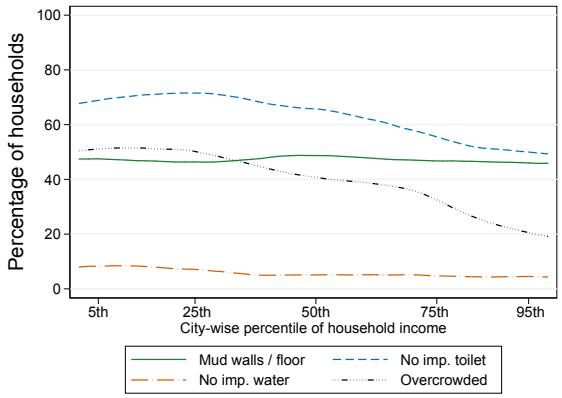
In Africa, slum housing is not only a problem of the very poor. Using representative household data, I plot four main deprivations of informal housing against household expenditure for Addis Ababa, and against household income for the primate cities of ten other African cities, in Panels A and B of Figure 1 respectively.[14] Even relatively wealthy households rarely live in homes with improved walls and floors,or improved sanitation and private improved water. By contrast, over-crowding declines rapidly with household wealth. Households seem to be able to move up to larger slum housing as they get richer, but not to make large fixed investments in home upgrades when they live in slums.

Figure 1: Household wealth and slums

(a) Consumption & slums in Addis Ababa



(b) Income & slums in African primate cities



These stylized facts provide the key motivation for this paper. The persistence of slums, even among the relatively wealthy, is concerning for policy-makers. The UN SGDs includes a target, under the seventh goal, of improving the lives at least 100 million slum dwellers. Yet the economic justification in the supply of housing is not clear. Is it the case that informal housing is simply the optimal choice of very poor households? Or could the state intervene to overcome constraints that stop the poor from being able to invest in better housing?

[13] I do this by combining national panel data from UN-Habitat and the World Bank. Mine is the first paper to do this, to the best of my knowledge.

[14] For Addis, I use the 2011 Household Consumption and Expenditure Survey, which is a large representative survey used for national poverty assessments. For other cities, including Kampala, Blantyre, Addis Ababa, Dar-es-Salaam, and Accra, I use the most recent LSMS data. In each case I normalize my outcome by the per adult equivalent household size.

2.2 Housing in Addis Ababa

Addis Ababa is an ideal developing-country setting in which to study government housing programs. Like so many other African cities, it faces the dual challenge of rapid urbanization, an ageing and overwhelming informal housing stock, and very little delivery of new formal housing. The population of the city was 3.2 million in 2014 and expected to double in the next 25 years (Davison, 2014). The percentage of households living in slums varies between 67% and 90%, depending on the definition. Few households live housing of comparable quality to that provided by the government. I estimate that only 2.6% of households in my sample live in homes with all of: concrete or brick walls, floors and solid roofs, private flush toilets, running water in the house, and electric lighting and cooking facilities.

Building or renting formal housing is challenging for the poor. To allow households in this setting to self-build housing units, the state makes land available for free for *housing cooperatives*: groups of households that come together to apply for land on which they can build self-financed housing units. Poor households don't seem to be able to use this scheme for two reasons. One, they are unable to find the capital or mortgage financing to make the large investments in new houses required. Two, these plots are usually available on empty, peripheral land without transport links; inevitably, it is only rich households with cars who live there.

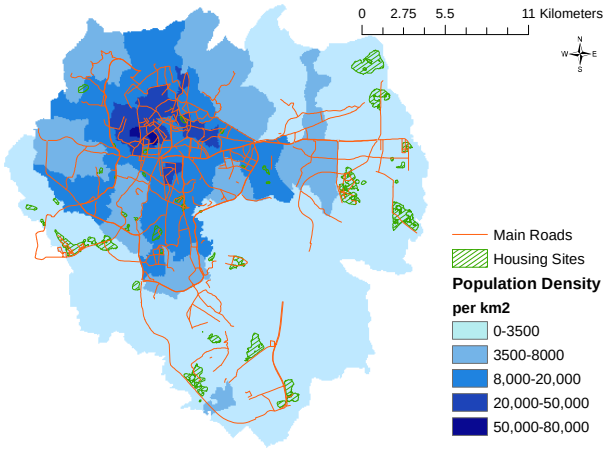
In my data, more than half of households rent their informal homes from private landlords. While nearly 30% of households in Addis Ababa live in homes that they own, they are largely absent from my sample because the program does not allow applicants who already own a home. Roughly a quarter of households in Addis Ababa and my data rent housing units that are owned by the local government (known as *kebele* housing). This housing stock is entirely informal and predominantly found in the centre of the city. Households who have access to these units live for free (or pay a nominal fee of less than 1% of the market rent). When households in my study move into government-built housing they lose large rent subsidies. From the state's perspective, letting these households live for free on this prime state-owned land in the city centre is very costly, so when the program I study induces households to move out of their *kebele* housing, this may constitute program-cost recovery.

2.3 The program: Formal apartments, built far from the city centre

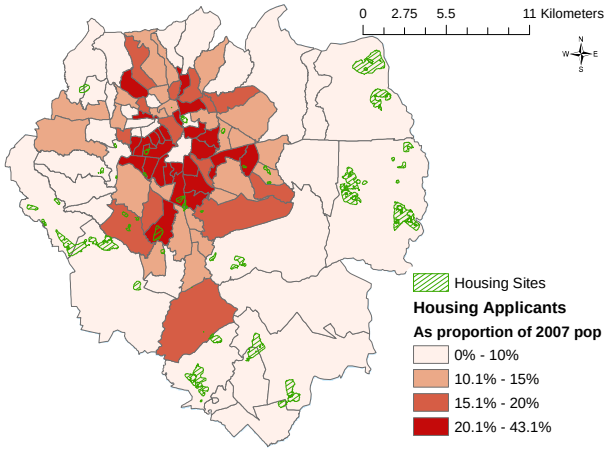
The state plans and builds new formal housing apartment at scale. Construction is outsourced to private firms, and located on relatively cheap peripheral land, to reduce program costs. Connective infrastructure, including roads, sewers and water, are provided at the same time. The largest of these sites comprises over 500 housing blocks, with space for up to 60,000 residents. Figure 2 shows the location of these sites relative to the city's population and transport networks. Almost all new housing between 2013 and 2018 was built more than 15 kilometres from the city centre.

Figure 2: Addis Ababa population and housing sites

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



(b) Applicants mostly live in the city centre



Housing units are arranged in 5-storey walk-up apartment blocks, with between 20 and 30 units in each block. See a photograph, in the appendix (Figure A.2). Housing blocks are positioned around public common spaces between the blocks. Units come equipped with water, sewerage and electricity connections, as well as basic toilets and basins. Households are responsible for upgrading their own housing units as they see fit, and, collectively, for developing and maintaining public spaces. All housing within a site becomes available for occupation at more or less the same time. Given the scale of the program, it is extremely rare for anyone to know their new neighbours from before they moved. But they do not lack for new neighbours: the sites have high population densities, similar to those in slum areas. 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 the program costs.

Households can choose the size of the homes when they apply. They choose between a studio apartment ($32m^2$) or a 1-, 2- or 3-bedroom apartment (51, 75, or $100m^2$, respectively).[15] These are very large homes, by the city's standards. Using cadastral surveys collected by the city government, I find that the size of city-centre informal housing units, many of which are occupied by multiple households, varies between $15m^2$ and $45m^2$.

I use detailed government data on the project finances to estimate the cost per unit delivered. The average cost of production per unit is $16,725. This includes construction costs, land costs, administrative costs, compensation for the few people were living on that land before the state built there, and the costs of all connective infrastructure. I compare the states' estimates of the land costs and find that they are generally consistent with the prices of land transactions in

[15] Studio and 3-bedroom apartments were relatively less common: 70% of the constructed units have 1- or 2-bedroom.

these peripheral areas. Housing units are then sold at subsidized rates to winning households at a total price that differs only by the number of bedrooms in the unit. The average price paid by each winning household is approximately $10,000. This implies a total price subsidy of nearly 40%, though this is considerably smaller when I subtract infrastructure costs of my per-unit cost estimates.[16]

When a household wins the opportunity to buy a house, they are required to make a down-payment equivalent to 20% of the total cost. If they make this down-payment, they sign a mortgage agreement and become the legal owner of the house. They 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 date of taking ownership of the unit. 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.

2.4 Applications and housing lotteries

Opportunities to buy newly built housing are allocated by lottery, from a pool of applicants. Individuals apply on behalf of households and only one application is allowed per household. The lottery is computerized, and, as I show in Section 3, it is fair. Any household satisfying two criteria are eligible to apply: 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.[17] 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.

This paper uses a lottery for housing that took place in March of 2015. This lottery allocated 34,000 apartments, the largest number awarded by the program to date. The lottery I study represents a step change in the magnitude of state-built formal housing available outskirts of the city, housing had been built closer to the centre to this point. 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 restricted eligibility for this lottery to 130,000 households that had registered early in the scheme. I draw my sample for this study from these households. The lottery prioritised female applicants, and government employees.[18] This variation in the

[16]The difference in the cost of production per housing unit sold depends on assumptions about how total building costs are distributed across apartment sizes. If I apportion those costs perfectly proportional to the floor size of each unit, it suggests that the subsidies provided by the state are significantly larger for the smaller units. In fact, for 3-bedroom apartments, the size of the subsidy (excluding infrastructure costs) is close to zero.

[17]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.

[18]Specifically, the lottery proceeds by randomly selecting 30% of the total beneficiaries from the group of female

probability of winning motivates my sampling strategy, outlined in detail in Section 3, in which I stratify my sample by the cells that were used for randomization.

Conditional on winning the lottery, households were randomly assigned to one of 34,000 new apartments spread across the city. Households preferences were not taken into account when assigning locations. 97% of all beneficiaries in the lottery were allocated to the ten main sites (see Table A.3). Some apartments are in small sites in the centre of the city, but the vast majority (90%) were assigned to five main locations, which were entirely new and scattered around the edge of the city. For the main analysis of this paper I focus only on households assigned to the periphery of the city only. As I show in Section 7, the treatment looks very different for households assigned to the city centre, which makes it important not to separate out these effects in the main analysis. Winning households moved into their units in the first half of 2016.

3 Data and estimation

3.1 Sampling & Surveying

My sample comes from government administrative records of households that had applied and were eligible, for the housing scheme.[19] I match this pools of applicants to the results of the March 2015 lottery. Fewer than 30% of households in the pool of eligible applicants received a house in the lottery of 2015. Therefore, to maximize power, I drew my sample after the lottery was run, allowing me to oversample from the pool of households who won the lottery so that my sample is split equally between winners and losers. In addition, the government conditioned winning probabilities on household characteristics in the administrative data. In particular, female applicants and applicants employed in the public sector were prioritized. To ensure that each household included in the study had experienced identical *ex ante* odds of winning the lottery, I divided treatment and control households into strata, among which all administrative characteristics were identical. I then draw my sample from those strata.[20]

Baseline surveys were conducted in May 2015, immediately after the results of the lottery were announced. The only available information by which to contact applicants was a single phone number in the administrative data.[21] It was impossible to track households when

applicants. Next, they select another 20% of the total beneficiaries from public employees. The remaining 50% are drawn at random from the remaining pool, regardless of gender or public 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.

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

[20] 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. My results are unchanged if I reweight my sample by stratification groups such the estimates are representative of the current applicant 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 not usable for tracking.

their numbers had become dormant or been disconnected. In total, 82% of listed households were reached. Inactive phone numbers account almost all (75%) of the non-response in the construction of the baseline sample. Importantly, whether a household had an inactive phone number was not affected by whether a household had won the lottery. This is reassuring, but perhaps unsurprising, as the phone numbers had been on file for many years before the lottery was conducted. Lottery winners were no more likely to respond to the survey than non-winners. In total, the survey team reached 783 lottery winners and 781 non-winners, with a total baseline sample size of 1564.

I conducted an endline survey from December to 2017 to February 2018, at which time households that moved into the units have lived in the housing for roughly 16 months, on average.[22] The survey team were able to contact 91.18% of the sample, which is a high response rate compared to other studies in this literature and is uncorrelated with treatment. See Table A.6. 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 jointly-significant effect on attrition. We might be worried that the pattern of attrition is significantly different between treatment and control, even if there is no significant difference overall between the two groups. I interact treatment with each of 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).

3.2 The lottery and sample balance

I find clear evidence that the housing lottery is fair. I conduct balance tests, shown in Table A.4. The results are similar with and without conditioning on the administrative outcomes on which randomization was conditioned.[23] I conduct a joint F-test of the predictive power of fourteen main survey outcomes, in addition to administrative outcomes. I fail to reject that the coefficients of the effect on winning the lottery of my list of covariates are jointly equal to zero.

The lottery outcome may have already affected household behaviour since the baseline survey was conducted shortly after the lottery results were announced. Not only do I find no significant imbalance along immutable household and household head characteristics, but I also find no evidence that winning the lottery has affected household labour supply, expenditure, income or attitudes at the time of the baseline survey. This is not surprising, given how recently these households had heard that they had won the lottery. Certainly, no households would have had

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

[23] We should expect unconditional balance if the lottery was fair because I stratified my sample on these administrative outcomes.

the opportunity to move into the new units yet.

3.3 WHO APPLIES FOR THE PROGRAM?

Government administrative records suggest that over 700,000 individuals registered for the housing scheme as a whole. Projections from the 2007 Census forward to 2015 suggest that there are a little over a million households in the city as a whole. Of course it possible that some households have more than one individual registrant, in violation of the program rules. Either way, I estimate that between 50% and 70% of households in the city have applied for the program.[24] The sheer size of the pool of applicants from which I draw my sample mitigates concerns that my results apply only to a highly selected group of households, although I would still be cautious about extrapolating my results to non-applicants.

Applicant households are similar along a number of measurable dimensions to the population of Addis Ababa as a whole. The main exception to this is that they are significantly less likely to report owning the home that they live since program eligibility was restricted to households who did not already own a home. Households are required to prove residency to apply for the scheme, and while this may be possible to fake, my data suggests that this is rare. Panel B of Figure 2 shows where the applicant households come from: they are overwhelmingly drawn from the city centre of the city, where slums and government-owned slums, in particular, are located.

Households in this study are not significantly better off than the average household in the city, nor do they live in significantly better housing. Table A.5 shows a comparison between my sample and representative data from the Household Consumption and Expenditure Survey (HCES) conducted in 2011.[25] Inflation-adjusted consumption per adult equivalent is similar, if slightly higher, than the average in the 2011 data, but lower if I account for economic growth. Indeed when I use new estimates for expenditure from the latest 2016 HCES survey, I find that households in my sample are, in fact, poorer than the average households in the city.[26] Figure A.3 shows that the distribution of household expenditure per adult equivalent is comparable, but to the left of that in representative data. While households in my sample are slightly more likely to have durable housing materials (notably, hard floors), their homes considerably more over-crowded, and have similar levels of access to private toilets and improved water. A similar proportion live in slums, according to the standard UN definition.[27] It is important that house-

[24] I am grateful to Pascaline Dupas and Marcel Fafchamps, who provided me with findings from a survey of the peripheral neighbourhoods of Addis Ababa, showing that roughly 48% of households surveyed were registered for the program. This is consistent with my findings, since I find that a higher proportion of households in the central parts of the city are registered, relative to the outskirts.

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

[26] In addition, 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.

[27] My main results are robust to dropping all non-slum households from my sample.

holds in my sample are not significantly richer than the rest of the city. As I will show in the next section, when a lottery winner rents out their government apartment, it is almost always to a household that is wealthier than they are.

3.4 ESTIMATION

My testing strategy is simple. Given the random assignment induced by the lottery, comparing the outcomes of lottery winners to non-winners. Under the assumption that winning the lottery does not affect household outcomes through other channels other than through access, the intention-to-treatment estimate identifies the impact of having access to government housing.

For each outcome, I will present results using my preferred intention-to-treat (ITT) estimator of winning the lottery. Due to the 97% take-up rate, this estimator is very close to the average treatment effect of subsidized home-ownership. Equation 1 estimates the intention-to-treat effect β_1 of winning the lottery (T_i) on outcome y_i. [28] I control for a pre-specified of household baseline characteristics x_{i0} in all specifications, as well the baseline outcome of interest $y_{i,pre}$ in all regressions (Bruhn and McKenzie, 2009).[29]

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

For certain tests, I describe whether certain effects (or lack of effects, as the case may be) appear to be driven by households who move in or whether households who remain in the slums experience similar changes. I present these results only as robustness checks, in the online appendix, since the decision to move into the housing unit is not randomized, and so selection could be driving the results. To ensure that my estimates are not driven by selection on observables, I estimate the effects on the outcome of interest in first differences, as well as in levels. Under the assumption of parallel trends (ie. that changes in y are not correlated with whether a household decides to move or not), I identify the effect of moving, for households who select into moving. In Equation 2, where β_3 measures the effect of winning the lottery and moving, while β_2 measures changes in outcomes for households who win but do not move.

$$y_i - y_{i,pre} = \beta_0 + \beta_2 \cdot \mathtt{S}_i + \beta_3 \cdot \mathtt{M}_i + \delta \cdot x_{i,0} + \mu_i. \tag{2}$$

Throughout the analysis, I follow a pre-analysis plan closely, which contains five primary

[28] 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.

[29] Included in the set of covariates x_{i0} are all variables from the administrative data used by the government to stratify the lottery: the gender of the applicant, whether the household head works for the government, type of housing unit applied for (studio, 1-, 2- or 3- bedrooms).

outcomes.[30] In the first part of the paper (Section 5, in which I study the willingness to pay for improved housing) I estimating the effect of winning the lottery on my first two outcomes: housing consumption and housing investment. In the second part of my argument (Section 6, in which I look at the effects of moving to mass-housing sites) I focus on the three remaining primary outcomes: labour supply, social networks, and public goods.

I define a summary index for each primary outcome using the method of Anderson (2008), and a list of outcomes that make up that index. For the sake of clear exposition, I focus on the main primary outcomes and selected constituent parts in the main results, but include all pre-specified tests in the online appendix. I use the method of Benjamini et al. (2006) to control the false discovery rate, to account for multiple hypothesis testing. Following Anderson (2008), I report the minimum q-value at which each hypothesis is rejected. I do this across the five main primary outcomes, and then within families. Generally, I relegate the presentation of these sharpened q-values to the online appendix as they do not affect the interpretation of the main results.

I want to be sure that my main results are not driven by changes in household composition. For example, if winning the lottery increases the likelihood that a working-age adult joins the households, this could mechanically inflate the total income of the household. Using estimating equations outlined in my main empirical strategy section, I find no effect of the program on household size, and members joining or leaving the household (see Table A.7).

4 Framework and rental market

4.1 What could be constraining the supply of formal housing?

In this paper, I ask whether the state has the ability to meet demand for housing that the private sector could not. The paper does not provide direct evidence on why this may be the case. However, in this section I draw on existing literature and stylized facts from developing country cities to shed some light on what could be constraining private sector supply of affordable formal housing. Collier and Venables (2014) provide an overview of the housing sector in African cities, and discuss many of the supply constraints that could be at play.[31]

The supply of housing may be constrained by particular state regulation of the housing con-

[30] https://www.socialscienceregistry.org/trials/2114. 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 18% of households in my control group won housing. At the time of the endline survey, very few of them had moved into the units that they won, some were still finalizing the mortgage down-payments. 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 coefficient estimates of having just won the lottery. My results are qualitatively similar without this adjustment.

[31] They argue that "the peculiarity of housing exposes it to multiple points of vulnerability not found together either in private consumer goods or in other capital goods".

struction sector. For example, inappropriate planning standards are often argued to hamper the supply of housing in cities (Brueckner and Sridhar, 2012; Glaeser and Ward, 2009). However, there are other reasons to think that housing markets in developing countries may not work perfectly even in the absence of government regulation. Formal housing construction is a large lumpy investment for which incremental upgrading is not an efficient substitute. Households might like to consume certain incremental upgrades, such as plastering, tiling, or installation of showers, but these upgrades could be difficult or expensive to install in a structure made from mud and wood. If they lived in a formal unit, these would be less costly to make. But it may be challenging for poor households to pay for the large fixed investment required for a concrete structure.

Missing mortgage markets make it challenging to build housing for which slum-dwellers would be willing to pay. In Addis Ababa, mortgage markets are almost entirely non-existent, while in many African countries mortgage markets cater exclusively to the rich (Parby et al., 2015). It may be very difficult for any bank to provide a loan of the necessary size to a person working in the informal sector and without access to existing collateral. Marx et al. (2013) argue that stylized facts about slums are consistent with a view of slums as "poverty traps", that living in an informal settlement specifically makes it challenging to accumulate the capital required to invest in new housing.

Housing construction may exhibit economies of scale when built in large developments, with standardized materials. A fragmented and small-scale construction sector may be unable to capture these scale economies. Construction of formal housing at scale on the edge of the city may be particularly challenging. Building on, and populating, previously undeveloped areas may require significant coordination (Owens et al., 2017). A single household may not want to build and move to a field on the edge of the city, unless a thousand other households do so at the same time, to provide security, social interaction and local demand for services and transport links. Furthermore, these greenfield developments may require connective infrastructure investments that the state has the ability to coordinate. Recent evidence from Tanzania shows that infrastructure planned in advance leads to increased housing investment. In the absence of this sort of planning, informal sprawl tends to grow on the edge of cities (Michaels et al., 2017). Land assembly problems could prevent private developers from putting together enough land to build at sufficient scale, whether it be the conversion of developed inner-city land or the assembly of enough rural agricultural land (O'Flaherty, 1994). The states' ability to exercise eminent domain to access large sites may allow them to build more efficiently.

In this section, I describe how winning the lottery immediately alters the choice-set of households, to guide interpretation of the findings in the paper. I present a very simple framework of household location and housing choice, to characterize how winning the lottery changes households' option sets and budget constraints. I then use detailed data on rents paid, rental income,

and mortgage repayments, to quantify these objects.

4.2 Model of household location and housing choice

I write down a model of a representative household with preferences over housing consumption h, consumption of the numeraire good c and location, given by distance from the city centre x. Households suffer disutility from living further from the centre, given by τ, which could, in principle vary across households, and could relate to the cost of commuting to work, the value of living near markets in the city centre, or attachment to social networks in one's local area. The function $r(x, h)$ characterises the market rent for housing quality x and housing services h. I assume that the function $r(x, h)$ is exogenously given. Furthermore, I assume that the construction of government housing does not affect rents for non-government housing through general equilibrium effects on the housing market.[32]

$$\max_{x,h} \frac{u(h, c)}{\tau x} \tag{3}$$
$$c = w - r(x, h)$$

In the baseline data, I observe household consumption and location choices. Most households live in slum housing and live within 8 kilometers of the city centre. Let x_1, h_1 characterise the location and housing choices of this household, where they pay market rent in a slum unit of $r(x_1, h_1)$.

I consider a household that wins a government apartment at location x_2, much further from the city, but with a set level of housing services h_f. This household must now pay mortgage repayments, and, in some cases, repay loans taken out just to make the required down-payment, given by $m(h_f)$. Conditional on the size of the apartment that the household applied for the state requires the same down-payment and mortgage repayments regardless of where a house is located. Households can then rent out the unit for the market rate, given by $r(x_2, h_f)$. Renting-out comes with some costs (such a real estate brokers' commission) given by δ so that a household that rents out earns $\delta r(x_2, h_f)$.

Households face the choice between moving into their apartments and consuming the higher quality housing at a worse location free of charge, facing the budget constraint $c_f = w - m(h_f)$, or remaining in slum housing, but facing the budget constraint $c_s = w - m(h_f) + \delta r(x_2, h_f) - r(x, h)$. I assume that households who do not move into government housing do not have access to some other affordable formal housing, though I do allow for them to adjust the quality

[32] This is unlikely to be true in practice, since the government program is a such a large shock to housing supply in the city. Since I am not able to measure such equilibrium effects, I abstract away from these effects. In principle, such effects should bias my measures of willingness to pay downwards, by reducing the market rent everyone else, and therefore improving the relative attractiveness of non-government housing.

and location of their slum housing, away from their original optimal choice x_1, h_1. Empirically, I confirm that very few households who do not occupy government housing live in formal housing, while slum households do move house reasonably often. Therefore, $\delta r(x_2, h_f)$ is the opportunity cost of moving in, in the form of foregone rental income. To simplify the problem, I define the net direct of winning the lottery on income as:

$$I = \delta r(x_2, h_f) - m(h_f) \tag{4}$$

There, households who don't move choose their preferred slum housing:

$$\begin{aligned} &\max_{x_s, h_s} \frac{u(h_s, c_s)}{\tau x_s} \\ &c_s = w + I - r(h_s, x_s) \end{aligned} \tag{5}$$

While households that move into their government apartments simply consume:

$$\begin{aligned} &\frac{u(h_f, c_f)}{\tau x_2} \\ &c_f = w + I - \delta r(h_f, x_2) \end{aligned} \tag{6}$$

My argument is that the lottery rations access for the opportunity to live in an owner-occupied unit, and that Expression (6) shows that the price that they pay to occupy to these units is given by $\delta r(h_f, x_2)$.[33] The key challenge to this interpretation is that the decision to move in could be driven by changes in households' current income, given by I above. Alternatively, household permanent income w could be increased in the long-run, if the households expect that the future value of their housing units will exceed the price that they paid.

Income effects could manifest in households housing decisions in two ways. First, increased income could lead to an increase in housing consumption, even if the household does not move to the government housing. It may be that the states' intervention in the housing market has no impact on access to affordable formal housing, it only drives increased demand through an income effect, so that an income transfer program would have the same effect on housing consumption. Second, it may well be that the states' intervention has improved access to affordable housing that wasn't available before, but that poor slum households would still not be able to

[33]Note that non-winners of the lottery also have access to government housing through the rental market. That is, they can remain in slums housing, or move to government housing, paying full market rent $r(h_f, x_2)$, and without enjoying the security of tenure afforded by living in their own home. Households in this setting may also have a preference for ownership, which could be driving a wedge between willingness to pay and willingness to accept. However, non-winners are not able to buy housing units like the treatment group were able to do, even at prices above the state-subsidized rate: sale of government housing is illegal.

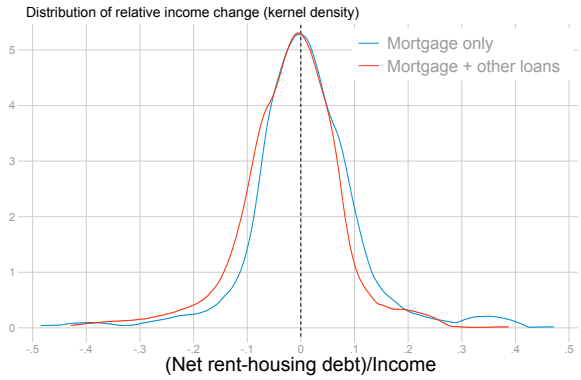
afford this housing at the market price in the absence of the income effects induced by winning the lottery. Households may still have a preference for government housing, but only with this shifted budget constraint. If this is true, households' decisions to move in and the level of housing services they consume, should be correlated with the size of the effect of the lottery on households' direct rental income. I now turn to the rental market data to quantify variation in the objects in the framework above, and to describe the estimation of income and wealth shocks experienced by lottery winners.

4.3 Rental markets for government housing

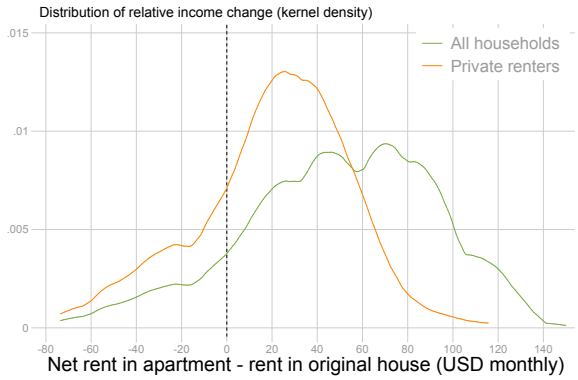
I have data on government housing rental markets both for owners who sublet their units in the experimental sample used in this paper, and a separate, larger, sample of 2,000 apartments on the rental market from a separate representative survey conducted at the same time as my endline survey. I then impute the potential rent for each housing unit, using simple hedonic regressions of observed rents on various apartment characteristics. Rents vary by the size of the apartment that households applied for, but also by numerous factors related to the location and amenities of the apartment, which were randomly assigned at the household level. For example, I find that the distance of a housing block from the main road is highly predictive of its market rent, homes on the fifth floor are worth considerably less than homes on the first and second floors, and apartments in blocks with space for a small shop on the ground floor are worth more. Table A.8 in the online appendix shows a simple hedonic regression used to predict market rents.[34] I use these results the rent that a home would fetch if it were rented out, even for households that live in their government apartments.

Figure 3: Household level rent estimates

(a) Panel A: Effect of winning the lottery on income



(b) Panel B: Effect of moving in housing costs



[34] The R^2 on this regression is 0.85.

4.3.1 Effect of lotteries on income

With my estimates of the potential rental income in hand, I characterize the effect on income of winning the lottery (I), the difference between the imputed market rent of a households unit, and the mortgage repayments required by that household. I know the exact size of the mortgage for each household, how much they have paid off, and how much they are required to pay each month. To these mortgage estimates, I add the costs of repaying loans that households took out, often from friends or money-lenders, to make the initial down-payments on their homes. Together this gives me an estimate of each households' housing liabilities m. I then normalize the estimated effect on income $\delta r(h_f, x_2) - m$ by baseline household income, to give a sense of the relative effect of winning the lottery. Figure 3, Panel A shows estimates for the effect on income of winning the lottery, both with and without additional informal loan repayments. I find that the effect on income of winning the lottery is generally small, and slightly negative on average, but centred close to zero. A few very poor households experience a relatively large increase in their income. The mass of households who experience slightly higher income gains are those who studio apartments, which were sold with larger subsidies relative to their market value than other size apartments.

4.3.2 Effect of moving on net housing costs

Next, I compute the net change in housing costs for households who move to the new units by estimating the difference between the rents they pay at their location in the slums $r(h_s, x_s)$ and the implicit cost of living in government housing $\delta r(h_f, x_2)$.[35] I show that in the overwhelming majority of cases, net rents in new apartments exceed rents in the slums. This is trivially true for households who enjoy access to rent-controlled government housing in the centre of the city, which they live in almost for free, but also holds for households renting on the private market. Figure 3, panel B shows the distribution of the net change in household costs that households would incur if they moved into government housing.

4.3.3 Housing values and the costs of production

How does the market price of government housing compare to the costs of producing it? My data only allows me to estimate the proportion of program applicants willing to move into government housing at the observed equilbrium market price. Crucially, if many lottery winners move into government housing, but at a market price that is below the costs of the production, this would make it hard to infer much about how many households in slums were made better off the state's intervention in the supply of housing. I am not able to trace the shape of the demand

[35] Since I find no evidence that the lottery affects the location decisions of households who do not move into the new condominiums, I take households' original baseline slum rent as a reasonable proxy for $r(h_s, x_s)$, after adjusting for inflation.

curve, and so the number of households willing to pay above the costs of the production would remain unknown. However, if the value of the new units, as inferred by the rents in these units, exceed the cost of production, then all households who move from slums into new units at this price reveal a willingness to pay for government housing that suggests that they were made better off by the supply of government housing.

Table 1: Government housing: estimated cost of production and estimated value

		Value estimates		
Unit Size	Production cost	P/E = 15	10% discount	HH Estimates
Studio	9,975	13,500	11,250	17,308
1-Bed	15,412	17,000	16,200	23,077
2-Bed	22,359	26,000	24,857	28,846
3-Bed	29,570	32,400	30,857	

I put together detailed data from the government housing agency on the costs of the program, across various inputs including land, infrastructure and roads, construction materials, financing, and administrative costs. Since the apartments are built in multi-storey buildings, I disaggregate the value of each apartment by apportioning total site production costs to each housing unit according to the total floor space of the units.[36] I then estimate the value of the housing units built by the state, using a number of different methods. First, I estimate the value of properties from observed rents using both a price-to-earnings ratio of 15 and a discount rate of 10%. Both of these estimates are considerably lower than the value of the units as estimated by their owners, and indeed by non-winners who were asked to estimate the value of the new houses.

Table 1 shows the comparison between my estimates costs of production and the value of the new units. I find that the value of the new apartments far exceeds the per-unit total costs of production (including the costs of infrastructure). This finding suggests that the supply of formal housing is not meeting demand in this setting.[37]

5 The demand for government housing among slum-dwellers

Of the estimated 34,000 households that won the lottery and bought the house, 46% moved in.[38] A further 4.5% are in the process of moving in. Of those that who have not moved into the houses that they own, most are renting them out. More households live in their houses than

[36] Given that housing blocks share common space and roads, this method may over-estimate the relative costs of larger apartments, but doing this differently does not qualitatively alter my findings.

[37] In a competitive market, the price of formal housing should be priced above its construction cost (Glaeser and Gyourko, 2008).

[38] Only 3% failed to pay the down-payments or had dropped out of the program before the lottery took place. Qualitative interviews with recipients suggest that some households are planning or upgrade their homes further, but have run out of funding, which has delayed their ability to move in. Others are waiting for the end of the school year to move their families, or simply waiting for more households to move in.

rent or sell. This is the key finding of the paper: just less than half of my sample, most of whom live in slums, prefer to live in government housing despite the high implicit cost that they pay to do so.

Table 2: The majority of occupied houses are owner-occupied

Status	Percentage
Moved in	45.73
Process of moving in	4.48
Renting out	39.16
Planning to rent out	3.78
Sold the house	3.78
Never bought the house	3.08

5.1 Housing and consumption

Table 3 shows how winning the lottery affects the consumption of households in terms of location, housing quality, non-housing consumption and overall housing costs. I show the simple ITT estimates of winning the lottery. Winning the lottery leads to large improvements in the quality of the structure that households occupy. Figure A.4 breaks down this effect into its constituent parts: the biggest increase is in probability that households have access to a flush toilet, a tap in their home, and walls made from durable materials.[39] These intention-to-treat effects on housing quality appear to be driven entirely by households who move in. In A.12 in the appendix I describe the chagnes in housing outcomes among those that move and those that do not, estimating Equation 2 in first differences. I find that households that do not move in have housing outcomes that are not significantly different from the control group.

Consistent with my estimates of the market rent for housing from Section 4.3, I find that winning lottery leads to large increases in households total housing costs: because mortgage repayments are slightly higher than rental income from the units, households who do not move experience small increases in housing expenditure. Households that move in pay significantly more in housing costs because mortgage repayments far exceed the cost that they were paying (and that control households pay) in slums. In other words, households who move into their housing units pay a significant amount to do so.[40]

I find that 8% of non-winners are renting government-built housing. This is not surprising. A back-of-the-envelope estimate suggests that nearly 10% of the total population of households in the city are renting government-owned housing. These households are renting from lottery

[39] See Table A.11 in the appendix for point estimates of the effects on housing outcomes with corrected q-values for multiple hypothesis testing.

[40] The estimates in row Table 3 of do not use measures of total housing *consumption*, as imputed for owner-occupiers of government housing using the rent regressions described in Section 4.3, but I get very similar results when I do.

Table 3: Winners consume more housing consume better housing by moving into their new units.

Outcome	N (1)	Control mean (2)	ITT Lottery (3)
Housing quality index	1,426	0.00	0.70***
			(0.06)
Net housing expenditures (USD monthly, p.a.e.)	1,426	18.74	5.46***
			(1.43)
Total non-housing consumption (USD monthly, p.a.e.)	1,426	43.85	-1.26
			(1.47)
Distance from the city centre (km)	1,426	5.40	4.35***
			(0.30)

Note: This table estimates the effect of winning the housing lottery on housing and consumption choices of households. Column (3) shows the *intent-to-treat* estimate of winning the lottery on household. Row 1 shows the effects on a standardized housing index, comprising of the constitute parts reported in Table A.11 . Net housing expenditure is measured as rent paid + mortgage repayments + rent income per adult equivalent in the home. The result showed here are robust to looking at total expenditure rather than pae. ***: p < 0.01, **: p<0.05, *: p<0.1.

winners. They are, presumably, the households in my sample with the highest willingness to pay for formal housing on the outskirts. This implies that my estimates of the effects of winning government housing are likely to be downward-biased, because some households in the control group were able to access formal housing that they would not otherwise, in the absence of any program at all. The large difference in take-up rates between treatment and control households must be driven by the priority access afforded by owning this housing. In my framework, this is modelled as driven by a rental market friction δ, but could also include some direct utility from the tenure security that comes from living in a home that one owns. I conducted extensive qualitative interviews with households in the program. Households report that they moved in because they wanted to enjoy the improved housing conditions. But some said that they would not otherwise have moved into the same unit if they had to rent it at the market rate. When asked why most said that it was the piece of mind of living in a home that they own that ultimately convinced them to move in. Therefore, the demand for government housing estimated here should be understood as the demand for owner-occupied housing.

5.2 Income effects

I interpret the decision to move in as revealing demand for formal housing among poor households who would otherwise live in a slum, suggesting that there is pent-up demand for improved housing that is not being met by the market. The major challenge to my interpretation of these findings is that rather reflecting latent demand for formal housing, the state created the demand for better housing by transferring wealth to winning households in the form of

subsidized mortgages. Equation 6 in Section 4 above shows that households must still pay the costs $\delta r(h_f, x_2)$ to move in; but winning the lottery induces a change in household income I that might have shifted their budget set outwards. According to this logic, giving these households a wealth transfer in the form of cash would have induced the same increase in housing consumption, even if the state had not intervened in the supply of housing.

The results in Table 3 provide the first evidence against this story. In a standard model where winning the lottery results in a large increase in wealth and households are able to draw down this wealth into the current period, we would expect both housing and non-housing consumption to increase. All lottery winners experience some kind of change to their future wealth winning the lottery. Yet I find that only households that moved into their units experienced increased housing quality. Furthermore, non-housing expenditure is unaffected by winning the lottery, either among those that move and those that do not. Household consumption, both on food and other goods, is unaffected, and the estimates are flat across the quantiles of household consumption (Figure A.5).[41]

Next, I test directly for wealth effects from winning the lottery. As described in Section 4.3, there is some variation in the value of the subsidy provided by the state, which generates variation in the total size of the wealth transfer to households, and the size of the current effect on household income. It could that some households experience the lottery as a large increase in total wealth, while others see little change. In Table 4 I correlate standardized measures of the raw and relative effect on income of winning the lottery on whether lottery winners moved into their housing units. Furthermore, I control for the type of housing unit the household applied for, since this a source of considerable variation in the magnitude of the transfer. Households who applied for studio and 1-bedroom apartments enjoyed slight increases in income and much larger wealth effects, while households who applied for larger units face mortgage repayments that exceed the rental value of units, and enjoy smaller wealth gains. I argue that these difference in prices were unanticipated since they are related to the governments' opaque pricing rules, although not random because households could self-select into the type of unit for which they applied. If anything, households who win larger apartments are less likely to move in.

After controlling for apartment size, the remaining variation in the effect on income is driven entirely by the randomly assigned location of the apartment. I find no evidence that variation in the value of the house affects the decision to move in. The estimated coefficients are small in magnitude. A one standard deviation difference in the income change (equivalent to a fifteen percent increase in households' baseline total income) increases the probability of moving in

[41] 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, an effect of seven per cent. Note that I find no significant impact on other sub-categories of spending, such as healthcare, education, clothing or entertainment. See A.18 for a detailed breakdown of the ITT effects on different expenditures, with adjusted q-values. One aspect of expenditure that is affected is transport costs, driven by households that move to the edge of the city. For this reason, I exclude transport for my consumption aggregates, as this is more like a tax of distance than a source of consumption.

Table 4: Effect of lottery-induced variation in rental income on moving in.

	Dependent variable: household moved into house				
	(1)	(2)	(3)	(4)	(5)
Change in income (SD)	0.004	0.018			
	(0.019)	(0.024)			
Relative change in income (SD)			0.011	0.024	
			(0.019)	(0.021)	
Positive change in income					0.035
					(0.048)
Applied for studio apartment		-0.040		-0.031	-0.031
		(0.192)		(0.186)	(0.189)
Applied for 1 Bedroom		0.066		0.079	0.073
		(0.183)		(0.179)	(0.181)
Applied for 2 Bedrooms		0.082		0.094	0.089
		(0.180)		(0.179)	(0.179)
Constant	0.457	0.400	0.457	0.388	0.375
	(0.019)***	(0.180)**	(0.019)***	(0.177)**	(0.176)**
R^2	0.00	0.01	0.00	0.01	0.01
N	715	715	715	715	715

This tables correlates the mechanical increase in income due to winning the lottery with whether households move into their apartments. The income change is the difference between the market rent (after broker fees) of government housing units and they required mortgage repayment on that unit. I use variation in this difference, induced by the type of housing unit for which a household applied, and random variation in the locational amenities of the unit to which a household is assigned. The dependent variable is set equal to one if the household moved into the housing unit, and the sample is restricted to only household who won the lottery. Column (1) shows the effect of the raw difference between rent and mortgage, Column (2) controls for the type of housing unit for which the household applied. Columns (3) and (4) look instead at the size of the income effect relative to the households baseline total income, adjusted for inflation. Column (5) looks at the effect of a dummy variable set equal to one if the net income effect was greater than zero. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

by between 0.4 and 2.4 percentage points, depending on the specification, over a mean of 46 percent. While these results do not conclusively rule out that the wealth effects from the lottery did not contribute to the affordability of the better housing at the margin, the evidence seems clear that these wealth effects are playing a small role relative to the state's provision of access to formal housing that was not available before. For example, if I consider households who win housing in one particularly remote site where housing values are low and applied for large houses that were priced at relatively high rates by the state, I estimate that the total purchase price paid by these households for their units is very similar to the market value of their units. Therefore, they enjoy no wealth effect. Yet I find that 40% of these 80 households in my sample moved in, only slightly fewer than the sample as a whole.

5.3 COMPLEMENTARY INVESTMENTS

Next, I look at the level of housing consumed by households after they moved in. My main housing index in Table 3 comprises only fixed characteristics of housing units, such as a piped water and concrete walls. These structural characteristics come automatically with the basic housing unit. Without further upgrades, these basic units are already a considerable improvement on informal housing, but there were a number of amenities, common in modern homes in rich countries, that households could choose to add.[42] These include doors between adjoining rooms, plastering, insulation in the ceiling, sinks and basins, and tiling. Figure A.6 shows the breakdown of total expenditure on various upgrades, using a survey module on upgrades across 32 different sub-categories. We asked, for each type of upgrade, whether the respondent household had access to the amenity provided by that upgrade in their old homes. Figure A.6 shows that the vast majority of these investments are novel: households did not have them in their old homes.[43]

I show that households make significant upgrades to their units, adding numerous amenities that they did not have in their old homes. Table 5, row 1 shows the impact on total housing investment in USD, over the last two years. Households who win invest heavily in further improvements to the units. They invest a total of nearly $2,000 over two years, which is equivalent to nearly 17% of the initial construction costs, and comparable to the amount that they already paid in down-payments. I conducted data collection with a subset of lottery winners, and find that almost all of these housing investments were made in new government apartments, including among lottery winners that did not move in, rather than in their original slum housing units. Households that rent out do so to improve the market rent of the units: I estimate an average annual rent return of 18% per dollar estimated for households that rent out (see Figure A.7). [44]

The control group invest very little in housing upgrades. The control mean of investment of $74 over the last two years is equivalent to 1.3% of total household expenditure over this period. It is possible that investment levels are depressed among these households if they are hoping to win the lottery and move out of their homes in future. I find their investments rates are slightly higher than the investment rates of households living in informal housing in representative household surveys, which is roughly 0.5% of total expenditure.[45]

[42] A notable improvement not included in my index, but that comes with basic units, are windows. Almost no informal houses in Addis Ababa have glass windows. This was an important change that came up in many qualitative interviews.

[43] Not all upgrades were novel. Most households reported having to do some labour, and make some investment, to clean up construction materials, and install front doors to make their homes habitable. However, my data shows that the vast majority of the money (75%) spent on upgrades was to improve units above-and-beyond the amenities enjoyed in informal housing.

[44] Descriptively, households who move in (and thereby consume these investments) spend significantly more on upgrades, but I do not place any causal interpretation on this finding.

[45] This goes up to 1.5% when I restrict my sample to home owner-occupiers in the representative data.

Table 5: Effect on total housing upgrade investments over the last two years.

Outcome	N (1)	Control mean (2)	ITT Lottery (3)
All housing investments *(USD, over two years)*	1,425	74.09	1,682.70*** (63.63)
Household duarable purchases	1,425	47.41	85.93*** (16.31)
Total savings	1,425	1,837.86	-1,168.34*** (100.01)
Total remaining mortgages	1,425	253.33	3,981.83*** (144.45)
Total loans (excluding mortgages)	1,425	140.79	289.98*** (71.39)

Note: This table estimates the effect of winning the housing lottery on housing investment and household finances. Column (3) shows the *intent-to-treat* estimate of winning the lottery on household. Row (1) shows the effect on all household investment in housing upgrades. ***: p < 0.01, **: p<0.05, *: p<0.1.

Why do households make these upgrades to their government-built units that they were not making in informal housing? There are two likely explanations. First, security of tenure could make households willing to make investments without fear that they'll lose them if they are forced to move out the units that they don't earn. I find that lottery winners experience significant increases in self-reported tenure security.[46] Second, formal housing technology reduces the costs of making important upgrades, 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. Certain investments are likely to be almost infinitely expensive without actually 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 formal apartments. By helping them to make the large fixed investment in a formal home, the state unleashes household demand for these amenities.

5.4 Who stays and who goes?

What are the key predictors of who moves in and who does not? I show that households that move to new apartments are not richer on average, nor are they significantly less likely to have lived in slums than those that do not. To investigate further, I employ simple machine learning

[46]This would not explain why, on owner-occupied informal housing, and in the private rental market in the rest of Addis Ababa, landlords do not make significant improvements to informal housing units. Although land cannot be privately owned in Ethiopia, long lease-holds do provide secure tenure.

techniques to uncover the key correlates of moving to the new housing, using approaches suggested by (Belloni et al., 2014). I rely primarily on lasso regressions to select from a large list of over 50 variables related to household wealth, community ties, attitudes, location, income, employment, demographics and housing conditions at baseline. Table A.10 shows post-lasso OLS estimation using only the selected variables from lasso-regressions. In column (1), I use optimally selected λ.[47] The results with variable selection using an artificially lower lambda parameter are shown in columns (2) and (3). Finally, in Column (4) I confirm that baseline housing, earnings and consumption, which are not selected by the lasso regression, are not correlated with whether households moved in. In addition, tenure security at baseline is not predictive: households do not seem to move in because they are facing the prospect of eviction from their slum home.

The results suggest that the households who move in are those that face the lowest costs of moving. First, households that are members of local neighbourhood savings groups at baseline (*iddirs*, in Amharic) are significantly less likely to move. These households presumably have the most to lose from leaving these communities groups, and may otherwise be more embedded in their local communities. Households who were living for free in their houses at baseline are less likely to move. Many of these households are squatters, who may lose access to their rent-free housing by moving.[48] In addition, households who have a member who walks to work are significantly less likely to move: these are households who value proximity to the city centre the most.

6 The effects of moving

Households move voluntarily to new housing sites on the edge of the city and are willing to pay above the costs of production to do so. But we may not yet be able to conclude that they are made better off by moving to government housing. Households may make mistakes when they move. They may realise that are they worse off living so far away from the city, and soon come to regret moving.[49] I am particularly interested in whether households are hurt by living so far away from economic activity in the centre and from their old social networks in neighbourhoods where they know almost no-one. Life in new housing sites could be worse than households anticipated.

Household decision makers may under-estimated the costs of moving further away, either for

[47] I use cross-validated k-fold lasso regression, where I set lambda to the largest lambda at which the MSPE is within one standard error of the minimal MSPE. Results are similar using this method and other theory-driven selection of the optimal lambda.

[48] I do not find that households who live in government-owned rent-controlled slums are less likely to move. Although they enjoy lower rents, they may also fear that the state will eventually reclaim their homes, which may make them more likely to move.

[49] Households who regret moving may move back to where they used to live in coming years, but some may find it hard to move back to where they used to live and be made permanently worse off by moving.

themselves or for other members of their family. Evidence suggests that living far away from the centre impedes labour market outcomes, particularly for the youth (Kain, 1992; Franklin, 2018). But these costs may not be easy to estimate for household decisions makers, especially if they do not observe how and where younger members work or look for work, or if they do not consult them in the decision-making process.

Whether the new sites are good places to live may depend on how many households move in. If many households move the neighbourhoods will flourish: population density will be high enough to sustain local economic activity and demand for regular public transport links to the centre. Households who move will have a large set of neighbours from which to establish new communities. But households are unlikely to be able to coordinate their decisions to move: households that do move may find other households have not. They may find themselves alone in new areas, without access to services, markets, and transport connections.

Finally, cooperation over the maintenance of public spaces could be more challenging in these new communities with lower social capital. Even if households privately accept, or even prefer, lower levels of social interaction with their new neighbourhoods, this might not be socially efficient if they are then unable to work together. The new housing sites may decline over time, even if they start out as good places to live in.

6.1 Labour market outcomes

I find no effect of winning the lottery on total earnings, hours worked or overall employment. When I look separately at changes in labour supply on moving and non-moving households, I also find no effects. Table 6 shows these results for my main household labour index and its constituent parts. I also find no evidence of heterogeneity at the household level, by estimating quantile regressions (Figure A.8).

These results hold when I look at individual level regressions, allowing me to control for individual characteristics (see Table A.20, Panel B). I find no evidence of heterogeneity by individual characteristics, by looking at the effects separately by gender, household seniority, and age (see Tables A.21, A.22 and A.23, respectively). This rules out of the possibility that household heads moved their families without adequately perceiving the costs that they would impose on household members other than themselves. I also find who that youth (who may rely more on social networks in the city centre to find work) are not negatively affected by moving.

I want to rule out that my null results are driven by the effect of moving, and some financial effect of winning the lottery, pushing in different directions but cancelling each other out. First, in the online appendix (Table A.14), I describe changes in labour outcomes among housholds who move, and households that do not move in. I find no significant difference, either in OLS or first differences. Second, I repeat the analysis conducted in Table 4 above in the online appendix for household labour supply. I correlate the relative size of the affect of the lottery on household

Table 6: Effect of the lottery on household employment outcomes.

Outcome	N (1)	Control mean (2)	ITT Lottery (3)
Household labour market index	1,425	0.00	-0.07
			(0.05)
Earnings per working age adult (monthly, USD)	1,425	87.73	-2.58
			(4.38)
Total employed per working age adult	1,425	0.67	-0.02
			(0.02)
Hours worked per working age adult	1,425	29.63	-1.28
			(0.85)

Note: This table estimates the effect of winning the housing lottery on housing and consumption choices of households. Column (3) shows the *intent-to-treat* estimate of winning the lottery on household. ***: p < 0.01, **: p<0.05, *: p<0.1.

income on labour market outcomes (Table A.16). I find no effect, suggesting that the lottery itself is not affecting employment.

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 A.20, Panel C, suggests that some workers are able to adjust their place of work, while most others face longer commuting times. Winning leads to slightly more churn in place of work, and the sector of work. Members of winning households are significantly more likely to have switched their form of employment, either from self-employment to wage-employment or in the opposite direction. There is no effect, however, on the probability that a respondent has changed 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 effect is large and significant in the ITT estimates, suggesting that a significant fraction of households changed their place of working after moving to the new sites. 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 households who moved were significantly less likely to work at jobs close to their homes at baseline and so were already commuting to work. However, there are a sizeable fraction of households living in the new housing sites that work very close to home. This is a 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.

Moving to public housing has the effect of increasing commuting times by 34 minutes per day per working, over a mean of roughly one hour per day (see Panel D of Table A.20 for ITT estima-

tes). Given how far the housing sites are from the city centre, these increases in travel times are relatively modest. Recall that households who move to the new sites live almost three times as far from the city centre. I find that the new housing sites are very well connected to the city by private mini-bus transport links, which helps to keep the city accessible to residents. Reported waiting times for mini-buses are very low. Households' adjustment of their work location may also contribute to the relatively low increases in commuting time. Winning the lottery leads to an increase in individual commuting costs of roughly $2.4 per month, although this cost is relatively small compared to total wages: income net of travel costs is not significantly affected.

So moving to new housing sites is not costless: households must adjust and spend more time in traffic. This is the price for enjoying high-quality housing at low rents. But the time-costs may not be so large, on net. The time costs of commuting appear to be offset completely by reduced time spent doing domestic labour tasks, with no net effect on total leisure time or time sleeping (see Table A.20, Panel C). This implies that net welfare costs of moving, in terms of time-use, are likely quite small.

I find no evidence that households are doing distortionary "guard labour": living in their units so that they can spend time there looking after their property. Households who move in actually report significantly higher tenure security and feelings of security in their home: these are concrete units that they are able to lock and leave, after all, which is not the case for informal housing. I cannot rule out that households like to live in the homes in order to look after them. But if this is happening, I don't find any evidence that it comes with any costs in terms of time or lost income.

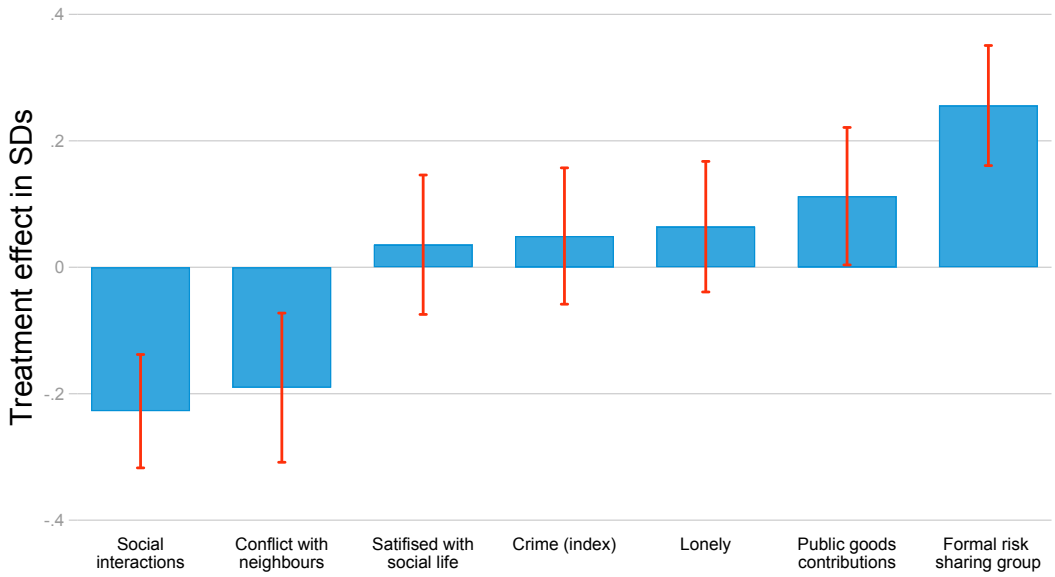
6.2 Social networks

Social life in the new housing sites is radically different to life in slums. Figure 4 summarizes the main effects of the lottery on social and community outcomes. Tables A.24 and A.25 in the appendix show the precise ITT estimates, with all pre-specified outcomes and adjusted q-values. I find a large reduction in the size of total social networks and the regularity of interactions with neighbours. Households in the new sites have less regular interactions with their neighbours, and with other friends that don't live in their neighbourhoods.

However, 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 neighbourhoods. They also report less reliance on social networks for economic affairs. I find no effect on loneliness, dissatisfaction with neighbourhood interactions.

Are households happy with this changed state of social affairs or is a price that they have to pay to live in this new formal housing? I find no evidence that households experience a reduction in welfare or well-being as a result of this reduction in social contact. When asked

Figure 4: Summary of main effects (ITT) on main social networks outcomes



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.

Qualitative work suggests that for many households, moving from slums was an acceptable change, which involved trade-offs. Households reported that life informal settlements involved considerable levels of conflict around the shared use of resources like toilets, cooking areas and other communal spaces. They attribute the fall in conflict to the fact that they no longer had to negotiate over the shared use of such spaces in government housing. They also report that neighbours in slums often asked for assistance, which could be a burden at times, and that they were happy to reduce those sorts of social ties when they moved out of the slums. In the data, I find that households not only reduce their overall social interactions but reduce their levels of economic interactions even within their remaining social network. That is, they reduce the number of other people they interact with on an economic basis by more than they reduce their total network size. In qualitative interviews households also report a value for the privacy that they enjoy in formal housing.

Consistent with this preference for privacy and reduced conflict, Table A.26 shows that winning households experience significantly reduced self-reported depression and anxiety. These effects appear to be driven primarily by households that move to the new housing sites and

not from winning the lottery itself.[50] Interestingly, I find no significant impact on self-reported well-being as measured by the Cantril ladder method. However, when I ask lottery winners to assess how happy they would be had they not won the lottery, they report significantly lower levels of well-being, while I find the opposite when I ask non-winners how happy they would be *had* they won.

I argue that these findings are 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.

That said, neighbourhood relations are still evolving. I restrict my sample only lottery winners living in the new sites and correlate the length of time since they moved into the housing with social interactions with their neighbours. I find that time in the sites is significantly correlated with the intensity of interactions with neighbours, but find no effect at all on measures of conflict in the neighbourhoods.

6.3 Community and public goods

I turn to the effects of winning the lottery on public goods and community. I find that lottery winners report significantly higher willingness to contribute both time and money to investments in public goods in their new housing sites than households in the slums. I also find increases in their reported beliefs about how willing their neighbours are to make such contributions. These effects are driven by households that move into the new housing sites.

Lottery winners are significantly more likely to be members of local risk-sharing groups called *iddirs*. 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 one main predictor of whether a household moves into the housing is whether they were a member of a risk-sharing group before they moved. Tables A.25 in the appendix shows a detailed breakdown of these results.

Furthermore, I find evidence that households that move increase their participation in neig-

[50] Although the negative coefficient on households that move is larger than for those that do not move, the difference is not quite statistically significant.

hbourhood committees that have formal rules of association and regular payment requirements. All housing blocks report that they have set up official management committees, usually with an executive management committee that organises monthly meetings to discuss neighbourhood issues and to make agreements about the provision of new public goods. These community groups appear to be highly inclusive. Most households who won the lottery and live in the sites report that they are invited to, and attend the committee meetings. Together with the findings documented in Section , these findings suggest a shift away from informal economic interactions towards more formal neighbourhood interactions. This could be due to more clearly defined property rights, and division between private and public space in new housing blocks.

7 Should government housing be built in the city centre?

The outcomes for households assigned to the periphery appear to be positive: demand for these housing units is high, and in nearly 50% of cases the lottery winners decided to move into the units that they own, without any evidence of negative effects on a range of economic outcomes two years later. But it is still not clear that the state is building the new housing in the right place. The many positive benefits of formal housing may outway the costs of distance in remote locations so that households with the opportunity to live in formal housing in the centre would be made significantly better off in comparison. Providing formal housing in the centre is considerably more expensive because the cost of this central land is considerably higher. But if the welfare gains are large enough, it may be justifiable.

So far, I have shown results only for households who were assigned to housing units on the periphery of the city. These households comprise more than 95% of the winning households in the lottery I study. However, a few households were randomly assigned to housing units at random. Table A.3 shows the 10 different sites in the data, with sample sizes and average distance from the city centre by site. I returned to the field to collect additional data from households randomly sampled only from these central locations. I focussed on households assigned to sites between 2 and 6 kilometres, and between 10 and 14 kilometres from the city centre. These households paid the exact same price as those who won on the periphery, including the size of their down-payments and monthly mortgage repayments but experience large income and wealth gains.

I then pool my data on households who were assigned to the centre with my main sample and estimate differential treatment effects by the randomly assigned distance of the housing unit from the centre. For each housing unit, I assign an estimated travel time to the centre of the city, using google maps traffic data.[51] I then estimate the location-specific effect of winning the

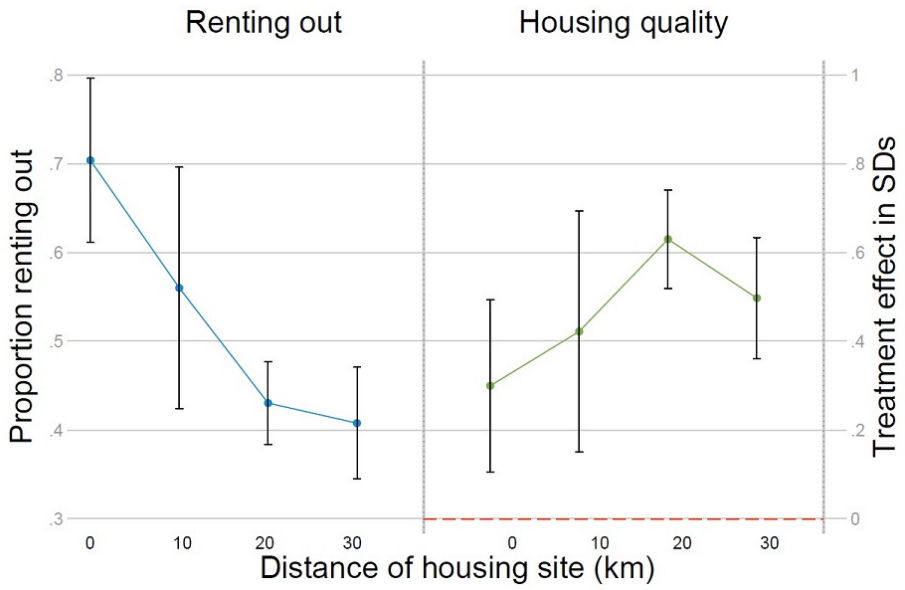
[51]For the very largest housing sites I estimate the time taken to walk from the edge of housing site to the main transport route, in order to estimate heterogeneous travel distances within housing sites.

lottery, by distance bin. I denote each category $\mathtt{T}_i^{\{d_1,d_2\}}$ where d_1 (d_2) is minimum (maximum) distance from the centre of the housing, then estimate the following equation:

$$y_i = \beta_0 + \beta_1 \cdot \mathtt{T}_i^{\{0,4\}} + \beta_2 \cdot \mathtt{T}_i^{\{6,12\}} + \beta_3 \cdot \mathtt{T}_i^{\{16,22\}} + \beta_4 \cdot \mathtt{T}_i^{\{25,30\}} + \alpha \cdot y_{i,pre} + \boldsymbol{\delta} \cdot \boldsymbol{x}_{i,0} + \mu_i. \quad (7)$$

I focus on the demand for this centrally located housing. Apartments in the centre are valuable: they rent out for three times the amount of those identical units located on the outskirts. Therefore, households who own units can rent out the units at a considerable profit. They trade-off this large opportunity cost of moving in against the opportunity to move into formal housing without having to relocate far from their existing homes and places of work. I find that the

Figure 5: Rates of renting out and effec onhousing quality by location of housing unit



moving-in rates for households with houses in the centre are almost half of those households on the periphery. Figure 5 shows how the proportion of households who have rented out their units decreases with distance from the city centre. The random assignment to locations allows me to reasonably infer how this group would have behaved if they had won housing on the outskirts. They are willing to pay the market rate for formal housing on the outskirts in the city, but in the centre, where the price is considerably higher, they prefer to remain in informal housing.

In other words, when the state gives poor households formal housing in the centre, they are outbid for their own units by richer households. It may still be the case that more formal housing should be built in the city centre, given the demand for it in the market. But my results suggest that it is not poor households who will be able to afford these units. Households who win in

the centre may be made better off by the rental income, but selling subsidized housing to them does not have the desired effect of moving them out of slums, and comes with very high implicit costs on the part of the state.[52]

8 Conclusion

I show that households living in slums in Addis Ababa, Ethiopia are willing to pay to move to formal housing on the outskirts of the city. The implicit price that they pay to do so is considerably higher than what they paid, on average, in slums before winning the lottery. The value of housing units implied by the rental market suggests that building this housing would have been 'profitable' were it sold to the highest bidder, instead of to poor households at subsidised rates. The housing program that I study leads to dramatic improvements in housing quality for beneficiaries. This effect comes not only from the basic level of housing provided by the state: the program appears to unleash enormous housing investments by winning households, who spend almost 20% of the total construction costs to upgrade their units.

It is important to keep in mind that households in my study who move out of slums do so voluntarily. I find evidence that households with higher costs of moving (in particular, households with closer community ties in slum neighbourhoods) choose not to move. Therefore, the intention-to-treat results in this paper, which show no evidence of harm from moving out of slums, should in no way be interpreted as the average treatment effect of forcibly evicting households from slums.

That said, I find that a surprisingly high proportion of households in slums are willing to pay to move to formal housing on the outskirts of the city, and moving does not come with significant disadvantages. Rather than providing an essential economic function for households who live in them, it appears that, for at least a substantial fraction of households, slums are a sub-optimal outcome. When given the choice, they will pay to move out. The program induces a large number of people to move out of slums, which may, in turn, improve social welfare if this reduces some of the externalities associated with slums. This paper does not provide any evidence on whether this is the case; this remains an open research question. I do, however, provide some evidence that moving households out of slums does not appear to impose negative externalities on those households left behind. In an online appendix (Section A.2), I use variation in the number of winners of the lottery in each urban district, as a proportion of district population. Using a wide range of specifications and datasets (my sample of non-lottery winners and another representative sample of households), I find no evidence of negative spillover effects among

[52] Indeed, I find that households who win in the centre are made significantly richer. Table A.30 shows the precise point estimates with tests for equal treatment effects across sites for a range of economic outcomes. The results suggest that these households prefer to use their income gains to reduce labour supply at the margin: I find that earnings are slightly lower on average for households who win in the centre.

untreated households.

Taken together, my results suggest that people in living the slums of developing country cities could be made significantly better off if more formal housing were made available. There may be better ways to achieve this, other than through state intervention in the supply of housing. Reform of land markets, the construction sector, and housing finance markets could do much to increase the supply of housing (Collier and Venables, 2014). Yet there is still reason to think that the state has a role to play in the planning of new settlements on the outskirts of the city, which may require coordination and the provision of connective infrastructure, such as roads and water connections (Michaels et al., 2017).

Achieving fundamental reform of land and housing institutions may be challenging, and a long time coming for African cities.[53] In the absence of sweeping reforms, it appears that state intervention in the supply of housing does appear to ease the housing crisis. But many commentators are concerned that government housing will simply replicate slum housing conditions, or replicate the experience of urban decline in social housing, thought to have occurred in developed countries. Mine are short-run results for relatively new housing estates. 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. My results on the Ethiopian program are encouraging in this regard: the new neighbourhoods are mixed income, have vibrant local markets and service economies, and community cooperation for the provision of public goods seems to be functioning well. Still, more work is required to understand the long-run effects of these policies.

[53] Collier and Venables (2014) identify five inter-locking failures in African housing markets. “addressing only one or two of them has little payoff if the others remain unresolved." Marx et al. (2013) write: “ Several programs with mass investments or wholesale relocation of slum households into housing estates appear to have been successful.”

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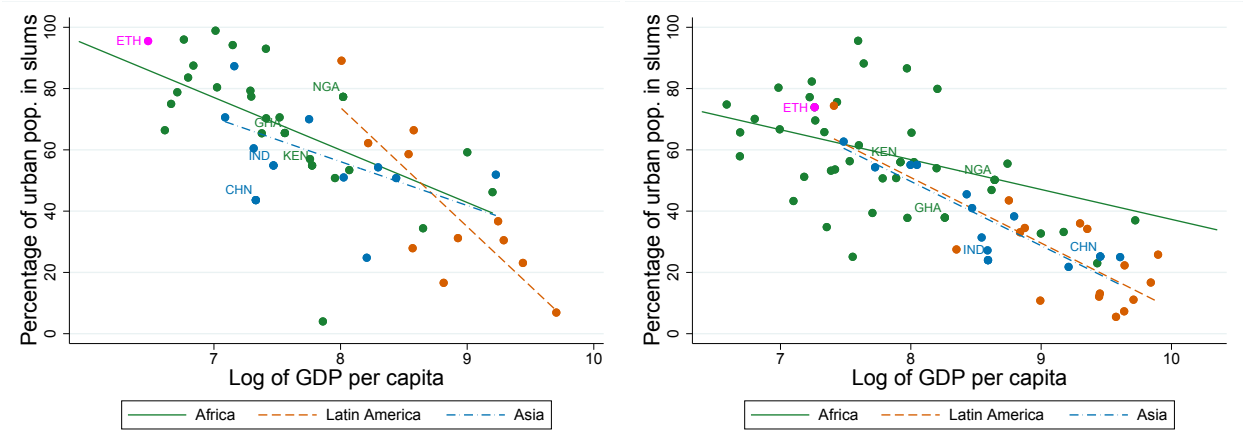
A.1 Appendix: Cross-country correlations

I relate GDP per capita to the proportion of urban households in slums in 1990 (Figure A.1). The strong correlation suggests that slums would go away if Africa managed to generate sufficient growth. And indeed the proportion of urban households living in slums in Africa has fallen from roughly 70% to 60% from 1990 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. The relationship between development and slum prevalence in 2014 is considerably weaker Africa that it is in the rest of the developing world (Panel B of Figure A.1): economic growth over the period 2005 to 2014 is not significantly correlated with changes in urban population living in slums. Furthermore, rapid urbanization has meant that both the absolute number and the proportion of people living in slums has grown over time.

Figure A.1: GDP per capita and slums across developing countries

(a) GDP and slums in 1990. **(b)** GDP and slums in 2014.



Data comes from UN-HABITAT, Madison World Tables, and the World Bank. Calculations my own.

A.2 Appendix: Spillovers of moving

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.[54]

This a real concern: 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.

Table A.1: Effects of proportion of neighbours winning the lottery (in standard deviations) on control group outcomes

		Effect of treated neighbours		
Outcome	Control mean (1)	Coeff (2)	Std. Err. (3)	Adj q-value (4)
Housing quality index	0.00	0.06	0.06	0.702
Expenditure, non-housing (monthly, USD)	165.82	0.88	5.92	0.883
Household labour market index	0.00	-0.05	0.05	0.721
Intensity of social interactions (index)	0.00	-0.07	0.07	0.702
Number of close social ties	11.41	0.39	0.66	0.781
Conflict among neighbours (index)	0.00	-0.07	0.09	0.721
Community and public goods index	0.00	0.12*	0.06	0.351
Household is a member of at least one iddir	0.54	-0.01	0.03	0.819
Household fear of eviction in future (scale)	0.36	0.01	0.03	0.781
Household has been evicted in last 2 years	0.09	0.03*	0.02	0.351

Note: This table estimates the effect of the proportion of households who won the lottery at the level of the urban district (110 districts in the city) on individuals in the control group, who did not win the lottery. For the purposes of legibility, I normalize the proportion of winners to standardized index with standard deviation 1. The mean of the raw proportion across districts is 7% with standard deviation of 3%. All regressions control for the proportion of households in the district who registered for the lottery. ***: $p < 0.01$, **: $p<0.05$, *: $p<0.1$.

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. Figure A.11 shows the proportion of households who won the 2015 lottery by district in my data.

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 A.1 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 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

[54]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.

correlated with the number of applicants in the district.[55] 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.[56] I show these results in Tables A.28. Even after adding these controls for the size and characteristics of the applicant pool, I find similar results to those in Table A.1. 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 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.

[55] As Figure 2 shows, areas in the centre of the city have a higher proportion of their residents as applicants. Therefore, in the results in Table A.1 I control for distance from the city centre, and include ten division fixed-effects.

[56] 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.

Appendix: Additional Figures and Tables

Table A.2: Government housing programs providing fully formal housing units for free or subsidies rates for the urban poor/slum dwellers in low and middle income countries.

Country	Policy	Scale (Units)
Ethiopia	IHDP	200,000 units so far 947,376 registered
Angola	Meu Sonho, Minha Casa	1 million
Kenya	The Big Four Agenda	1 million by 2022
South Africa	RDP	3 million complete
Egypt	Social housing	1 million by 2020
Nigeria	Affordable housing program	1 million annually (aim)
Brazil	Minha Casa, Minha Vida	4.2 million
Mexico	Infonavit	4.3 million
Chile	MINVU	100,000 per year
Columbia		50,000 per year
rental programs:		
Algeria		3.8 million

This is an inexhaustive list based on my own research and reading of government reports.

Table A.3: Housing sites and number of units awarded

Site	Number of Units	Distance (km)	Average rent
Yeka Abado	12501	19	92
Tulu Dimtu	12272	25	66
Yeka ayat	2865	17	95
Gelan	1272	18	*
Genet Menafesha	1212	15	85
Summit	750	15	*
Basha Wolde Chilot	535	2	170
Karakore	495	14	88
Lideta Redevelopmnt	393	3	170
Mekanisa Kotari	352	6	*
Jemo		10	105
Total (main 10 sites)	32647		
Total (all sites)	33585		

Figure A.2: Government housing in a new site (photograph by Charlie Rosser)

Table A.4: 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.5: 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
N	1,564	3,741

Figure A.3: Kernel density: household consumption among housing applicants and representative data from the Ethiopian household consumption and expenditure survey (HCES) from 2011 and HCES from 2016

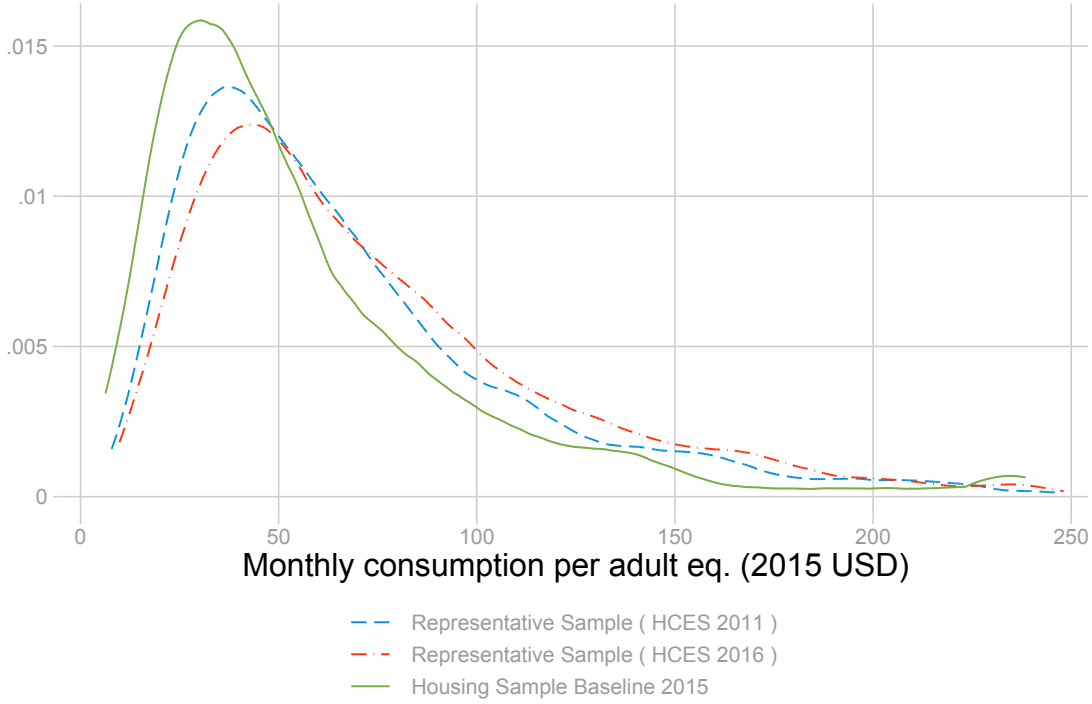


Table A.6: Predictors of attrition

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.7: 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.8: Predicted apartment rent using apartment location and amenities (in USD pm)

	Coef	SE
Floor (level)	-1.878***	(0.381)
Studio	-59.45***	(1.739)
1- Bed	-34.71***	(1.490)
3- Bed	33.78***	(2.740)
Site FE 1	-40.02***	(1.565)
Site FE 2	-28.77***	(1.896)
Site FE 4	-46.03***	(2.545)
Site FE 5	-26.60***	(3.077)
Block has communal slaughter area	4.039***	(1.236)
Block has shop space	2.462*	(1.317)
Distance from roads	-6.591***	(0.107)
Basic quality of finishing (baseline)	1.442**	(0.637)
Observations	1,406	
R-squared	0.851	

Table A.9: Partial correlations of baseline outcomes of interest with the decision to move in.

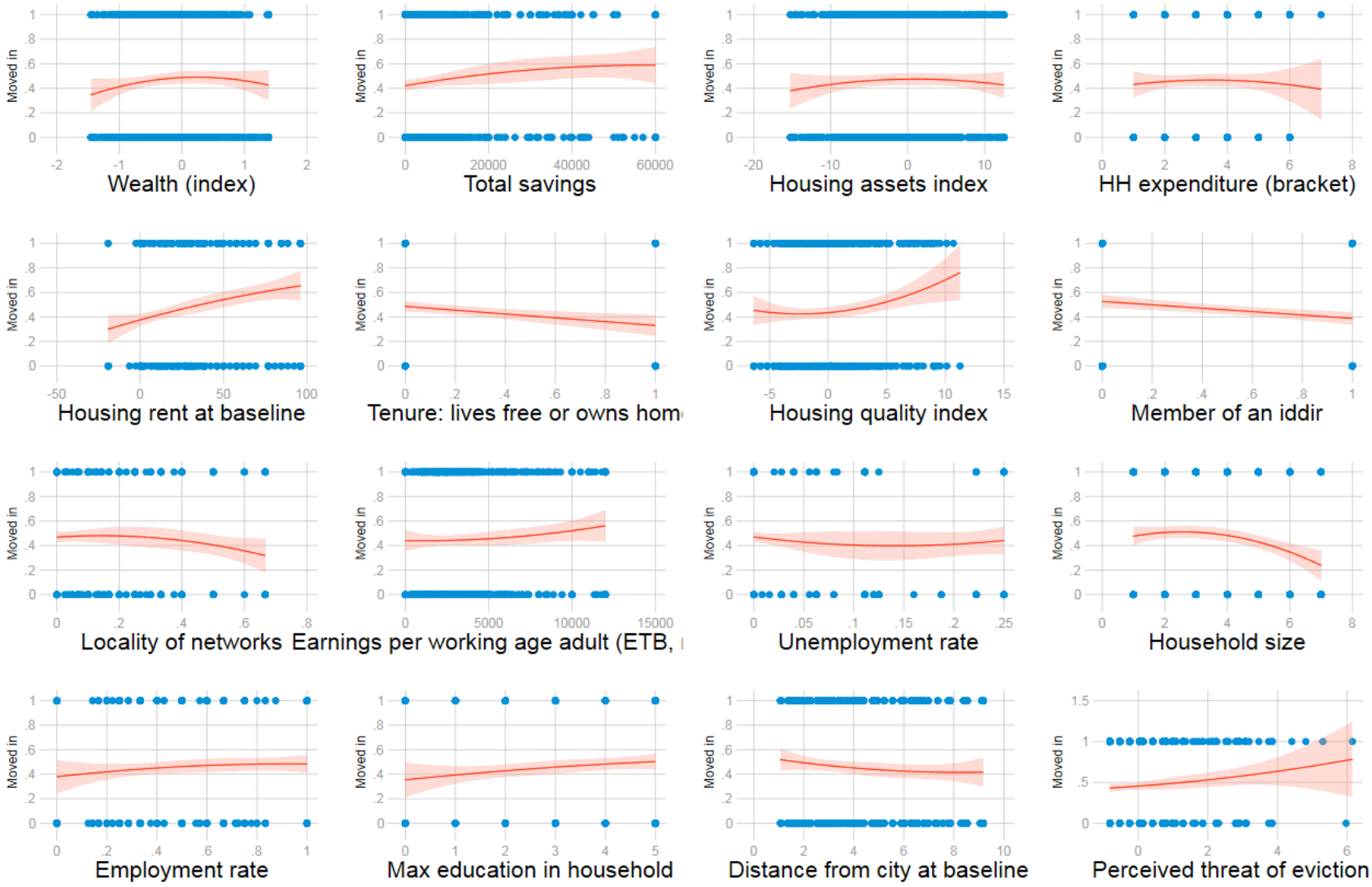


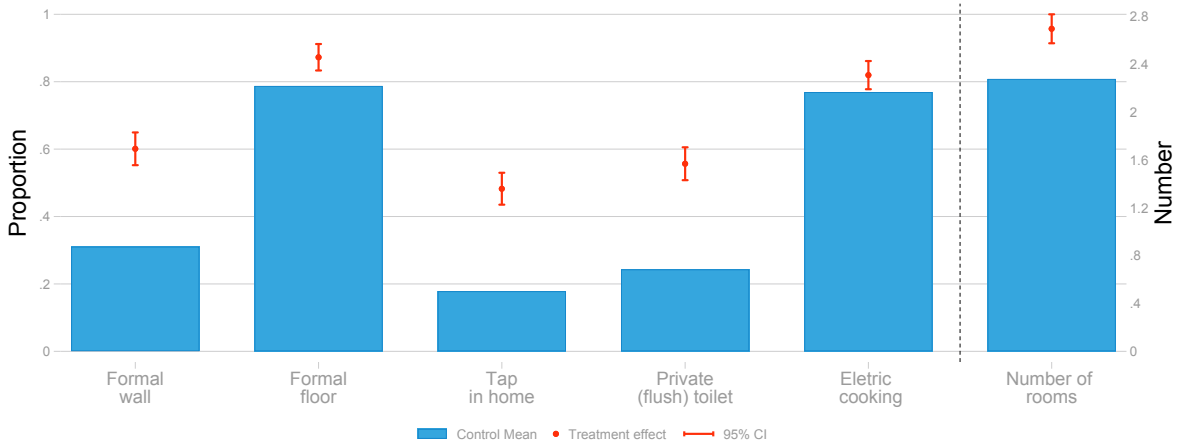
Table A.10: Predictors of moving in among lottery winners. Dependent variable: household moved into their government house.

	Post-lasso estimates			
	$\lambda = 70$ (lse)	$\lambda = 50$	$\lambda = 40$	
Member of an iddir	-0.097	-0.105	-0.093	-0.090
	(0.038)**	(0.042)**	(0.043)**	(0.039)**
Rent paid (monthly USD 1000s)	1.413	1.607	1.296	0.940
	(0.548)**	(0.547)***	(0.561)**	(0.643)
Tenure: lives free or owns home	-0.113	-0.096	-0.104	-0.120
	(0.050)**	(0.050)*	(0.050)**	(0.051)**
Household size		-0.010	-0.013	
		(0.011)	(0.011)	
Age of head		0.005	0.005	
		(0.002)***	(0.002)***	
Member lived within 15 mins of work		-0.030	-0.026	
		(0.027)	(0.027)	
Member walks to work		-0.098	-0.119	
		(0.073)	(0.075)	
Female head			-0.056	
			(0.039)	
Perceived relative wealth			-0.040	
			(0.024)*	
Total income (monthly USD 1000s)				-0.022
				(0.035)
Total consumption (pae, monthly USD 1000s)				0.437
				(0.411)
Lived in slum				-0.049
				(0.039)
Head unemployed				-0.049
				(0.111)
Eviction risk (z-score)				0.022
				(0.017)
R^2	0.04	0.06	0.07	0.05
N	715	715	706	715

This tables shows the determinants of whether lottery winners move into the units that they won. In the first three columns, I show the post-Lasso OLS estimates of a set of variables selected with different values of λ. In the first column, I select λ optimally using cross-validation and with largest lambda that is within one standard deviation from level at which the mean-squared prediction error is minimized. I then incrementally reduce λ in columns (2) and (3). In Column (4) I add controls for a set of variables that might be driven the select into moving, to rule out that these have an effect.

Figure A.4: Housing improves across all dimensions

(a) ITT Effect of winning the lottery



(b) Difference in housing quality among households that move.

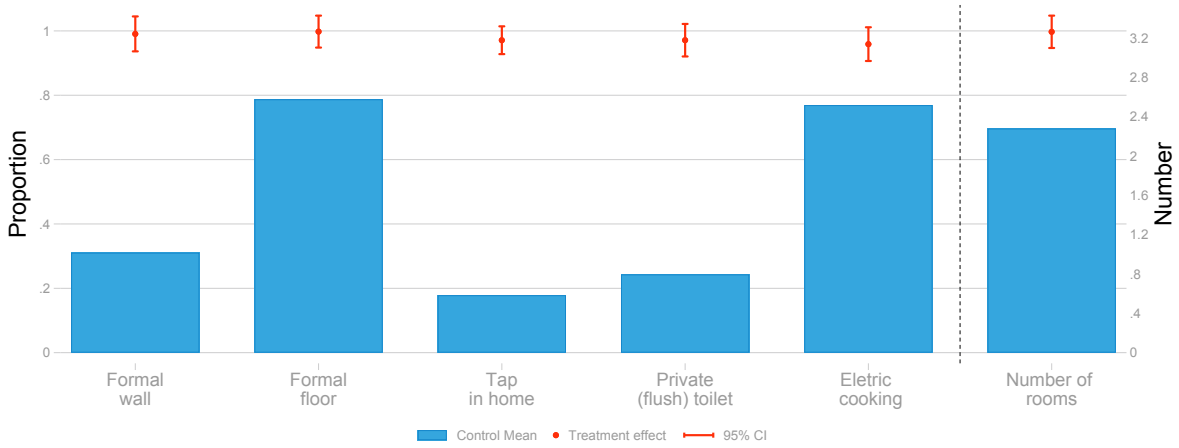


Table A.11: Housing Quality: Effect of winning the lottery

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.12: Winners consume more housing consume better housing by moving into their new units.

Outcome	Control mean (1)	ITT Lottery (2)	By Moving Decision Moved (3)	Stayed (4)	Equality pval (5)
Housing quality index	0.00	0.70***	1.33***	-0.04	0.00
		(0.06)	(0.24)	(0.18)	
Net housing expenditures (monthly, p.a.e.)	18.74	5.46***	8.49***	3.17*	0.02
		(1.43)	(1.85)	(1.79)	
Total non-housing consumption (p.a.e.)	43.85	-1.26	1.31	-1.73	0.25
		(1.47)	(2.42)	(2.19)	
Distance from the city centre (km)	5.40	4.35***	9.35***	0.57	0.00
		(0.30)	(0.24)	(0.36)	
		N = 1426 for all regressions.			

Note: This table estimates the effect of winning the housing lottery on the location, housing and consumption choices of households. Column (2) shows the *intent-to-treat* estimate of winning the lottery on households, regardless of whether they moved. Columns (3)- (4) decomposes that effect by whether a household moved into the house that they own (column 3), or they did not move into the household that they (column 4). Column (5) shows the p-value of a joint F-test that the coefficients in columns (3) and (4) are equal. Row 1 shows the effects on a standardized housing index, comprising of the constitute parts reported in Table A.11 . Net housing expenditure is measured as rent paid + mortgage repayments + rent income per adult equivalent in the home. The result showed here are robust to looking at total expenditure rather than pae. ***: p < 0.01, **: p<0.05, *: p<0.1.

Table A.13: Effect on total housing upgrade investments over the last two years.

Outcome	Control mean (1)	ITT Lottery (2)	By Moving Decision Moved (3)	Stayed (4)	Equality pval (5)
Housing upgrades	74.1	1,690.7***	1,959.8***	1,487.4***	0.00
		(64.1)	(103.5)	(73.2)	
Household duarable purchases	47.4	87.7***	202.2***	1.2	0.00
		(16.6)	(30.6)	(12.7)	
Total savings	1,385.6	-492.3***	-625.9***	-384.5**	0.12
		(125.9)	(142.7)	(152.0)	
Total remaining mortgages	253.3	3,975.3***	4,360.0***	3,684.8***	0.01
		(143.9)	(201.7)	(183.5)	
Total loans (excl. mortgages)	140.8	292.1***	233.8***	336.2***	0.36
		(72.0)	(81.7)	(97.0)	
		N = 1426 for all regressions.			

Note: This table estimates the effect of winning the housing lottery on housing investments and savings choices of households. Column (2) shows the *intent-to-treat* estimate of winning the lottery on households, regardless of whether they moved. Columns (3)- (4) decomposes that effect by whether a household moved into the house that they own (column 3), or they did not move into the household that they (column 4). Column (5) shows the p-value of a joint F-test that the coefficients in columns (3) and (4) are equal. . ***: p < 0.01, **: p<0.05, *: p<0.1.

Table A.14: Neither winning the lottery, nor moving, affects household labour market outcomes.

Outcome	Control mean (1)	ITT Lottery (2)	By Moving Decision Moved (3)	Stayed (4)	Equality pval (5)
Household labour market index	0.00	-0.05	0.10	0.03	0.61
		(0.05)	(0.12)	(0.12)	
Earnings per adult (monthly $)	87.73	-1.80	-0.20	-3.00	0.64
		(4.43)	(5.55)	(5.13)	
Total employed per adult	0.67	-0.02	-0.01	-0.00	0.88
		(0.02)	(0.02)	(0.02)	
Hours worked per working age adult	29.63	-1.11	-0.74	1.11	0.27
		(0.86)	(1.52)	(1.48)	
		N = 1426 for all regressions.			

Note: This table estimates the effect of winning the housing lottery on the labour supply of households. Column (2) shows the *intent-to-treat* estimate of winning the lottery on households, regardless of whether they moved. Columns (3)- (4) decomposes that effect by whether a household moved into the house that they own (column 3), or they did not move into the household that they (column 4). Column (5) shows the p-value of a joint F-test that the coefficients in columns (3) and (4) are equal. . ***: p < 0.01, **: p<0.05, *: p<0.1.

Table A.15: Replication of main housing/moving table for households that were renting at baseline.

Outcome	Control mean	ITT	By Moving Decision		
		Lottery	Moved	Stayed	Equality pval
	(1)	(2)	(3)	(4)	(5)
Housing quality index	0.01	0.74***	1.53***	0.09	0.00
		(0.08)	(0.23)	(0.19)	
Net housing expenditures (pae)	27.82	-1.38	-2.25	-0.60	0.58
		(2.00)	(2.08)	(2.80)	
Total non-housing consumption (pae)	46.21	-4.27*	-3.75	-3.85	0.98
		(2.21)	(2.98)	(2.80)	
Distance from the city centre (km)	6.10	4.15***	8.80***	-0.04	0.00
		(0.35)	(0.31)	(0.34)	
Moved house (%)	32.83	28.82***	65.31***	-3.96	0.00
		(3.59)	(2.72)	(4.08)	

Figure A.5: Quantile regression: effect of lottery on household non-housing consumption

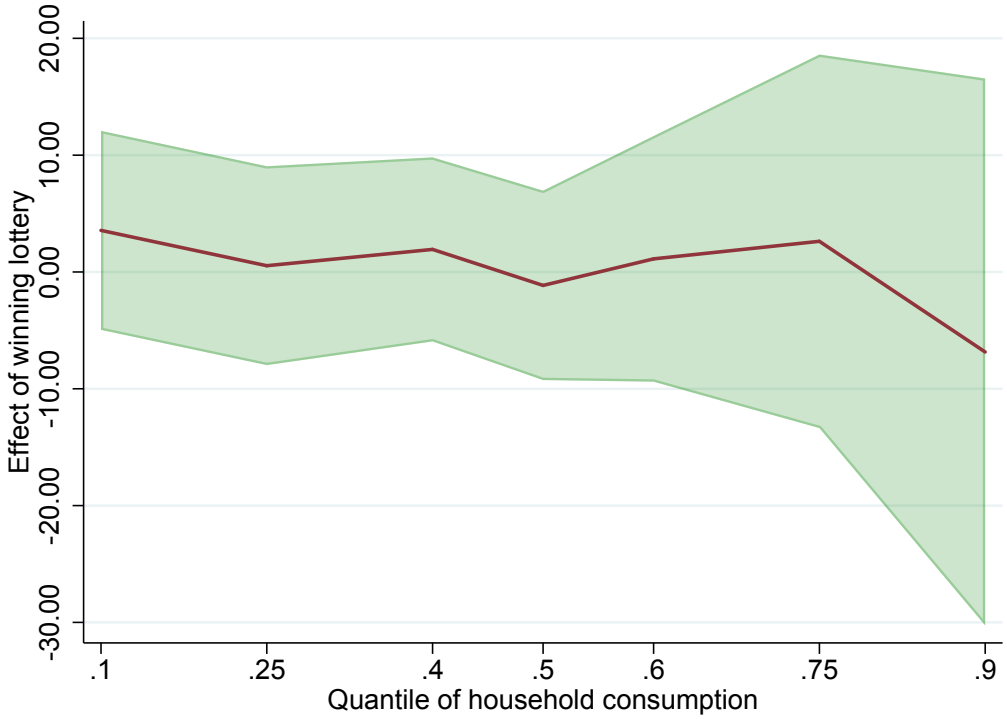


Table A.16: Effect of lottery-induced variation in rental income on labour supply.

	Household labour supply index				
Income effect (SD)	-0.056	0.114			
	(0.047)	(0.076)			
Applied for studio apartment		-0.422		-0.335	-0.363
		(0.397)		(0.371)	(0.376)
Applied for 1 Bedroom		-0.470		-0.370	-0.411
		(0.376)		(0.356)	(0.360)
Applied for 2 Bedrooms		-0.085		-0.022	-0.043
		(0.358)		(0.356)	(0.357)
Relative income effect (SD)			0.030	0.123	
			(0.044)	(0.052)**	
Positive Income effect					0.193
					(0.097)**
Constant	-0.060	0.331	-0.093	0.253	0.177
	(0.137)	(0.393)	(0.136)	(0.381)	(0.380)
R^2	0.20	0.22	0.20	0.22	0.22
N	656	656	656	656	656

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

This tables correlates the mechanical increase in income due to winning the lottery withhousehold labour supply. The income change is the difference between the market rent (after broker fees) of government housing units and they required mortgage repayment on that unit. I use variation in this difference, induced by the type of housing unit for which a household applied, and random variation in the locational amenities of the unit to which a household is assigned. Column (1) shows the effect of the raw difference between rent and mortgage, Column (2) controls for the type of housing unit for which the household applied. Columns (3) and (4) look instead at the size of the income effect relative to the households baseline total income, adjusted for inflation. Column (5) looks at the effect of a dummy variable set equal to one if the net income effect was greater than zero. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table A.17: Replication of main housing/moving table for households that were in government housing or squatting at baseline.

Outcome	Control mean	ITT	By Moving Decision		
		Lottery	Moved	Stayed	Equality pval
	(1)	(2)	(3)	(4)	(5)
Housing quality index	-0.03	0.67***	2.16***	-0.14	0.00
		(0.09)	(0.25)	(0.22)	
Net housing expenditures (pae)	6.97	13.99***	23.47***	8.17***	0.00
		(2.17)	(3.42)	(2.28)	
Total non-housing consumption (pae)	42.34	0.77	2.60	1.15	0.78
		(2.02)	(4.83)	(4.08)	
Distance from the city centre (km)	4.30	4.87***	10.44***	1.46**	0.00
		(0.56)	(0.39)	(0.74)	
Moved house (%)	13.49	36.75***	86.44***	6.26	0.00
		(3.81)	(2.52)	(3.86)	

Table A.18: Expenditure and investment: Effect of winning the lottery.

Outcome	Control mean	ITT Estimate Lottery			
		N	Coeff	Std. Err.	Adj q-value
	(1)	(2)	(3)	(4)	(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

Figure A.6: Detail on upgrading investments made by households

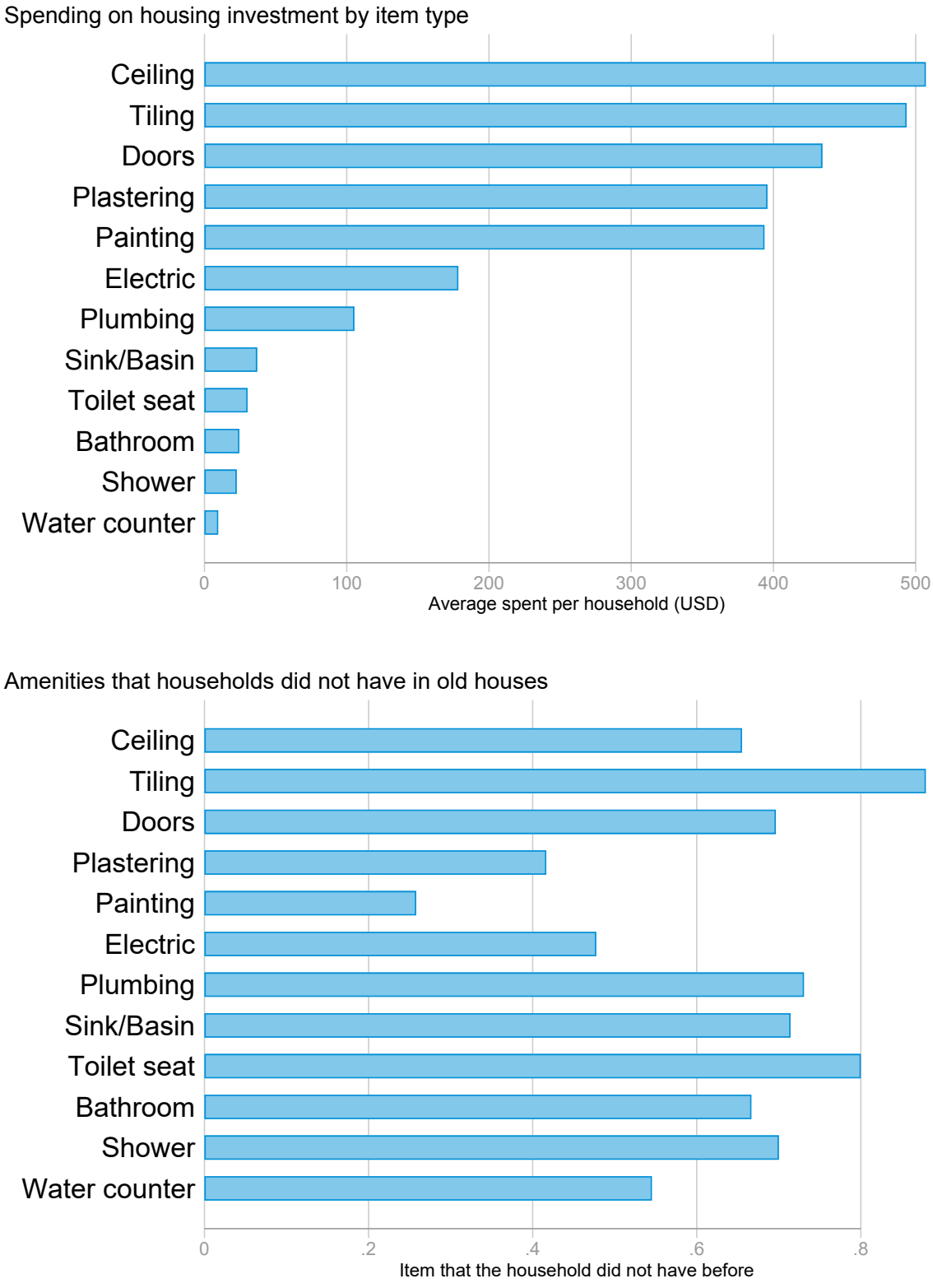


Figure A.7: The effect of home upgrades on rent charged for renting households

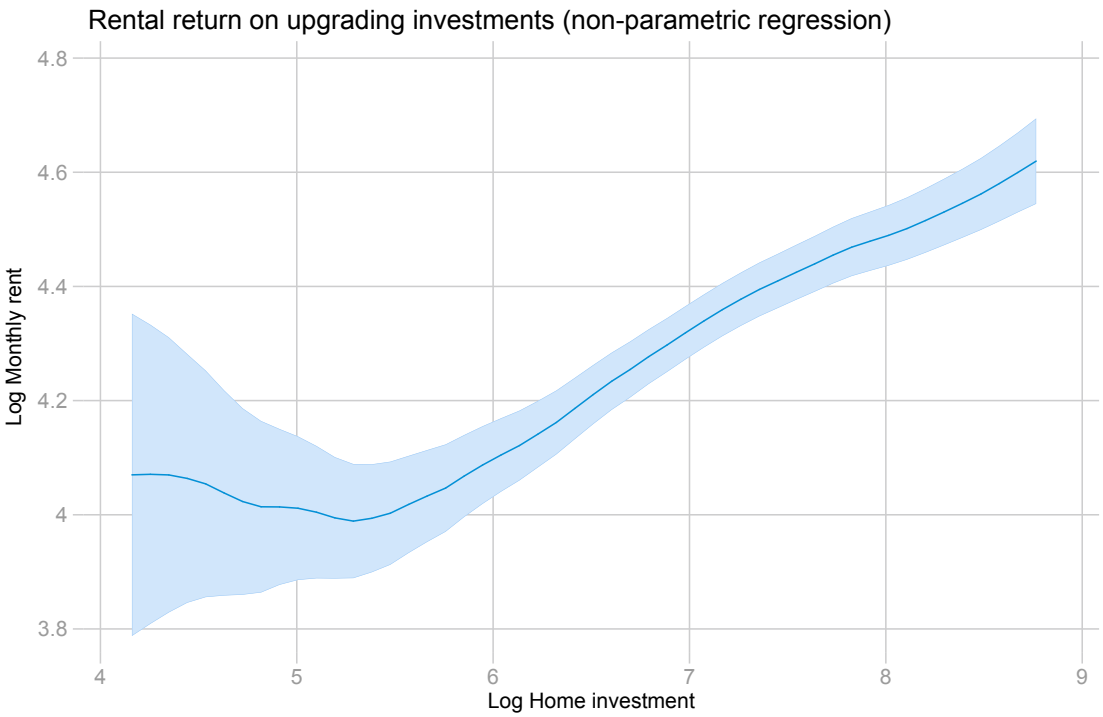


Table A.19: Detailed breakdown of ITT effects on labour market outcomes and time use (household and invidudal)

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
Panel D: Individual time-use					
Time on all domestic tasks (daily)	2.790	4,579	-0.204**	0.082	0.033
Time on all domestic tasks (working age only)	3.215	3,691	-0.187*	0.096	0.087
Time commuting to work (daily)	0.629	3,691	0.164***	0.033	0.001
Leisure (daily) (residual of all other time use)	6.482	4,579	0.108	0.132	0.519
Leisure (working age only)	6.239	3,691	0.088	0.149	0.554

Figure A.8: Quantile regression: effect of lottery on household labour market outcomes

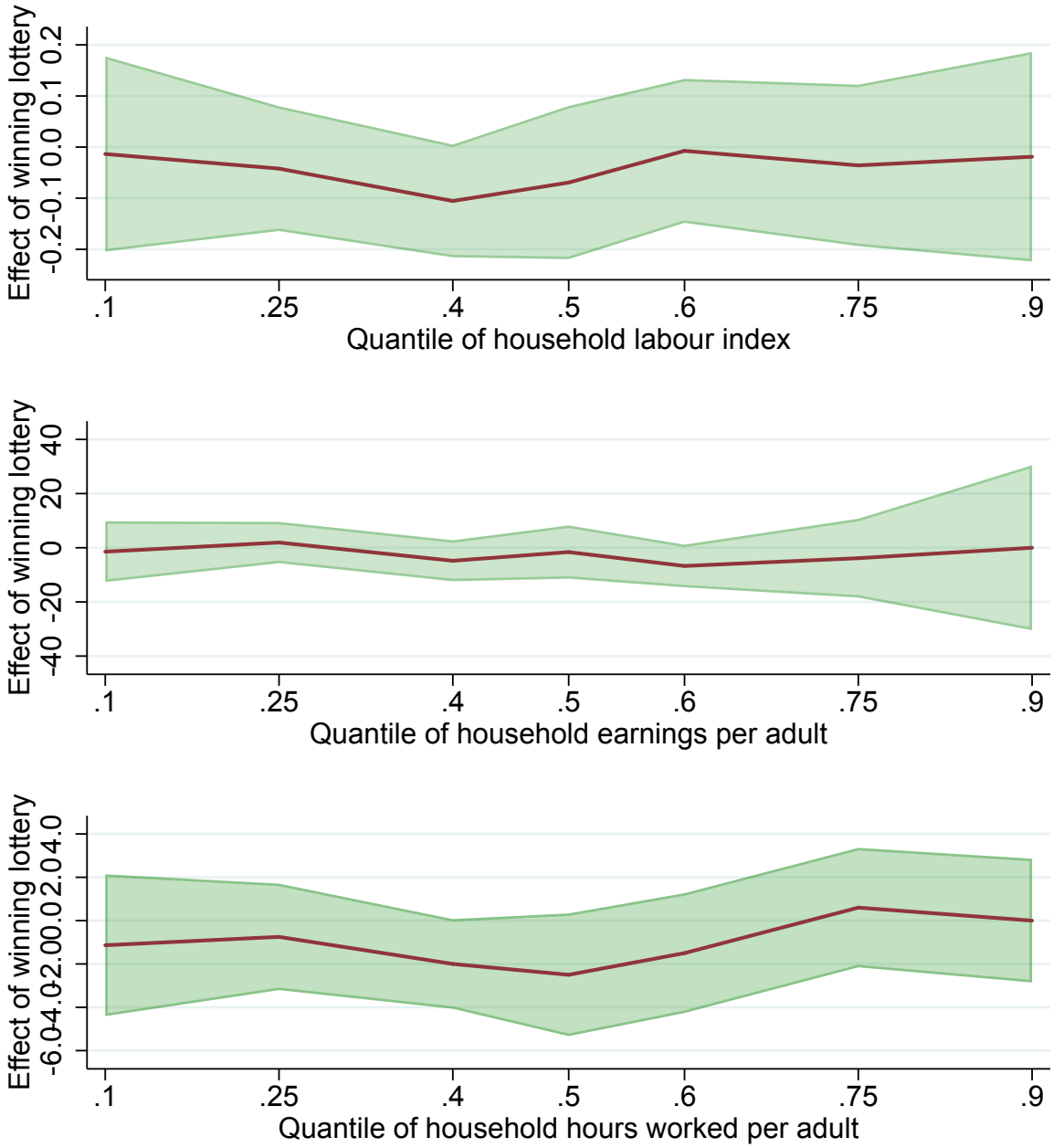


Figure A.9: Changes in occupational choice

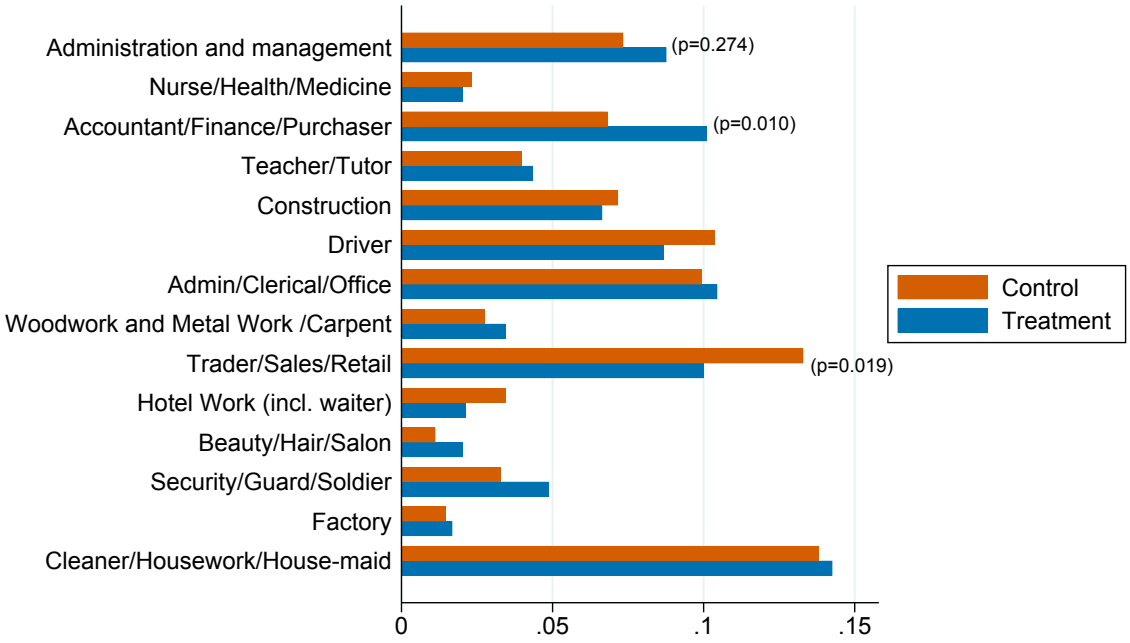


Table A.20: Individual-level ITT impacts on labour outcomes for original household members (excluding individuals who joined since the lottery).

Outcome	Control mean (1)	N (2)	ITT Estimate Lottery Coeff (3)	Std. Err. (4)	q-value (5)
Individual monthly earnings (USD)	83.637	3,059	-2.850	3.461	0.548
Individual hours worked in the last 7 days	29.818	3,059	-0.872	0.800	0.452
Respondent did any work in the last 7 days	0.630	3,059	-0.015	0.015	0.452
White collar-work	0.196	3,059	0.027**	0.013	0.129
Switched between self/wage employment	0.098	1,628	0.034*	0.018	0.133
Switched occupations (40 main occupations)	0.488	1,524	0.007	0.027	0.803
Works in areas near housing sites (2 main sub-cities)	0.109	1,929	0.058***	0.019	0.013
Works within walking distance of home	0.222	1,929	-0.012	0.019	0.646
Works from home	0.059	1,929	-0.004	0.009	0.678
Time on all domestic tasks (daily)	2.790	3,723	-0.253***	0.085	0.013
Time commuting to work (daily)	0.629	3,050	0.172***	0.035	0.001
Leisure (daily) (residual of all other time use)	6.482	3,723	0.139	0.134	0.452

Table A.21: Individual-level ITT impacts on labour outcomes, with heterogeneity by gender.

Outcome	Control mean	ITT Lottery	By Gender Women	By Gender Men	Equality pval
	(1)	(2)	(3)	(4)	(5)
Individual monthly earnings (USD)	82.077	-1.740	1.867	-4.879	0.23
		(3.391)	(4.375)	(4.266)	
Individual hours worked in the last 7 days	29.991	-1.056	-1.073	-1.655	0.66
		(0.788)	(0.939)	(1.131)	
Respondent did any work in the last 7 days	0.637	-0.021	-0.020	-0.027	0.77
		(0.015)	(0.017)	(0.022)	
White collar-work	0.187	0.028**	0.028*	0.025	0.88
		(0.012)	(0.016)	(0.018)	
Switched between self/wage employment	0.102	0.033*	0.040**	0.004	0.25
		(0.018)	(0.018)	(0.029)	
Switched occupations (40 main occupations)	0.476	0.005	0.012	-0.022	0.51
		(0.027)	(0.029)	(0.049)	
Works in areas near housing sites	0.115	0.073***	0.073***	0.075***	0.92
		(0.018)	(0.018)	(0.024)	
Works within walking distance of home	0.295	-0.034*	-0.038*	-0.023	0.64
		(0.020)	(0.021)	(0.029)	
Works from home	0.060	-0.003	-0.009	0.010	0.27
		(0.010)	(0.010)	(0.017)	
Time on all domestic tasks (daily)	2.846	-0.204**	-0.053	-0.339***	0.02
		(0.082)	(0.109)	(0.094)	
Time commuting to work (daily)	0.621	0.164***	0.220***	0.091**	0.01
		(0.033)	(0.040)	(0.039)	
Leisure (daily) (residual of all other time use)	6.390	0.108	-0.124	0.316**	0.02
		(0.132)	(0.150)	(0.151)	

Table A.22: Individual-level ITT impacts on labour outcomes, with heterogeneity by seniority.

Outcome	Control mean	ITT Lottery	By household seniority Head & spouse	Other members	Equality pval
	(1)	(2)	(3)	(4)	(5)
Individual monthly earnings (USD)	82.077	-1.740	0.851	-3.120	0.55
		(3.391)	(3.682)	(5.591)	
Individual hours worked in the last 7 days	29.991	-1.056	-1.480	-1.124	0.81
		(0.788)	(1.102)	(1.058)	
Respondent did any work in the last 7 days	0.637	-0.021	-0.025	-0.020	0.85
		(0.015)	(0.021)	(0.018)	
White collar-work	0.187	0.028**	0.036**	0.016	0.43
		(0.012)	(0.017)	(0.019)	
Switched between self/wage employment	0.102	0.033*	0.013	0.046**	0.27
		(0.018)	(0.021)	(0.023)	
Switched occupations (40 main occupations)	0.476	0.005	0.007	0.004	0.94
		(0.027)	(0.041)	(0.034)	
Works in areas near housing sites	0.115	0.073***	0.116***	0.036*	0.01
		(0.018)	(0.022)	(0.021)	
Works within walking distance of home	0.295	-0.034*	-0.005	-0.059**	0.13
		(0.020)	(0.028)	(0.024)	
Works from home	0.060	-0.003	-0.007	0.001	0.68
		(0.010)	(0.018)	(0.007)	
Time on all domestic tasks (daily)	2.846	-0.204**	-0.259**	-0.136	0.38
		(0.082)	(0.120)	(0.085)	
Time commuting to work (daily)	0.621	0.164***	0.131***	0.203***	0.23
		(0.033)	(0.037)	(0.047)	
Leisure (daily) (residual of all other time use)	6.390	0.108	0.024	0.210	0.40
		(0.132)	(0.156)	(0.166)	

Table A.23: Individual-level ITT impacts on labour outcomes, with heterogeneity by age.

Outcome	Control mean (1)	ITT Lottery (2)	By Age Older > 35 (3)	By Age Younger < 35 (4)	Equality pval (5)
Individual monthly earnings (USD)	82.077	-1.740	-2.783	0.639	0.55
		(3.391)	(4.903)	(3.849)	
Individual hours worked in the last 7 days	29.991	-1.056	-1.727*	-0.956	0.55
		(0.788)	(1.011)	(1.022)	
Respondent did any work in the last 7 days	0.637	-0.021	-0.027	-0.020	0.78
		(0.015)	(0.018)	(0.020)	
White collar-work	0.187	0.028**	0.037**	0.018	0.40
		(0.012)	(0.018)	(0.016)	
Switched between self/wage employment	0.102	0.033*	0.016	0.064**	0.11
		(0.018)	(0.018)	(0.027)	
Switched occupations (40 main occupations)	0.476	0.005	0.006	0.003	0.95
		(0.027)	(0.031)	(0.041)	
Works in areas near housing sites	0.115	0.073***	0.067***	0.082***	0.60
		(0.018)	(0.020)	(0.022)	
Works within walking distance of home	0.295	-0.034*	-0.018	-0.054**	0.24
		(0.020)	(0.023)	(0.026)	
Works from home	0.060	-0.003	-0.005	-0.001	0.84
		(0.010)	(0.010)	(0.016)	
Time on all domestic tasks (daily)	2.846	-0.204**	-0.572***	0.040	0.00
		(0.082)	(0.108)	(0.096)	
Time commuting to work (daily)	0.621	0.164***	0.199***	0.134***	0.23
		(0.033)	(0.045)	(0.036)	
Leisure (daily) (residual of all other time use)	6.390	0.108	-0.053	0.214	0.17
		(0.132)	(0.164)	(0.142)	

Table A.24: Summary of impacts on social interactions: ITT with adjusted q-values

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

Table A.25: Summary of impacts on community and public goods

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

Table A.26: Effects on well-being

Outcome	Control mean (1)	ITT Lottery (2)	By Moving Decision Moved (3)	By Moving Decision Stayed (4)	Equality pval (5)
Well-being index	-0.010	-0.057	-0.033	-0.075	0.54
		(0.054)	(0.069)	(0.060)	
Subjective well-being on cantril ladder	4.282	-0.054	0.079	-0.155	0.04
		(0.090)	(0.112)	(0.102)	
Reported change in well-being	0.284	0.024	0.010	0.035	0.71
		(0.055)	(0.069)	(0.062)	
Optimism: expected future well-being	5.295	0.076	0.304**	-0.097	0.01
		(0.119)	(0.147)	(0.136)	
Depression and anxiety index	0.009	-0.107*	-0.152**	-0.073	0.26
		(0.055)	(0.068)	(0.063)	

Figure A.10: Distance of randomly assigned housing site from centre (with top-up sites)

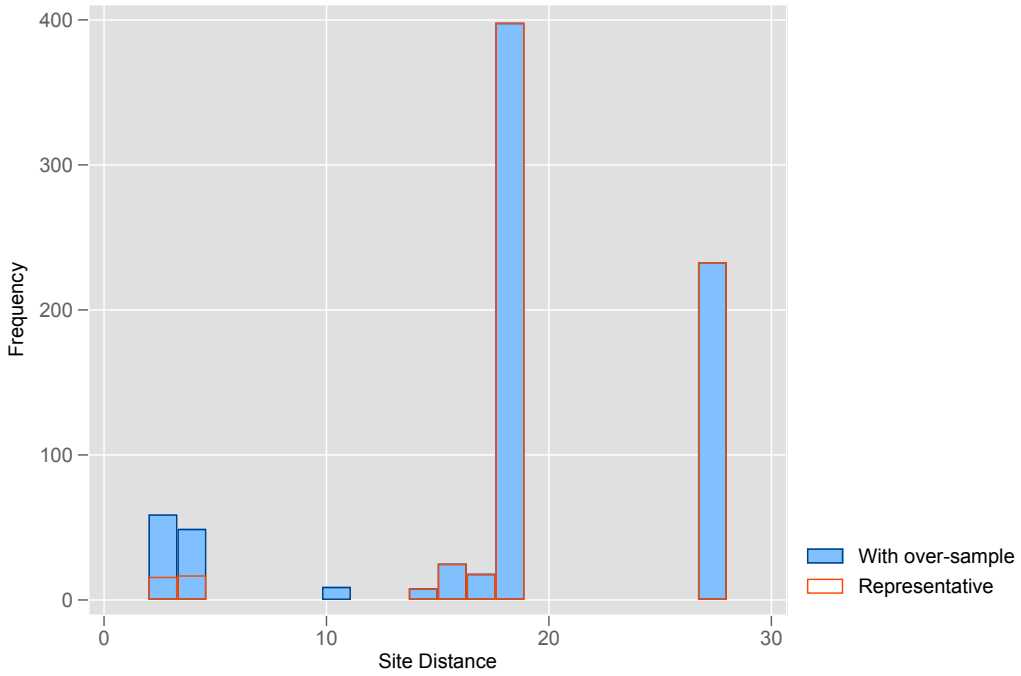


Table A.27: Effects on health

		ITT Estimate Lottery		
Outcome	Control mean (1)	Coeff (3)	Std. Err. (4)	q-value (5)
Health condition index	0.011	-0.025	0.031	0.839
Malaria	0.002	-0.001	0.001	0.868
Diarrhea	0.008	-0.004	0.002	0.617
Physical	0.011	0.004	0.003	0.617
Dental	0.004	0.001	0.002	0.839
Eye	0.008	0.002	0.003	0.839
Skin	0.004	-0.002	0.002	0.839
Asthma	0.008	-0.004*	0.002	0.617
ENT	0.009	0.005	0.003	0.617
Tuberculosis	0.001	-0.001*	0.001	0.617
HighBloodPressure	0.012	0.001	0.003	0.923
Diabetes	0.009	0.004	0.003	0.617
HeartProblems	0.003	0.000	0.002	0.923
Commoncold	0.044	0.009	0.007	0.617
Typhoid	0.007	0.000	0.003	0.923
Back pain	0.009	0.002	0.003	0.868
Goiter	0.001	-0.001	0.001	0.617
Jardia	0.002	-0.002	0.001	0.617
Kidney infection	0.008	-0.000	0.003	0.944
Other	0.026	0.002	0.005	0.923
Ilness prevent normal activities	0.086	0.003	0.009	0.923
Ilness prevent activities (employed)	0.092	-0.003	0.013	0.923
Ilness prevent activities (working age)	0.086	-0.002	0.010	0.923
Sought health care (condition on sickness)	0.857	-0.019	0.028	0.839

Figure A.11: Proportion of neighbourhood population treatment in 2015 lottery

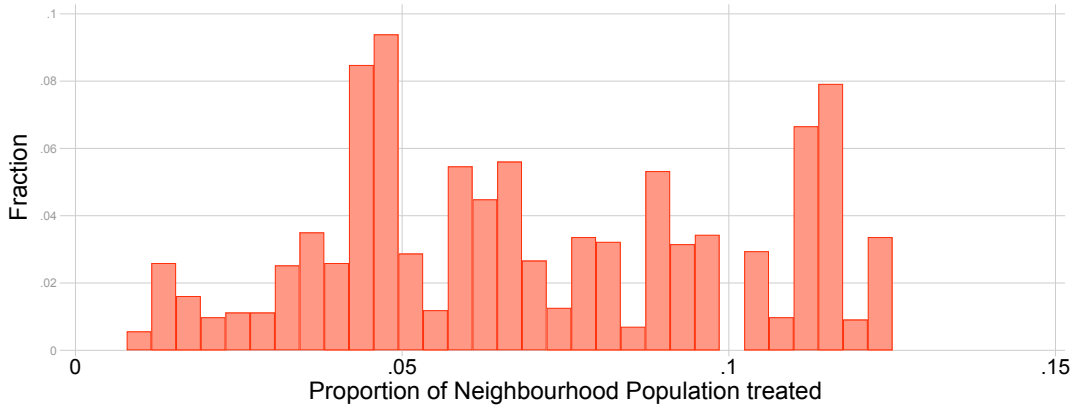


Table A.28: Effects of proportion of neighbours winning on control group outcomes (with controls for number of applicants)

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

N= 711

Table A.29: Effects of proportion of neighbours winning on independent representative sample of households below the poverty line, collected in late 2016

Outcome	Control mean (1)	Effect of winning neighbours			
		N (2)	Coeff (3)	Std. Err. (4)	Adj q-value (5)
Housing quality index	0.00	26,955	0.21**	0.08	0.098
Monthly expenditure	2,969.00	5,925	-110.11	119.91	0.849
Monthly food consumption	1,917.23	5,922	-47.14	82.19	0.849
Labour supply index	0.00	5,855	0.02	0.06	0.895
Employment rate	0.63	5,855	0.00	0.02	0.895
Household wage earnings	2,306.26	5,926	88.11	164.56	0.849
Household is member of an iddir (community group)	0.90	5,924	0.10**	0.04	0.098
Tenure security index	0.00	5,924	-0.16	0.23	0.849
Household evicted in the last two years	0.05	5,924	0.02	0.01	0.849
Household fears eviction (scale)	2.03	5,924	0.02	0.17	0.895

Table A.30: Differential outcomes by randomly assigned site distance. Coefficents plotted in 5

Outcome	Site distance-specific treatment effect				Equality p-value
	0-4 km	6-12 km	16-22 km	25-30 km	
	(1)	(2)	(3)	(4)	(5)
Proportion renting out	0.704	0.560	0.430	0.408	0.000
	(0.047)	(0.069)	(0.024)	(0.032)	
Housing quality (index)	0.300***	0.422***	0.630***	0.497***	0.008
	(0.099)	(0.139)	(0.057)	(0.070)	
Consumption	-0.153	0.010	0.116**	-0.088	0.013
	(0.100)	(0.141)	(0.057)	(0.071)	
Earnings	-0.314***	-0.082	0.067	-0.077	0.003
	(0.103)	(0.144)	(0.059)	(0.072)	
Networks(index)	-0.382***	-0.291**	-0.398***	-0.369***	0.906
	(0.106)	(0.148)	(0.060)	(0.074)	
Public Goods	0.159	-0.090	0.093	0.055	0.530
	(0.110)	(0.151)	(0.062)	(0.078)	
Sample per site	108	50	423	233	

Table A.31: Main effects reweighted for remaining applicant pool

Outcome	Control mean	ITT Estimate Lottery			
		N	Coeff	Std. Err.	Adj q-value
	(1)	(2)	(3)	(4)	(5)
Housing quality index	0.000	1,426	0.686***	0.067	0.001
Expenditure, non-housing (monthly, USD)	165.821	1,426	77.457***	6.798	0.001
Household labour market index	0.000	1,420	-0.060	0.057	0.289
Intensity of social interactions (index)	0.000	1,426	-0.369***	0.058	0.001
Community and public goods index	0.000	1,413	0.123**	0.060	0.051

Table A.32: Main effects by household size (four or more members at baseline)

Outcome	Control mean (1)	Differential effects: Small hh Coeff (2)	Small hh Std. Err. (3)	Big hh Coeff (4)	Big hh Std. Err. (5)	Equality pval (6)
Housing quality index	0.000	0.496**	0.247	0.600***	0.224	0.750
Expenditure, non-housing (monthly, USD)	156.281	83.242***	8.338	75.167***	8.454	0.493
Complementary housing investment	74.090	1,709.1***	87.570	1,673.2***	98.456	0.791
Total non-housing consumption (pae)	43.851	-1.655	3.258	0.743	1.859	0.514
Household labour market index	0.000	0.263*	0.154	-0.131	0.118	0.038
Intensity of social interactions (index)	0.004	-0.248***	0.095	-0.450***	0.101	0.133
Community and public goods index	-0.027	0.226**	0.106	0.246**	0.104	0.890

Table A.33: Main effects by housing quality (split at median of baseline housing quality index)

Outcome	Control mean (1)	Differential effects: Higher qual Coeff (2)	Higher qual Std. Err. (3)	Low qual Coeff (4)	Low qual Std. Err. (5)	Equality pval (6)
Housing quality index	0.000	0.507**	0.224	0.823***	0.150	0.225
Expenditure, non-housing (monthly, USD)	156.281	89.144***	9.488	68.138***	7.083	0.073
Complementary housing investment	74.090	1,834.2***	101.195	1,548.4***	81.857	0.031
Total non-housing consumption (pae)	43.851	0.422	2.954	-1.456	2.265	0.606
Household labour market index	0.000	0.277**	0.135	-0.159	0.138	0.022
Intensity of social interactions (index)	0.004	-0.367***	0.105	-0.335***	0.092	0.815
Community and public goods index	-0.027	0.325***	0.110	0.146	0.101	0.209