Housing and Fertility*

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Abstract

We examine how access to housing impacts fertility rates, harnessing random variation from Brazilian housing credit lotteries. 20-25-year-olds randomly obtaining housing show increased average probabilities of having children (32%) and more children (33%), with no corresponding increase in fertility for those above 40. The lifetime completed fertility increase for a 20-year-old is twice as large from immediately obtaining housing rather than at age 30. Stronger increases in fertility are seen for households in areas with lower quality housing, lower income, and lower female income shares. Recipients relocate to areas with lower crime rates, higher per capita income, and higher home-ownership rates.

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1 Introduction

The world is aging. Fertility rates have fallen to historic lows globally (Figure A.1). The replacement level—the fertility rate at which a population is stable, not counting immigration—is 2.1 children per woman, and in 2021, countries comprising 73% of the world's population were beneath this threshold, compared to just 4.3% in 1960 (United Nations, 2022; GBD 2021 Fertility and Forecasting Collaborators, 2024; OECD, 2024). This trend has significant implications for economic growth, labor markets, and the design of social welfare systems in both developed and developing economies (Barro and Becker, 1989; Bloom, Canning, and Fink, 2010; Goldin, 2024). Governments worldwide have implemented various policies to address the issue, with varying degrees of success.[1] Despite these efforts, however, the downward trend in the fertility rate continues. Understanding the factors that influence fertility decisions is, therefore, a first-order concern for both policy and research.

Housing—typically the largest household asset (Gomes, Haliassos, and Ramadorai, 2021; Goetzmann, Spaenjers, and Van Nieuwerburgh, 2021)—is a natural factor in shaping fertility choices, and one prominently mentioned in classic economic analyses of fertility (Becker, 1960). Housing costs have risen worldwide, and access to mortgage credit—typically the largest household liability—has not kept pace, making it increasingly difficult for many households to achieve their desired housing outcomes. While commentators have suggested that access to adequate and affordable housing could provide families with the necessary space and financial security to have children (Institute for Family Studies, 2025),[2] establishing a causal link between housing and fertility is complex, given the joint determination of housing choices and family formation decisions,[3] and the difficulty of direct randomization given the sheer scale of housing costs.

We study a natural experiment to assess the impact of access to mortgages and housing on fertility rates, exploiting random variation in access to housing credit through a lottery system used by housing consortia (known as "consórcios") in Brazil. Consórcios pool household contributions and run lotteries to randomly allocate lump-sums to participants to finance house purchases. Effectively, the study tracks the randomized allocation of roughly

[1] According to Olivetti and Petrongolo (2017), direct financial incentives for childbearing have shown limited effectiveness in boosting fertility rates. Policies improving work-family balance, like affordable childcare, have been more promising, though effects remain modest. See, for example, "Putting a price on them" *The Economist*, May 25, 2024, which discusses the persistent challenge of boosting fertility through policy.

[2] See, for example, "Birth rates in rich countries halve to hit record low", *Financial Times*, June 20, 2024.

[3] To take just one channel, accessing credit is usually the result of endogenous selection that can depend on characteristics correlated with fertility outcomes. For example, households with better income prospects during their peak years for both fertility and income generation might have easier access to credit markets, and find it easier to bear the costs of child-rearing.

BRL 17 billion (USD 10 billion) in funding to 153,155 people over an 18-year window. To identify the causal effect on fertility, we compare the fertility outcomes of lottery winners to those of non-winners. We find that randomly obtaining a mortgage to finance a housing purchase through consórcios increases the unconditional probability of having children by 1.15 percentage points and the number of children by 0.016, economically relevant numbers that translate into increases of 3 and 4 percent of the unconditional base rates of these outcomes. More importantly, for 20 to 25-year-olds in their peak childbearing years, randomly obtaining housing credit leads to a 32 percent increase in the probability of childbearing and a 33 percent increase in the number of children relative to the base rate, with no increase in fertility for those above age 40. Most importantly, completed fertility—the average number of children born to women by the end of their childbearing years—for a 20-year-old is twice as large if they immediately obtain housing rather than obtaining it at age 30.

Our empirical research design tracks participants in a widespread group-lending mechanism in Brazil known as consórcios. These consórcios use credit lotteries that generate random variation in the timing of access to credit to finance durable goods.[4] We focus on real estate groups, which comprise individuals who wish to finance housing purchases, meaning that we can estimate how relaxing housing constraints affects those seeking to overcome these constraints. Importantly, consórcio participants are comparable to the broader working-age population in terms of observable characteristics. Moreover, according to a 2024 consórcio administrator association (ABAC) internal survey of real estate consórcio participants aged 20-35 in Brazil (Figure A.2), 31% purchased property to start a family (1/3 to marry, 2/3 to have children) and 43% lived with parents prior to purchasing their desired real estate. The high proportion of respondents reporting family-formation motives and parent co-residence is consistent with housing constraints significantly influencing household fertility decisions, a pattern also observed in US survey responses (see, e.g., Institute for Family Studies (2025)).

All participants in a consórcio group make identical monthly contributions that are adjusted for house price inflation. Each month, the pooled contributions are allocated as a credit to finance housing purchases to a subset of participants. This subset of credit recipients is determined through both lotteries and auctions. In the lottery allocation, consórcios use a contractually specified algorithm to translate the outcome of the national lottery (*Loteria Federal*) into ticket numbers that have been assigned to all participants beforehand. All participants make contributions from the inception of the group until all participants have been awarded credit.

[4] An advantage of studying variation in the timing of access is that it enables sharp inferences about fertility, given the natural variation in childbearing ability across the life-cycle.

Our empirical design builds on Doornik et al. (2024b), who also exploit time-series variation in access to credit lotteries in vehicle-purchase consórcios. In our setup, we exploit the random timing of access to housing credit through a staggered difference-in-differences (DID) methodology in which we compare outcomes for participants who receive credit through a lottery with participants who have not yet received credit within the same group (using group-time fixed effects).[5] This design controls for selection by and into specific consórcio groups. Moreover, the fact that participants in a consórcio group do not share social ties and are not geographically proximate mitigates concerns about multiplier or other general equilibrium effects that may differentially affect treated and untreated individuals (Cai and Szeidl, 2019; Breza and Kinnan, 2020).

Most groups allocate credit through both lotteries and auctions. The choice to participate in a consórcio through an auction rather than a lottery could be related to other variables that affect fertility. To resolve potential endogeneity concerns related to auctions, we therefore implement an instrumental variables (IV) strategy. The contractual design of consórcios, combined with our data, allows us to simulate all groups *as if* all credit were allocated through lotteries. More specifically, since we know the algorithm that each consórcio group employs to translate the national lottery number into the winning ticket number, we can identify who would have obtained credit through a lottery if the group held no auctions. We use these simulated lottery winners as an instrument to predict actual lottery winners (see Section 4 for details). Since the instrument is based on the outcomes of random lotteries, it is orthogonal to other characteristics and satisfies the exclusion restriction.

We begin with reduced-form analysis, comparing outcomes for participants who are predicted to win a housing credit lottery with outcomes for participants who have yet to be predicted to win a housing credit lottery within the same group. These reduced-form results show that predicted lottery winners have higher fertility rates. To recover the treatment effect for individuals who win a credit lottery and receive credit to purchase a home, we instrument the actual lottery winners with the simulated outcomes in our IV analysis. We find that the unconditional probability of having children increases by 1.15 percentage points (3.8% relative to the mean), and the number of children increases by 0.016 (3.2% relative to the mean) in the years following credit access.

We next investigate how the treatment effect changes across the life-cycle. Medical literature suggests that the female reproductive system is most productive for childbearing until about the age of 40 (Velde and Pearson, 2002; Jacobsson, Ladfors, and Milsom, 2004).

[5] We ensure that our results are not affected by heterogeneous treatment effects across units over time (Callaway and Sant'Anna, 2021; Sun and Abraham, 2021; Borusyak, Jaravel, and Spiess, forthcoming; de Chaisemartin and D'Haultfoeuille, 2020; Goldsmith-Pinkham, Hull, and Kolesar, 2022).

After this age, the chances of successfully conceiving deteriorate rapidly, and childbearing also involves significant health and mortality risks for both mother and child. We find that the largest increase in fertility occurs among individuals in the 20-25 age group. For this set of individuals, randomly allocating housing credit increases the probability of having children by 2 percentage points (32% relative to the mean for this group), and the number of children increases by 0.026 (33% relative to the mean for this group). Consistent with the cited medical literature, we find no effect for individuals above the age of 40.

To assess the overall fertility impact of access to housing, we track completed fertility—the average number of children born to a cohort of women by the end of their childbearing years. Specifically, we measure the effect on completed fertility for individuals who are at least 40 years old at the end of the sample (beyond productive childbearing years) and were aged less than 40 at the point of joining consórcio groups (within productive childbearing years). By analyzing the random variation in wait times for housing credit across this set of individuals, we estimate the decline in completed fertility for each year of waiting for housing. Our estimates reveal that for an individual between the ages of 20 and 24, completed lifetime fertility doubles when receiving housing access immediately, relative to obtaining it ten years later (between the ages of 30 and 34). These results highlight the substantial impact that access to housing can have on fertility decisions and suggest that policies to improve this access could positively influence overall fertility rates. More specifically, a targeted approach to accelerate access to housing credit and higher-quality housing for those in their peak childbearing years could be particularly effective at increasing fertility.

To better understand the economic forces through which access to housing can impact fertility, we work out a simple theory model that extends the classical quantity-quality trade-off framework (Becker and Lewis, 1973; Becker and Tomes, 1976; Doepke et al., 2023) to incorporate housing. In the model, households derive utility from consumption, housing, and the number of children, and make investments in the quality of children's human capital via costly education. We introduce a housing adequacy constraint that requires a minimum level of quality-adjusted housing per child, capturing how overcrowding or inadequate housing conditions can constrain family size decisions. The model yields several useful predictions. First, improving quality-adjusted housing unambiguously leads to an increase in the optimal number of children. Second, rental savings have an ambiguous effect on fertility. On the one hand, freed-up resources allow households to support more children, but on the other hand, increasing disposable income could reduce fertility as a result of the newly higher opportunity costs of child-rearing. Third, the model predicts that the effect of housing on the fertility rate is lower for high-income households because of the higher opportunity cost of their time, and higher for low-income households who are closer to the binding housing adequacy constraint. Fourth, assuming that women bear the larger part of child-rearing costs, the model predicts that gaining access to housing is less beneficial for households with a higher female income share—capturing the relatively higher opportunity cost of women's time in such households.

To map the model's predictions to our empirical results, we first examine the interaction between rental savings and fertility outcomes. Winners who previously rented potentially save on monthly housing expenses once they deploy the credit allocation towards their housing purchase, obviating the need for rental payments. We deploy transaction-level data from Brazil's three primary payment systems to identify renters and rental payments, and find no significant differential treatment effects between renters and non-renters. Moreover, while rent levels are positively correlated with fertility outcomes, the estimated effect is economically negligible and statistically insignificant. These findings echo the ambiguous predictions from the model on this channel, and suggest that while rental savings could generate an income effect, it is unlikely to be at play in our results; rather, our results mainly speak to the causal effects of access to housing on fertility.

Next, we find that the fertility response to home-ownership varies cross-sectionally in a manner consistent with the model. First, we find that households that initially resided in lower quality and more congested housing experience a larger increase in fertility upon becoming homeowners. Second, we examine how credit access affects residential mobility and neighborhood quality.[6] Winners exhibit a three percentage point higher probability of changing ZIP codes, with effects concentrated among younger individuals aged 25-35. These moves represent upward mobility: winners relocate to areas with lower crime rates, higher per capita income, and higher home-ownership rates. The stronger effects for younger winners and those who move to areas with more limited rental options are consistent with mortgage access helping to overcome rental market frictions that previously prevented households from accessing better neighborhoods. Taken together, these findings suggest that alleviating housing adequacy constraints is a key mechanism through which housing affects fertility decisions.

Finally, we examine the cross-sectional variation in treatment effects with both household income and the female share in household income. As predicted by the model, the increase in fertility is larger for lower-income households, for whom credit constraints presumably bind more tightly. We also find that the increase in fertility is higher for households with a lower share of female income in total household income, i.e., households in which women's opportunity cost of child-rearing is likely lower. Overall, our empirical findings align closely

[6]A caveat applying to the location data is that we only observe individual's ZIP codes. Most of Brazil has one ZIP code per city.

with the predictions of our model.

The remainder of the paper is organized as follows. The introduction continues below with a brief literature review. Section 2 develops the theoretical framework that provides a structure for our analysis. Section 3 provides a detailed discussion of consórcio institutions, mortgage credit, fertility trends in Brazil, and our data sources as background for the research design. Section 4 describes our research design and empirical analysis. Section 5 concludes.

Related Literature

Fertility We contribute to the literature on fertility choice and the determinants of fertility.[7] The canonical models of quantity-quality trade-offs (Becker, 1960; Becker and Tomes, 1976) suggest that a larger number of children (quantity) tends to lower investment in each individual child (quality). More recent studies examine the role of factors such as income, education, and labor market conditions (e.g., De La Croix and Doepke (2003); Manuelli and Seshadri (2009); Aaronson, Lange, and Mazumder (2014); Kim, Tertilt, and Yum (2024)); land use regulation (Shoag and Russell, 2018); preferences and priorities (Kearney, Levine, and Pardue, 2022); financial incentives via maternal leave (Lalive and Zweimüller, 2009; Raute, 2019); and infertility treatments (Bögl et al., 2024) in shaping fertility patterns. Others have explored how housing-related factors relate to fertility, such as house prices and housing wealth (Yi and Zhang, 2010; Clark, 2012; Dettling and Kearney, 2014; Ang et al., 2024), financial deregulation of mortgage markets (Hacamo, 2020), and government support for student loans (Goodman, Isen, and Yannelis, 2021) and the mortgage market (Dettling and Kearney, 2025). Recently, Cumming and Dettling (2024) find that fertility increases following a decline in monetary policy rates via reduced mortgage payments. Our paper complements this work by uncovering significant causal effects of access to housing on fertility using a large-scale natural experiment, and by studying the economic mechanisms through which these effects occur.

Our paper is also related to the literature on the role of intra-household bargaining in fertility decisions. Doepke and Kindermann (2019) propose a theoretical framework to understand how power dynamics within households can influence fertility choices. By examining the link between female bargaining power and fertility rates, their research underscores the significance of intra-household negotiations in shaping reproductive behavior. Similarly, Ashraf, Field, and Lee (2014) provide evidence on the importance of household bargaining in fertility decisions through an experimental study in Zambia. They document that when women have greater bargaining power, they are better able to achieve their desired fertility

[7] Doepke et al. (2023) provide an excellent survey of the literature.

outcomes, even in the face of opposition from their husbands. We provide empirical evidence that the fertility response to improved housing conditions is weaker for households with higher female income shares, suggesting that women with greater bargaining power may prioritize other goals over having additional children. These results shed light on the effects of housing and mortgage credit on intra-household dynamics and fertility choices.

Housing We contribute to the literature on the effects of home-ownership. The literature in this area has studied how home-ownership affects property maintenance and community involvement (Rossi-Hansberg, Sarte, and Owens III, 2010; Rossi and Weber, 1996; DiPasquale and Glaeser, 1999; Di Tella, Galiant, and Schargrodsky, 2007); children's lives (Green and White, 1997; Haurin, Parcel, and Haurin, 2002);[8] portfolio choice (Lustig and Van Nieuwerburgh, 2005; Sinai and Souleles, 2005; Chetty, Sándor, and Szeidl, 2017); consumption (Case, Quigley, and Shiller, 2005; Campbell and Cocco, 2007; Carroll, Otsuka, and Slacalek, 2011; Mian, Rao, and Sufi, 2013; Berger et al., 2018; Paiella and Pistaferri, 2017; Aladangady, 2017; Browning, Gørtz, and Leth-Petersen, 2013; Guren et al., 2021); and labor market outcomes (Belchior, Gonzaga, and Ulyssea, 2023).[9]

More recently, Sodini et al. (2023) investigate the effect of home-ownership on wealth accumulation and consumption using a quasi-experimental research design studying privatization policies that were initially rolled out to a group of renters, and then abruptly stopped. Apart from the differences in setting and research design, our paper specifically focuses on how access to home-ownership affects fertility decisions. Dovetailing with the conclusions of Sodini et al. (2023), our work provides justification for housing subsidies to incentivize childbearing, a key policy target in recent years.[10]

Access to Credit Our work also relates to the literature on access to credit, where there is an active debate on the effects of extending credit to low-income households (Karlan and Zinman, 2011; Angelucci, Karlan, and Zinman, 2015; Attanasio et al., 2015; Augsburg et al., 2015; Banerjee et al., 2015; Crepon et al., 2015; Tarozzi, Desai, and Johnson, 2015; Meager, 2019; Gertler, Green, and Wolfram, 2024; Bari et al., 2024). Relatedly, Doornik et al. (2024a) argue that consórcios expand access to credit, and recipients of credit in consórcios improve labor mobility (Doornik et al., 2024b) and reduce female mortality (Doornik, Schoenherr,

[8] This includes interesting work on the impacts of neighborhood quality on children's welfare and future life outcomes (Bayer, Ferreira, and McMillan, 2007; Kling, Liebman, and Katz, 2007; Jacob, Kapustin, and Ludwig, 2015; Chetty, Hendren, and Katz, 2016; Chyn, 2018; Agostinelli et al., 2024).

[9] In contrast to examining the effects of access to housing, others examine the effects of housing wealth conditional on owning a home (Lovenheim and Mumford, 2013; Daysal et al., 2021; Tan et al., 2023).

[10] See, for instance, Poterba and Sinai (2008); Jeske, Krueger, and Mitman (2013); Elenev, Landvoigt, and Van Nieuwerburgh (2016); Diamond and McQuade (2019); Kuhn, Schularick, and Steins (2020); Bach, Calvet, and Sodini (2020); Favilukis, Mabille, and Van Nieuwerburgh (2023), including the effects of rent controls (Diamond, McQuade, and Qian, 2019).

and Skrastins, 2025). Our work adds to this debate, showing that randomized access to housing credit affects the important household decision of childbearing.

2 Theoretical Framework

This section provides a simple theoretical framework to illustrate the main effects of access to housing on the fertility rate and inform our empirical hypothesis tests. The model builds on Doepke et al. (2023), extending this setup to incorporate housing.

2.1 Model

Households derive utility from consumption (c), quality-adjusted housing (h), the number of children (n), and children's human capital through education (e). Household preferences are represented by a log-linear utility function:

$$u(c, h, n, e) = log(c) + \beta \cdot log(h) + \delta \cdot log(n) + \delta \cdot \gamma \cdot log(e + \theta) \tag{1}$$

where $\beta, \delta > 0$ are parameters that represent the weights in the utility function associated with housing and children, respectively. Parental investments in education raise children's human capital according to the investment technology $(\theta + e)^\gamma$, where γ captures the return on educational investments, and θ represents intrinsic human capital without parental investment.

Parents earn a market wage w, and raising each child takes a fixed amount of time, ϕ. The price of educational investment is p per unit of e, which can also be thought of as school fees. The price per unit of housing is p_h, capturing the cost of utilities, maintenance, and all other housing-related expenses. r is the rent paid per unit of housing.[11]

The household faces a budget constraint determined by their wage (w), the time cost of raising children (ϕ), the cost of education investment (p), the price of housing p_h and rent r:

$$c + (p_h + r) \cdot h + p \cdot e \cdot n \leq (1 - \phi \cdot n) \cdot w \tag{2}$$

We normalize the time endowment to one, meaning that ϕ represents the fraction of time per child necessary for child-rearing.

[11] We can interpret w more broadly as any income from sources that require significant time investment, such as labor income and entrepreneurship, and thus would be affected by the time demands of child-rearing. In Online Appendix B, we also augment the model by including income from sources that do not require significant time investment, such as financial income.

Additionally, we introduce a housing adequacy constraint, which ensures that each child has access to adequate housing quality.[12] The housing adequacy constraint is written as:

$$\frac{h}{n} \geq q \tag{3}$$

where q represents the minimum housing requirement per child. A higher q indicates worse housing conditions where each child needs more quality-adjusted housing (due to factors like less efficient layouts, or overcrowded neighbourhoods), while a lower q indicates better housing conditions where each child needs less quality-adjusted housing (reflecting more family-friendly housing designs with efficient layouts, or neighborhood locations with better outdoor amenities). Rental housing and multigenerational living arrangements could typically involve higher q due to either contracting frictions on modifications/remodeling or lower control over space allocation. Homeownership, on the other hand, provides higher flexibility to optimize housing layouts, effectively reducing the space requirement per child.[13]

Solving the model (see Online Appendix A) gives the optimal number of children ($n^\star$):

$$n^\star = \frac{\delta}{1+\delta+\beta} \cdot \frac{(1-\gamma+\frac{\beta}{\delta})}{\left(\phi - \frac{p}{w}\cdot\theta + \frac{p_h+r}{w}\cdot q\right)} \tag{4}$$

Several factors affect $n^\star$. There is a clear negative effect of raising the opportunity cost of child-rearing (ϕ)—a higher time cost of raising each child directly reduces the incentive to have more children. There is also a negative effect from increases in the minimum housing per child (q): as housing becomes less family-friendly (higher q), the housing adequacy constraint tightens, thus reducing the optimal level of fertility.

Other factors, such as the returns to education (γ) and the price of education relative to wages (p/w), also influence $n^\star$, with parents substituting quantity for quality when education investments yield greater returns, or choosing to have more children but investing less in each child's education when education becomes more expensive relative to income. The model highlights the key trade-offs parents face when deciding on their optimal number of children,

[12] In the Brazilian context, this constraint is particularly relevant as multigenerational households are common, with many young families living with parents or extended family members, creating significant adequacy limitations. According to a 2024 consórcio administrator association (ABAC) internal survey of real estate participants, approximately 43% of Brazilian households include extended family members.

[13] We could also introduce a continuous cost associated with child-rearing as housing per child becomes progressively more limited, but use this simple constraint formulation here in the interests of brevity.

taking housing and education considerations into account.[14]

2.2 The Effect of Access to Housing on Fertility

In the setting that we study, randomly provided access to housing credit from the consórcio has two effects which can be mapped directly to the model. The first is that for some households, per-period housing expenses reduce. This is because a winning household that rented housing prior to winning paid both the periodic consórcio mortgage payment as well as per-period rental costs; post-win, rental expenses no longer need to be paid (lower r). The second is that there are differences in both the quality and the floor-space area of rental and purchase housing stock. Random access to credit thus permits access to housing with lower housing adequacy requirements per child (lower q).[15]

Through these two effects, the model predicts that improving housing access increases fertility. This is because with lower rental costs (lower r) and/or better housing (lower q), the optimal number of children is higher, i.e., $\frac{dn^*}{dq} < 0$ and $\frac{dn^*}{dr} < 0$ (see Propositions 1 and 2 in Online Appendix A.1).[16] It also follows that the predicted positive effect of housing access on fertility is stronger for households with lower initial housing quality—such households have greater potential for improvement in q, while those in high-quality housing have less room for improvement, pointing to a weaker effect on fertility.

The model also shows that the positive effect of housing access on fertility decreases with household income, as higher-income households face greater opportunity costs associated with child-rearing (see Proposition 3 in Online Appendix A.1). Intuitively, when housing is made more affordable, lower-income households experience a relatively greater positive impact on their fertility decisions, because for higher-income households, the time and resources devoted to child-rearing come at a higher cost in terms of foregone income and career opportunities.

A final observation is that the model predicts that the positive effect of housing access on fertility is expected to be weaker for households with a higher share of female income when women bear a larger share of the opportunity cost of child-rearing (see Proposition 4 in Online

[14] In Online Appendix B.3, we extend the model to compare the effects of housing policies on fertility with other potential interventions such as paid childcare, childcare subsidies, and education costs.

[15] Mortgage payments, being a fixed and mandatory commitment for homeowners in the consórcio program, effectively reduce disposable income. Therefore, without loss of generality, we consider w (wages) to be net of mortgage payments in our model. This allows us to focus on the effects of other housing-related costs and factors on fertility decisions.

[16] The rental effect is more subtle if households also view the rental expense saving as fungible to net wages w; we discuss this in Section 4.5. A higher w increases the opportunity cost of child-rearing and works in the opposite direction, leading to an overall ambiguous prediction on rental savings.

Appendix A.1). Intuitively, if women undertake the major share of child-rearing, a higher female income share increases the household's opportunity cost of having children, thus reducing the fertility boost from housing despite the relaxed housing adequacy constraint.

These testable implications provide a benchmark for the empirical strategy explained in the next sections, where we aim to estimate the causal effect of access to housing on fertility and heterogeneity in this effect based on household characteristics.

3 Institutional Background and Data

This section provides institutional background and data about the principal variables that we study. We provide a description of consórcio groups, how they allocate credit designated for the purchase of real estate, and institutional details of processes surrounding default. We next discuss trends and summary statistics on fertility in Brazil, and then turn to a more detailed description of the data that we utilize in our empirical analysis.

3.1 Brazilian Real Estate Credit Market

We begin by discussing the broader context of the Brazilian real estate credit market, and the role of consórcios in this environment. Many Brazilian households live in cramped housing conditions with limited physical space per person, making access to adequate housing a particularly important constraint. For potential homeowners in Brazil who wish to acquire a home but lack the resources to do so, there are two main options: borrowing through the Brazilian institutional real estate credit market, or participating in real estate consórcios.

The Brazilian institutional real estate credit market operates through two complementary systems: the Sistema Financeiro de Habitação (SFH) and the Sistema Financeiro Imobiliário (SFI). The SFH, established in the 1960s, primarily serves lower-income individuals by providing subsidized long-term housing finance. It is funded through savings deposits collected by banks and financial institutions participating in the Sistema Brasileiro de Poupança e Empréstimo (SBPE). Under the Conselho Monetário Nacional (CMN) Resolution 4.676/2018, SPBE institutions must allocate a minimum of 65% of these deposits to housing loans within the SFH framework.

In contrast, the SFI, created by law 9.514/1997, was designed to handle real estate loans outside the SFH's scope. Its key innovation was integrating real estate operations with capital markets, enabling the creation of mortgage-backed securities (CRIs) and developing a secondary market for real estate credits. Unlike the SFH, the SFI has no mandatory quota requirements and generally finances higher-value properties through these capital market instruments. In 2023, capital markets accounted for 38% of real estate financing in the SPBE, surpassing savings (accounting for 36%).

Real estate consórcios have emerged as a significant way to finance real estate purchases in Brazil, representing approximately 6% of total real estate credit in 2022—consórcios accounted for BRL 16 billion in real estate financing, while SFH and SFI combined, for BRL 251 billion.[17,18] In 2023, the number of consórcio participants reached a historic high of 1.5 million, with the amount of credit outstanding reaching nearly BRL 150 billion.[19] These institutions are managed by authorized administrators, and monitored by the Banco Central do Brasil (BCB). Participants in real estate consórcios contribute monthly installments to a shared pool of funds. They allocate funds to members through random lottery draws, or bidding processes; we describe the specific institutional details below.

3.2 Real Estate Consórcios

Basic Features

Real estate consórcios administer financial products where participants pool funds to save towards the purchase of a property. These groups are typically administered by the finance division of a real estate developer, a bank, or a specialty finance company. The administrator is responsible for marketing the consórcio, selecting participants, managing payments, and enforcing contracts. They are compensated through an administrative fee levied on all participants. Screening of applicants is minimal, and it is easy for anyone with a social security number in Brazil to participate.

Participants are informed about the identity of the administrator, the price of the property, the group's duration, and the target number of participants when selecting a group. All participants make equal pre-determined payments at regular intervals, typically monthly, with both payments and credit amounts adjusted for house price inflation. The monthly payments also cover the administrative fee, and establish a guarantee fund to cover losses from individual defaults. All participants must continue their contributions for the full term, including those who have received credit. The group continues until all participants have received credit for a property. Due to the organization through a central administrator, personal connections between consórcio participants are uncommon. Enforcement against default relies on the purchased property serving as physical collateral.

[17] ABAC blog, "Crédito imobiliário por consórcio (2022)"
[18] Home Hub, "Crédito imobiliário em maio (2023)"
[19] ABAC blog, "Créditos contratados (2023)"

Reasons to Participate: Survey Evidence

According to a 2024 consórcio administrator association (ABAC) internal survey of real estate consórcio participants aged 20-35 in Brazil (Figure A.2), 31% purchased property to start a family (1/3 to marry, 2/3 to have children), 16% and 17% for career or business purposes, respectively, and 9% for other reasons. In terms of pre-consórcio living arrangements, 43% of respondents lived with parents, 27% rented, 24% owned property, and 6% had other arrangements. The high proportion of family-formation motives (31%) and parent co-residence (43%) is consistent with housing constraints significantly influencing household fertility decisions. These results are congruent with those reported in US surveys, where a large proportion of young adults cohabit with their parents and cite housing costs as the main obstacle to family formation (Institute for Family Studies, 2025).

Credit Allocation

All participants in a consórcio begin by making equal contributions to the communal pool. Each month, some participants receive credit via either lotteries or auctions to purchase a property. By law, at least one property must be allocated through a lottery each period.

Lotteries are based on the national lottery in Brazil (*Loteria Federal*), which is broadcast on TV. Each participant receives a ticket number at the beginning of the group. Based on an algorithm which is contract-specific, the national lottery number is translated into a ticket number, and the participant holding the respective ticket number is declared the winner of the lottery. Each algorithm is designed such that at the beginning of the group, all participants have the same unconditional probability of winning the lottery at any point in time. A detailed description of one such algorithm is provided in Online Appendix C.1.

In auctions, participants bid a fraction of the property's total value. Bids advance payments in time, similar to making a higher down-payment, and future contributions are adjusted accordingly. For example, if a property is worth $500,000 with monthly contributions of $10,000, a participant bidding 40 percent would pay $200,000 immediately, and cease payments 20 months before the group's end. Winners of bidding obtain housing credit once all documentation is completed, the same as for lottery winners, and the bid is paid.

When a participant is allocated the credit, she receives a lump sum equivalent to the value specified in her contract. This credit must be used for housing purposes within 3 to 6 months, depending on the contract with the administrator. The property is bought in the participant's name, but with a fiduciary lien in favor of the consórcio group until all payments are completed. This ensures the credit is used for housing purposes and cannot be diverted.

While the majority of allocated credit is used for property acquisition, the credit can also be applied to fund home remodeling, or purchase land for future construction, offering flexibility in improving their housing situation and alleviating housing adequacy constraints. There are no restrictions on location or the type of house.

It is worth noting that in this setting, access to home equity or collateral is not a potential channel through which housing access affects fertility decisions. Since real estate properties purchased through consórcios are subject to a fiduciary lien, the consórcio administrator retains legal ownership of the property until the credit is fully repaid. Consequently, participants cannot access home equity until they obtain legal home-ownership at the end of the group. This institutional feature distinguishes our study from other contexts where home equity or collateral might play a role in influencing the decisions of homeowners, such as, for example, Hurst and Stafford (2004); Lustig and Van Nieuwerburgh (2005, 2010); Leth-Petersen (2010); Mian and Sufi (2011); Lovenheim and Mumford (2013); Dettling and Kearney (2014); DeFusco (2018) and Cloyne et al. (2019).

Defaults

After an individual obtains credit and purchases a property, the property becomes the group's collateral, which can be seized if payments are late. Participants cannot sell the property without the administrator's approval to ensure that it is not transferred to a high credit risk individual.[20] As stated above, the consórcio administrator retains legal ownership of the property until all payments are completed and the credit is fully repaid; legal homeownership is only fully transferred to participants at the end of the group term.

If a participant defaults before receiving credit, their past payments are retained until they win a lottery, at which point their paid-in funds are released, instead of the full amount of credit being allocated. Moreover, defaulting participants receive only a fraction of these previous payments, paying a contractual default penalty of roughly 16 percent on average.[21]

Defaults before receiving credit do not affect other participants' win-related payouts. While the set of participants gets smaller with pre-win defaults, the pool of funds available to these participants increases because of the penalty mentioned above. However, defaults after receiving credit can impose costs on the group if the collateral value is insufficient to recover the full credit amount. Losses are first covered by the guarantee fund, which is designed for this purpose, and administrators usually absorb any excess losses. In practice,

[20] Consorciós register all real estate and vehicle collateral under the fiduciary lien (*alienação fiduciária*), which allows for an out-of-court settlement in the event of default. As a consequence, collateral can be recovered quickly upon default.

[21] Doornik et al. (2024a) explore the benefits of the penalty theoretically and empirically.

losses have historically rarely exceeded the guarantee fund's capacity. That said, in the event that this does occur, any remaining funds in the reserve fund are split equally among participants at the group's termination.

Aggregate Statistics

Between 2002 and 2020, housing consórcios had 1,651,649 active participants, comprising 1.2 percent of the working-age population or 3.3 percent of all formally employed individuals in Brazil. The average house value across all groups is BRL 109,910 (roughly USD 61,000). Thus, consórcios financed approximately USD 100 billion worth of housing during this period. Average monthly consórcio payments paid by participants in the sample amount to roughly 0.6 percent of house value. In addition to covering the costs of the house, the payments also include an administrative fee, and a payment into a guarantee fund to cover losses. The share of houses allocated through lotteries is 40.05 percent, with the rest allocated through auctions. Consistent with consórcio groups not relying on social ties among participants, about 3 to 5 participants come from the same municipality in the average group. Thus, social ties among participants are uncommon. Finally, about 6.2 percent of participants default after receiving credit, in which case the house may be seized by the group to cover outstanding payments. If the liquidation value of the house is higher than the outstanding payments, defaulting participants keep the difference.

3.3 Fertility in Brazil

Brazil has experienced a significant decline in its total fertility rate (TFR) over the past six decades, and the TFR in Brazil is relatively low compared to other Latin American countries.[22] According to data from the Brazilian Institute for Geography and Statistics (IBGE), the country's TFR has fallen from 6.3 children per woman in 1960 to 1.9 in 2010, which is well below the population replacement rate of 2.1.[23] This trend is attributable to several factors, including housing costs—our topic of study in this paper—as well as urbanization, advances in medicine, increased use of contraceptive methods, sex education, family planning, the substantial participation of women in the labor market, and the rising costs of raising and caring for children. Brazil's unique factors, such as its national health system (SUS), which provides wide access to contraceptive methods, and its comprehensive

[22]Figure A.3 in the Online Appendix shows that Brazilian fertility rates in the 1960s were above the world average. By 2023, these rates had declined to levels comparable to those in developed economies like the US and UK, highlighting the rapid pace at which fertility rates declined in Brazil.

[23]IBGE, *Fecundidade no Brasil, 1940–2010*

sex education in schools, may also have contributed to the country's relatively faster decline in TFRs compared to other Latin American nations.

There are significant regional differences in TFRs within the country. The Southeast region, which includes the four Brazilian cities with the highest GDP, has the lowest fertility rate at 1.67 children per woman. In contrast, the North and Northeast regions, which are the poorest in Brazil, have the highest fertility rates at 2.34 and 1.92, respectively.[24] These regional differences reflect cross-regional variation in urbanization, economic development, and access to education and healthcare. Despite these regional variations, Brazil's overall fertility rate remains below the critical replacement level of 2.1, highlighting the concern with potential social and economic implications of a rapidly aging population.

3.4 Data

The data for this paper come from two main sources. Data on consórcios is from the Sistema de Administração de Grupos/Cotas de Consórcio (SAG) database, which is maintained by the BCB. Information on children per household is from the Population Registry at the Receita Federal.[25] Data on labor market outcomes is from the Relação Anual de Informações Sociais (RAIS), an employer-employee matched database that includes employment information and wages for all formally employed workers in Brazil.

The database on consórcios provides information on the administrator, all participants, the good that is being allocated (e.g., real estate), and the dates when credit is awarded to participants. The BCB has been collecting data on all consórcio groups since 2008, including consórcios that started earlier, but were still ongoing at that time. The earliest starting date of a consórcio group in our sample is 2002, and the sample ends in 2020.

For our empirical analysis, we also require information about the algorithms through which consórcio groups translate the national lottery draw into a number that matches the ticket number of a participant. This information is not readily available in the database, so we hand-collect these data from as many administrators as possible, and verify the algorithms in the data. The final sample for our analysis thus comprises all groups for which we can collect the algorithm used to translate the national lottery number into participants' ticket numbers, and for which our algorithm correctly predicts at least one lottery winner (63% of all groups). Our data track all lottery winners for each of these groups.[26]

Table I provides unconditional descriptive statistics for our sample. Panel A provides

[24]DATASUS Table A05B (accessed 2025)
[25]Households are defined by residential addresses.
[26]Table A.1 in the Online Appendix provides a description of all variables in the paper.

descriptive statistics at the level of consórcio groups, and Panel B at the participant level. The data contain 3,040 consórcio groups that allocate housing through auctions and random lotteries between 2002 and 2020. The sample of members of these groups who win a lottery leaves us with an average group size of 50 participants, with a median of 52 participants. Thus, the total number of participants in our sample is 153,155. Given the average house value of about BRL 109,910, the experiment tracks the randomized allocation of roughly BRL 17 billion (USD 10 billion) in funding. The average group lasts for 154 months, with a median of 144 months.

Twenty-two percent of participants have a formal job with a monthly income of BRL 2,480. This compares to an average formal employment share of 94 (37) percent and a monthly salary of BRL 2,098 (BRL 1,715) for mortgage applicants (the Brazilian working-age population). In Brazil, a mortgage from a bank can be obtained only against formally verifiable income, which is why there is a high formalization rate among mortgage borrowers. In this regard, Consorcio participants are more representative of the Brazilian population than mortgage borrowers. The average participant is 40.5 years old, and 67 percent of all participants are men. 26 percent of participants have children, and there are 0.44 children per participant.

We also compare consórcio participants with recipients of Brazil's subsidized housing program, *Minha Casa Minha Vida* (MCMV), a large-scale federal initiative launched in 2009 to provide affordable housing to low-income families (Belchior, Gonzaga, and Ulyssea, 2023; Krause et al., 2023). MCMV participants have significantly lower incomes, averaging BRL 907, and are comparable in age (38.1 years) to consórcio participants. Regarding fertility, both groups exhibit similar probabilities of having children. However, when they do have children, MCMV participants tend to have slightly larger families. Ultimately, consórcio participants represent an important middle-income demographic, situated between social housing recipients and traditional mortgage borrowers.

4 Empirical Analysis

This section presents our empirical analysis to assess the effects of access to credit for investment in housing on the fertility rate.

4.1 Baseline Specification

To exploit time-series variation in credit allocation in consórcios, we estimate the following specification to assess the relationship between access to mortgage and fertility outcomes:

$$Fertility_{it} = \alpha_i + \alpha_{gt} + \beta \cdot win_{it} + e_{it} \tag{5}$$

where i denotes individuals, g denotes consórcio groups, and t denotes time. $Fertility_{it}$ is the outcome of interest, measured either as a dummy variable indicating whether individual i's household has children by year t, or as the number of children individual i's household has by year t. The variable win_{it} is a dummy variable that takes the value of one for individuals who win a real estate credit lottery in year t or earlier, and zero otherwise. Employing a difference-in-differences methodology with individual fixed effects (α_i) tracks changes for the same individual and controls for sample composition effects. Group-time fixed effects (α_{gt}) control for selection by and into a specific group.[27]

As described in Section 3.2, groups allocate credit through a combination of auctions and lotteries. While we restrict the sample to participants who obtain credit through lotteries, the presence of auctions generates an endogeneity problem with respect to changes in the pool of lottery participants over time. Specifically, individuals who remain in the lottery pool over time are more likely not to have obtained credit through auctions, which may reflect characteristics correlated with the decision to have children. For example, individuals may not bid in auctions because of limited funds as a result of tighter financial constraints. In this case, staying in the lottery pool may be correlated with a lower ability to have children. Alternatively, individuals may not bid in auctions because they do not feel like they urgently need access to housing since their housing adequacy constraint is not binding. In this case, staying in the lottery pool may be correlated with a higher ability to have children. As a result, endogenous selection into the lottery pool over time could bias the estimate of β in equation (5) upwards or downwards.

4.2 Instrumental Variable Approach

To overcome this selection challenge, we apply the instrumental variable approach used in Doornik et al. (2024b). Data on participants' ticket numbers and historical national lottery numbers enable us to simulate credit lotteries as if there were no auctions. This allows us to identify which participants would have won a lottery in a given month if a group allocated

[27]These are called "risk group" fixed effects in the language of Angrist and Pischke (2009) and ensure that we are comparing winning and losing participants within specific consórcio groups.

all credit through lotteries and there was no selection into the lottery pool over time.

We implement this procedure for each group, translating national lottery numbers into ticket numbers based on the group's algorithm. By doing so, period by period, we obtain the schedule of lottery winners as if all credit were allocated through lotteries. For example, consider a group with 150 participants that runs for 50 months and allocates credit to three individuals each period, two based on auctions and one based on a lottery. By applying the algorithm to the national lottery number each month and behaving as if all participants entered the lottery, we can replicate an "as-if" allocation, i.e., as if one lottery was held each month for all 150 participants, with no auction option, one winner, and no attrition from the pool of participants. This procedure provides us with a group of 50 predicted lottery winners, determined by the outcomes of the national lottery. Because of the presence of auctions in real-world groups, the instrument is not perfectly correlated with winning a lottery.[28]

We begin our analysis by documenting that the simulated lotteries are a strong predictor of winning an actual lottery by estimating

$$win_{it} = \alpha_i + \alpha_{gt} + \beta \cdot win\ sim_{it} + e_{it} \tag{6}$$

where $win\ sim_{it}$ is a dummy variable that takes the value of one from the year an individual is predicted to win a simulated credit lottery and zero before. Since $win\ sim_{it}$ is based on simulated random lotteries, it is orthogonal to e_{it}, conditional on group membership. Unlike win_{it} in equation (5), which represents actual lottery wins potentially influenced by auctions, $win\ sim_{it}$ provides an exogenous instrument for credit allocation, addressing potential endogeneity concerns.

Panel A of Table II presents the first-stage estimation results from equation (6). The results show that being predicted a lottery winner in simulated lotteries is associated with a 31.3 percentage point higher probability of winning an actual lottery. The instrument is strong, with an F-statistic ranging from 90.92 to 132.27.

Having established that winning a simulated lottery is a strong predictor of winning an actual lottery, we examine the reduced-form relationship between simulated lottery wins and the fertility rate by estimating:

$$Fertility_{it} = \alpha_i + \alpha_{gt} + \beta \cdot win\ sim_{it} + e_{it}. \tag{7}$$

[28]For instance, an individual predicted to win the lottery in our simulation might have already received credit in a different period because the originally predicted winner had already received credit through an auction, thus making the individual next in line.

Panel B of Table II shows the reduced-form results. Column I displays the effects of getting access to housing credit on the probability of having children, while Column II shows the effects on the number of children. Both columns demonstrate that our instrument positively predicts a higher fertility rate in families who are predicted to win the lottery. Being predicted to win the lottery increases the probability of having had children by 0.36 percentage points and the number of children by 0.0051.[29] Overall, these results reinforce the validity of the instrument since it is related to our outcome variables.

The reduced form estimates in Panel B of Table II can be interpreted as the fertility effects of winning a credit lottery with the probability given in the respective first stage. To obtain estimates for the fertility effects of an individual winning a credit lottery, we estimate a two-stage least squares (2SLS) specification

$$Fertility_{it} = \alpha_i + \alpha_{gt} + \beta \cdot win_{it} + e_{it} \tag{8}$$

where the main independent variable win_{it} (a dummy variable taking the value of one from the year an individual wins a lottery) is instrumented with the simulated lottery outcomes ($win\ sim_{it}$) as in equation (6).[30]

The results from the 2SLS estimation are reported in Panel C of Table II. The results in column I imply that the probability of having children in a household increases by 1.15 percentage points in the years after individuals obtain credit, corresponding to an increase of about 3.8 percent of the unconditional mean of the outcome variable. The results in column II imply that the number of children in a household increases by 0.016 in the years after the individuals obtain the credit, representing an increase of 3.2 percent of the unconditional mean. As we show later in this section, these estimates reflect average effects across our entire sample population, including individuals of all ages, and mask substantial heterogeneity. Altogether, these results suggest that access to credit for investment in housing leads to an increase in the number of children in a household.

To formally test for the absence of pre-trends in our outcome variables, we run a dynamic 2SLS specification as follows:

$$Fertility_{it} = \alpha_i + \alpha_{gt} + \sum_{s=-5, s\neq -1}^{5} \beta_s \cdot win_{it}^s + e_{it} \tag{9}$$

[29] Since some participants could already own a home before participation, these are likely lower-bound estimates of the effect of housing.

[30] Since the endogenous variable is just identified, the 2SLS estimate is a Wald estimate and is equivalent to the reduced-form coefficient scaled by the first-stage estimate.

where win^s_{it} are dummy variables which take the value of 1 for each year s relative to the year an individual wins a lottery, and 0 otherwise. This variable is instrumented with the corresponding simulated lottery outcomes $win\ sim^s_{it}$. We omit the year before an individual wins a lottery, which is equivalent to normalizing to zero in the year before winning a lottery. We pool the years from and including 5 years before individuals win a lottery and the years from and including 5 years after individuals win a lottery each into one estimate, respectively.

Figure 1 shows the dynamic evolution of the effect of winning the consórcio lottery on the probability of having children (in red) and the number of children (in blue). The results in this figure indicate no systematic pre-treatment trends for any of the outcome variables, suggesting that the parallel trend assumption holds. Over time, we consistently observe a significant rise across all outcomes following treatment, substantiating the causal relationship between winning the housing lottery and subsequent fertility choices.

Recent literature in econometrics has highlighted potential issues when examining staggered treatment effects. Specifically, short-term effects may be overweighted when the treatment effect is not constant over time for the same unit (Goodman-Bacon, 2021; Borusyak, Jaravel, and Spiess, forthcoming) or across units such that treatment effects vary with the timing of treatment (Callaway and Sant'Anna, 2021; Sun and Abraham, 2021; Borusyak, Jaravel, and Spiess, forthcoming; de Chaisemartin and D'Haultfoeuille, 2020; Goldsmith-Pinkham, Hull, and Kolesar, 2022). In our context, this concern would arise if treatment effects for earlier and later lottery winners within the same consórcio group were different.

To address this issue and support the validity of our estimates, we employ the methodology developed by Sun and Abraham (2021), which is robust to heterogeneous treatment effects across individuals over time. Since neither of the methods above supports 2SLS estimation, we examine the reduced-form estimates:

$$Fertility_{it} = \alpha_i + \alpha_{gt} + \sum_{s=-5, s\neq -1}^{5} \beta_s \cdot win\ sim^s_{it} + e_{it}. \tag{10}$$

Figure 2 presents the results from estimating equation (10) with (dashed lines) and without (solid lines) the application of the Sun and Abraham (2021) methodology for the probability of having children (in red) and the number of children (in blue). The estimates obtained using both approaches are nearly identical, suggesting that heterogeneous treatment effects do not pose a concern in our setting. If anything, the point estimates without the application of Sun and Abraham (2021) are somewhat more conservative. Since the variation in equations (8) and (9) are based on the same variation as the reduced form estimates, the robustness of the reduced form estimates to heterogeneity in treatment effects across units over time suggests that the IV estimates are robust to the same type of heterogeneity.[31]

Effects by Age

Finally, we explore how the treatment effect varies with the age of a participant. Medical literature suggests that, on average, the end of fertility occurs around the early 40s (Velde and Pearson, 2002; Voorhis, 2007; Eijkemans et al., 2014).[32] These findings suggest that it is safe for women to bear children until the age of 40. After this age, childbearing involves risks to both the mother and the child. The mother can develop severe health consequences such as gestational diabetes, pre-eclampsia, placental abruption, or even death (Berg et al., 1996; Jacobsson, Ladfors, and Milsom, 2004). The child is also at an increased risk of Down's syndrome and other chromosomal abnormalities (Sherman et al., 2007).

To assess how the treatment effect changes with age, we interact the independent variables and instruments in equation (8) with the age of participants at the time of joining the group. Figure 3 reveals that the effect of accessing a mortgage is most pronounced for individuals aged 20-35.[33] The economic magnitudes of the effect are substantial. Individuals aged 20 to 25 years experience a 33% increase in the probability of having children, and a 32% increase in the number of children. For individuals aged 25 to 35 years old, the corresponding effects range between 10% and 21% for the probability of having children and 9% to 13% for the number of children. Importantly, consistent with the medical literature, we do not observe any treatment effects for individuals aged 40 or over.

4.3 Completed Lifetime Fertility

In this section, we assess how each year of delayed access to housing affects completed lifetime fertility—the average number of children born to a cohort of women by the end of their childbearing years. It is hypothetically possible that in anticipation of eventually obtaining housing, consórcio participants simply postpone conceiving children, with limited effects on completed fertility, but the evidence above is inconsistent with a simple delay. This

[31] Figure A.4 in the Online Appendix shows that the impact of access to housing credit on the number of children in the household is similar for both male and female participants.

[32] Eijkemans et al. (2014) found that almost 90% of women have their last child before 45 years old, and 100% by 50 years old. In addition, the probability of successful in vitro fertilization drops significantly with age, from 50% around the late 20s to less than 5% for women over 43 years old (Voorhis, 2007).Health insurance coverage in Sweden for in-vitro fertilization fades-out after the age of 40 (Bögl et al., 2024).

[33] The large effects for ages 20-35 capture both first births and additional children, with first births likely predominating at this age.

is because the dynamic estimates of winners and not-yet winners in Figures 1 and 2 do not eventually converge. Our analysis in this section strengthens this conclusion, demonstrating significant and lasting effects on completed lifetime fertility.

To gauge the effect on completed fertility, we analyze individuals who are above age 40 in 2020, the final period in our sample. This approach aligns with the medical literature, as well as our previous findings, which show that housing access effects on fertility significantly decline after age 40. We also consider only those individuals who were younger than 40 at the point of joining the group, thus ensuring they could potentially have children after joining the group. For this sample, we estimate the following two-stage least squares equation:

$$Completed\ Fertility_i = \alpha_g + year\ win_i + e_i. \tag{11}$$

where $year\ win_i$ measures the number of years (since joining the group) an individual takes to win the credit lottery, instrumented with the simulated waiting period ($year\ win\ simulated_i$). $Completed\ Fertility_i$ measures completed fertility—number of children, or probability to have children—for individual i in 2020. The identifying variation comes from the fact that some people are predicted to win a credit lottery earlier than others within the same group (in the presence of group fixed effects α_g).

To assess how the treatment effect changes with age, we interact the independent variables and instruments in equation (11) with the age of participant i at the time of joining the group. To control for differences in fertility rates by cohort, we also add year of birth fixed effects. Table III reveals significant economic effects stemming from delayed access to housing in the age group between 20-34. More specifically, in terms of completed fertility, an individual who is 20 is 0.012 pp less likely to be a parent and has 0.022 fewer kids for each additional year of waiting for housing. Figure 4 puts these estimates in relative terms. For an individual who wishes to acquire a house at the age of 20, obtaining the house at age 21 leads to 6% fewer children, and obtaining a house at age 30 leads to approximately 50% fewer children over their lifetime. Overall, the evidence here is consistent with delayed access to housing negatively and significantly affecting completed lifetime fertility.

4.4 Residential Relocation Dynamics

Building on our identification strategy using lottery-based instrumental variables (equation 8), we investigate how credit access through lottery winning influences residential choices. More specifically, we focus on the quality characteristics of winners' destination ZIP codes to understand whether improved access to housing credit facilitates upward mobility through neighborhood transitions.[34] The residential data comes from the Brazilian Census of 2010, while our crime statistics are derived from murder information from police reports from Sao Paulo state aggregated at the ZIP code level.

Our analysis of post-win residential patterns reveals that lottery winners exhibit significantly higher mobility rates. Panel A of Figure 5 shows that the probability of having changed a ZIP code increases immediately upon winning and continues to rise in subsequent years, reaching approximately 3 percentage points higher for winners than for non-winners. This mobility response shows substantial age heterogeneity—winners aged 25-35 demonstrate a 3-4 percentage point increase in ZIP code changes, with the effect declining monotonically with age and becoming negligible for those over 40 (panel B).

The quality dimensions of these moves suggest meaningful improvements in neighborhood characteristics. The evidence in Figure 6 shows that lottery winners relocate to areas with lower crime rates (panel A) and higher income per capita (panel B), consistent with moves to better neighborhoods. Winners also relocate to areas with higher home-ownership rates (panel C), indicating that these desirable neighborhoods have more limited rental options. These effects are particularly strong for younger winners. This evidence suggests that access to housing credit allows households to move to better neighborhoods, surmounting frictions such as limited rental access in such desirable locations.

4.5 Cross-Sectional Variation in Treatment Effects

In this section, we investigate the heterogeneous treatment effects predicted by our theoretical model in Section 2. We conduct four cross-sectional tests to investigate the heterogeneous effects of housing on fertility. First, we examine how the quality of initial housing conditions influences the fertility response to accessing a mortgage, testing the prediction that the benefits of improved housing are more pronounced for households that are initially in lower-quality dwellings. Second, we explore the role of rental payment savings in altering the impact of housing on fertility, assessing whether the effect is stronger for households experiencing greater reductions in rental expenses. Third, we analyze the relationship between income and the fertility response to housing, investigating whether higher-income households exhibit a weaker effect due to the increased opportunity cost of having children. Finally, we investigate the extent to which intra-household gender roles (measured by the female contribution to household income) affect the change in fertility following random access to housing credit.

[34] Our dataset is restricted to ZIP code-level tracking, which introduces measurement imprecision. In Brazil, where municipalities often share a single postal code, our geographical mobility measures are necessarily coarse.

Quality of Housing

Our model suggests that the benefits of housing on fertility are more significant when the quality of housing experiences a greater improvement following access to housing credit. To test this prediction, we acquire data on housing quality at the origin zip code level, and examine whether the treatment effect is stronger for households residing in areas with lower-quality housing, or in areas with a high population density per available bedroom.

Specifically, we use data from the Brazilian Census to construct measures of housing quality, such as the proportion of households with wood walls or exposed brick walls, as well as the average number of people in the household per bedroom. We then estimate equation (8) and interact these housing quality measures with the independent variable as well as the instrument to assess whether the impact on fertility varies based on initial housing conditions. If the model's predictions hold, we expect to find larger treatment effects for households living in areas with poorer housing quality.

Table IV provides the results from this analysis. The results support the prediction of the model, that is, the treatment effect on fertility is greater, the poorer the initial living conditions. Both the probability of having children and the number of children increase more for individuals living in zip codes with a higher fraction of households with wood walls (columns I and IV), exposed brick walls (columns II and V), and a higher number of people per bedroom (columns III and VI). The cross-sectional results are stronger for the number of children, "intensive margin" outcome (columns IV to VI), than for the probability of having children, "extensive margin" outcome (columns I to III) both in terms of statistical significance and economic magnitude. This suggests that while the impact of improved housing on the extensive margin of fertility (the decision to have children) may be less sensitive to initial housing conditions, the effect on the intensive margin (the number of children) is more strongly influenced by the quality of housing.

The economic magnitudes of these effects are substantial. For instance, a one-unit increase in the fraction of households with exposed brick walls in a zip code ($ExpBrickWalls_{zip}$) is associated with a 7.74 percent increase in the number of children following random access to a mortgage (column V). This effect size is approximately five times larger than the average treatment effect, and represents an increase of almost 15 percent relative to the unconditional average of the outcome variable. This implies that the fertility response to improved housing for households living in areas with a high prevalence of exposed brick walls is not only statistically significant but also economically meaningful.

Rental Savings

Unlike a standard mortgage, winning a credit lottery in a consórcio does not affect the timing, magnitude, or total number of mortgage payments. All participants make contributions from the start of the group until the end. Thus, mortgage payments are equivalent for both lottery winners and not-yet lottery winners and cancel out in our empirical specifications (owing to the group-time fixed effects). That said, randomly accessing a mortgage allows renters to move into their purchased house and stop paying rent.

This channel of lower rental expenses is potentially relevant for about 27% of participants who rent prior to participating in consorcios (Figure A.2). To differentiate between the two mechanisms, i.e., housing and income effects,[35] we compare the outcomes of lottery winners who rent at the time of winning with those who do not rent housing services. If the fertility increase is primarily driven by rental savings, we should observe larger increases in fertility for individuals who rent. Conversely, if better housing conditions are the main driver, we should expect comparable increases in fertility, since both groups experienced improved housing adequacy. To test this prediction, we employ transaction-level data from the Brazilian Payment System, specifically the Sistema de Transferência de Reservas (STR), Sistema de Transferência de Fundos (CIP-Sitraf), and Boleto Bancário (Boleto), all obtained from the Central Bank of Brazil. These three payment systems constitute practically all the electronic payment systems in Brazil during our sample period.[36] STR and CIP-Sitraf are real-time gross settlement payment systems that comprehensively record all electronic interbank transactions in Brazil. Boleto bancário represents a Brazilian payment mechanism facilitating cash or bank transfer payments for goods and services via barcode-based invoices that can be paid at bank branches. All three datasets include timestamp information and unique identifiers for both creditors and debtors.

For renter identification, we extract rental payment transactions from the STR and CIP-Sitraf gross settlement systems by filtering for payment descriptions containing "alug" (the common root for "rent" in Portuguese). Additionally, we isolate all rental payments directed to real estate agencies from the Boletos data. Our analysis reveals that consórcio participants allocate approximately 1,400 BRL to rent, constituting roughly 22% of their income—a proportion consistent with housing expenditure patterns observed both in Brazil

[35] Rental savings incorporate both income and wealth channels. Lower rent frees up resources today (an income effect) and also provides more wealth in terms of the present value of rental savings (a wealth effect).

[36] According to the *Dados Estatisticos dos Instrumentos de Pagamento* from the Central Bank of Brazil, bank transfers and direct debts such as boletos represent 87% of all electronic transfers in 2011. PIX, an instant payment system, was launched in November 2020 in Brazil.

and internationally (Larrimore and Schuetz, 2017; Bastos et al., 2023).[37]

Table V presents our empirical findings using equation (8). The specification controls for differential fertility trends among those who do and do not rent by adding renter by time fixed effects. Columns I and III demonstrate that fertility outcome changes between renters and non-renters are statistically indistinguishable for both the extensive margin (probability of having children) and intensive margin (number of children), respectively. In columns II and IV, we further interact our independent variables with the logarithm of pre-treatment rent to directly examine the relationship with the magnitude of rental payment savings. While both fertility measures exhibit positive correlations with rent, the estimated effects are economically negligible and fail to reach statistical significance at conventional levels.

This finding that renters and non-renters show similar fertility responses upon accessing housing credit can be better understood by examining the relative importance of different forces in our model. While renters experience a reduction in housing costs $(p_h + r)$ through eliminated rental payments, the evidence is consistent with improvements in housing adequacy (q) driving the fertility increases—both renters and non-renters experience these improvements.

This result can also be decoded using our theoretical framework by considering various interpretations of rental savings. On the one hand, households that practice mental accounting (see, e.g., Hastings and Shapiro (2013))—treating different sources of money as non-fungible and mentally earmarking funds for specific purposes—could perceive rental savings narrowly as solely reducing housing costs $(p_h + r)$. On the other hand, for households that treat money as fully fungible, rental savings could effectively function as increased net wages (w), which, according to our model, could actually reduce fertility, as they raise the opportunity costs of child-rearing. Our evidence of insignificant differences between renters and non-renters is also consistent with these two effects counterbalancing each other. Collectively, our results suggest that rental savings, interpreted through either channel, are unlikely to be the primary mechanism driving our main findings.

Household Income

The model shows that the joint relationship of housing and income on fertility is ambiguous. On the one hand, higher income might allow individuals to purchase a bigger house and further alleviate housing adequacy constraints. On the other hand, the opportunity costs of having children are higher when labor income is higher. To empirically test the direction of this relationship, we therefore estimate equation (8) and interact our independent and in-

[37] According to Bastos et al. (2023) Brazilians typically spend between 15-20% of their income on rent.

strumental variables with the consórcio participant's income, their household's total income, and whether the household receives federal benefits—a useful indicator of low-income status. These variables are taken from RAIS, Receita Federal and Cadastro Unico.

Table VI presents the results. Columns I and IV show that higher participant income is associated with both a lower probability of having children after randomly accessing mortgage credit, as well as a smaller number of children. These findings suggest that higher income leads to smaller effects of housing on household fertility rates. Similarly, household income is negatively associated with having children upon winning the lottery (columns II and V), although this is only significant when the number of children is the outcome variable. Consistent with these results, low-income households receiving federal benefits exhibit higher fertility rates following random housing credit access (see columns III and VI).

Overall, higher-income households experience smaller increases in fertility upon randomly getting housing credit. This finding is consistent with the opportunity cost of child-rearing rising with income, potentially offsetting the fertility benefits of improved housing conditions.

Female Fraction of Household Income

In many households across the world and typically in Brazil, women do most of the child-rearing. This leads to a situation in which the time cost of having children depends mostly on women's wages rather than on household total wages. Consistent with this, our model in Section 2 predicts that the benefits of housing decrease with the female income share in the household. To test this, we estimate equation (8) and interact the independent and instrumental variables with the share of female income in the household.

Table VII reports the results. We find that both the probability of having children (column I) and the number of children (column II) decrease with a higher share of female income in the household. The economic magnitude is as follows: a 10 percentage point increase in the female income share is associated with a 0.056 percentage point decrease in the probability of having children, or about 0.19 percent of the unconditional mean. Similarly, a 10 percentage point increase in the female income share is associated with a 0.0054 decrease in the number of children or about 1 percent of the unconditional mean.

Thus, the opportunity cost of having children is primarily determined by women's wages rather than household wages. The negative relationship between the female income share and the fertility response to housing suggests that as societies become more egalitarian and women contribute a larger portion of household income, the benefits of improved housing conditions on fertility may diminish.

Simultaneous Analysis of Heterogeneous Treatment Effects

In Online Appendix Table A.2, we simultaneously examine the multiple channels through which housing may affect fertility. We estimate equation (8) and interact the independent and instrumental variables with variables representing each of the channels discussed in previous sections. The results largely confirm our earlier findings, with housing quality, participant income, and the fraction of female income in the household remaining significant factors. As before, renters do not exhibit a differential treatment effect.

4.6 Discussion

Various policies have been studied for their impact on fertility rates. Labor market interventions (such as parental leave extensions) have shown modest effects. Lalive and Zweimüller (2009) found that extending paid parental leave in Austria from one to two years increased higher-order births by 5-7 percentage points. These policies aim to reduce the opportunity cost of having children by providing job security and financial support during early childcare.

Other economic policies show varying results. While Cohen, Dehejia, and Romanov (2013) find substantial fertility increases from child subsidies, Carneiro et al. (2021) observed no significant effect of cash transfers on fertility in Nigeria. These policies typically aim at directly reducing the financial burden of child-rearing. Broader economic measures, such as pro-natal transfers and education taxes, have shown significant effects, with Kim, Tertilt, and Yum (2024) reporting a 28% increase in fertility in Korea. These measures often work by altering the relative costs and benefits of having children.

Recent research by Cumming and Dettling (2024) explores how changes in disposable income arising through monetary policy-induced mortgage payment changes can influence fertility. They find that a 1% increase in quarterly disposable income leads to a 0.86% increase in birth rates. This highlights how policies that do not directly target fertility can also have significant impacts on family planning decisions.

In a similar vein, housing interventions offer a different approach to influencing fertility rates. Unlike policies that directly target fertility, housing improvements address broader aspects of family life. Our study finds that access to housing through consórcios increases the probability of having children by up to 33% and the number of children by 32% for 20 to 25 year-olds. Improved housing conditions may reduce perceived constraints on family size, while simultaneously providing the necessary stability for family planning. These effects are substantial and comparable to some of the larger impacts found in the literature, including those from changes in disposable income due to mortgage payment fluctuations.

Since we rely on an instrumental variable strategy, our estimates are local average treatment effects for individuals targeted by the instrument. More specifically, our estimates apply to consórcio participants who obtain credit for housing purchases through lotteries. Consórcio participants are a selected group of individuals; our estimates apply to this group and may differ for the general population. By revealed preference, consórcio participants expect to benefit from access to housing, which may not apply to the same extent to the average individual in the population. In sum, our estimates apply to individuals who believe that obtaining credit to finance a housing purchase will benefit them, but are unable to invest in housing because they are credit-constrained. To the extent that consórcio participants are similar to the average working-age population, as discussed in section 3.4, our results are also informative about this group.

In future research, it would be valuable to more deeply investigate the precise microfoundations of how housing affects fertility. Besides relaxed space constraints, homeownership could serve as a significant positive signal of stability and resources within the marriage market, thereby influencing family formation and subsequent fertility decisions. Concurrently, enhanced housing quality could contribute to improved maternal and child health, potentially reducing infant mortality and possibly miscarriages.

5 Conclusion

By exploiting randomized time-series variation in access to mortgage credit through a group-lending mechanism in Brazil (consórcios), we document that home-ownership has causal, significant, and persistent effects on fertility decisions. Consistent with the relaxation of housing adequacy constraints, individuals who win the consórcio lottery experience an increase in the probability of having children, as well as the number of children. The effects are stronger for households initially residing in areas with lower-quality housing. Individuals also exhibit upward neighborhood mobility and move to more desirable areas.

Our results indicate that the positive effect of access to housing on fertility is not merely a result of delayed childbearing. While individuals may postpone having children until they achieve home-ownership, biological constraints (the fact that fertility declines sharply with age past the age of 40) suggest that the observed increase in fertility is not simply a timing effect. Our estimates suggest that for an individual aged between 20-24, waiting ten additional years for housing would lead to a completed fertility rate that is half as large relative to obtaining housing immediately.

In conclusion, our study demonstrates the significant impact of access to housing on fertility decisions and underscores the importance of considering housing markets and policies in addressing demographic challenges. As policymakers and researchers continue to grapple with the complex interplay of factors influencing fertility rates, the insights provided by our paper offer valuable guidance for designing effective interventions and policies. By promoting access to affordable and adequate housing, supporting the provision of childcare and educational facilities, and leveraging market-based solutions to target credit to high-return populations, policymakers can create an enabling environment for family formation and mitigate the adverse consequences of declining fertility rates.

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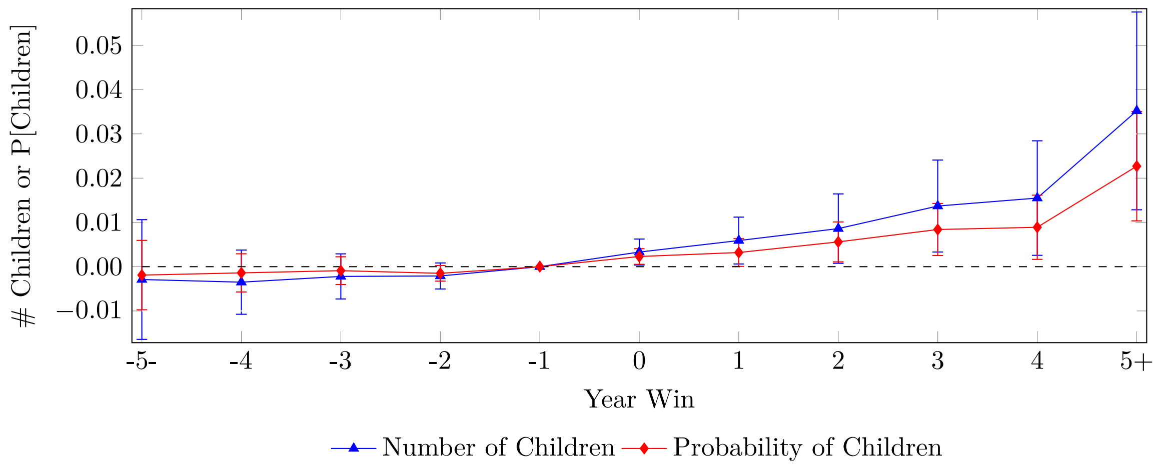
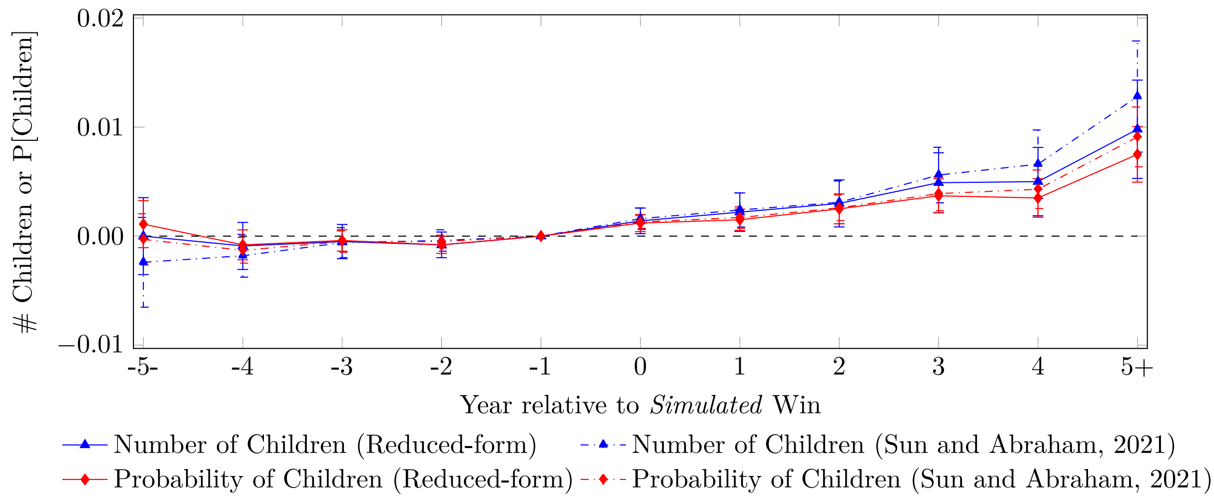
Figure 1: **Housing and Fertility**



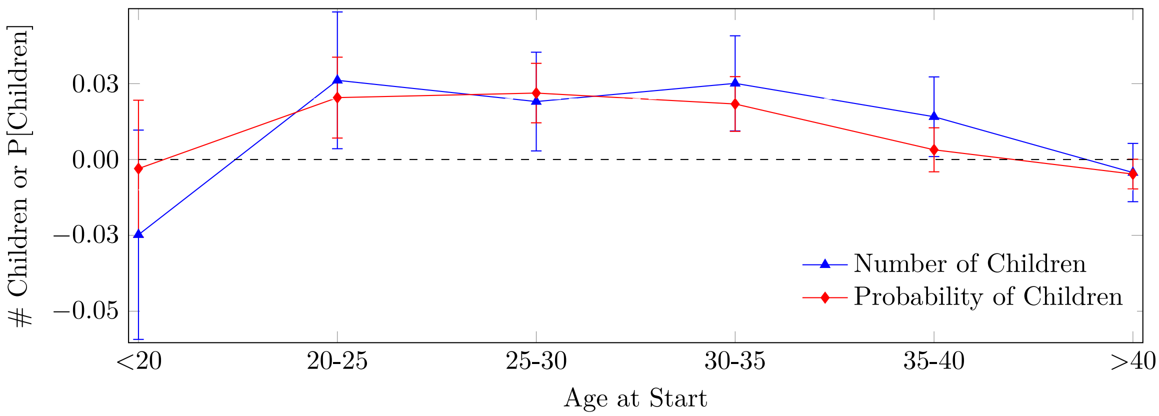
This figure depicts the dynamic treatment effects (with 95 percent confidence intervals) of winning a consórcio lottery the probability of having children (in red) and the number of children (in blue) in the housheold by year t, estimated using the 2SLS specification in equation (9). The x-axis shows years relative to the lottery win, with the omitted category being the year before the win (t = -1).

Figure 2: **Housing and Fertility: Heterogeneous Treatment Effects**



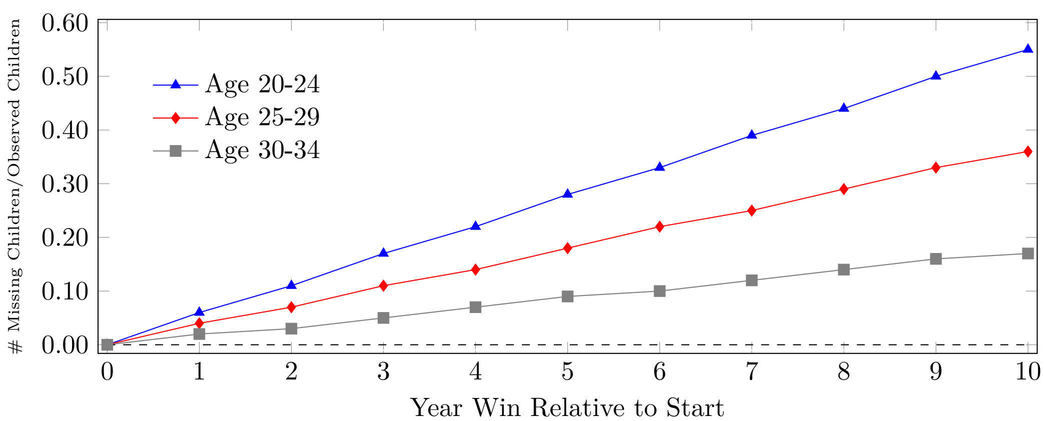
This figure depicts the reduced-form dynamic treatment effects (with 95 percent confidence intervals) of being predicted to win a consórcio lottery on the probability of having children (in red) and the number of children (in blue) in the household by year t, estimated using the equation (10). The x-axis shows years relative to the predicted lottery win, with the omitted category being the year before the predicted win (t = -1). Estimates with and without the methodology in Sun and Abraham (2021) are depicted as dashed and solid lines, respectively.

Figure 3: **Housing and Fertility: Age Effects**



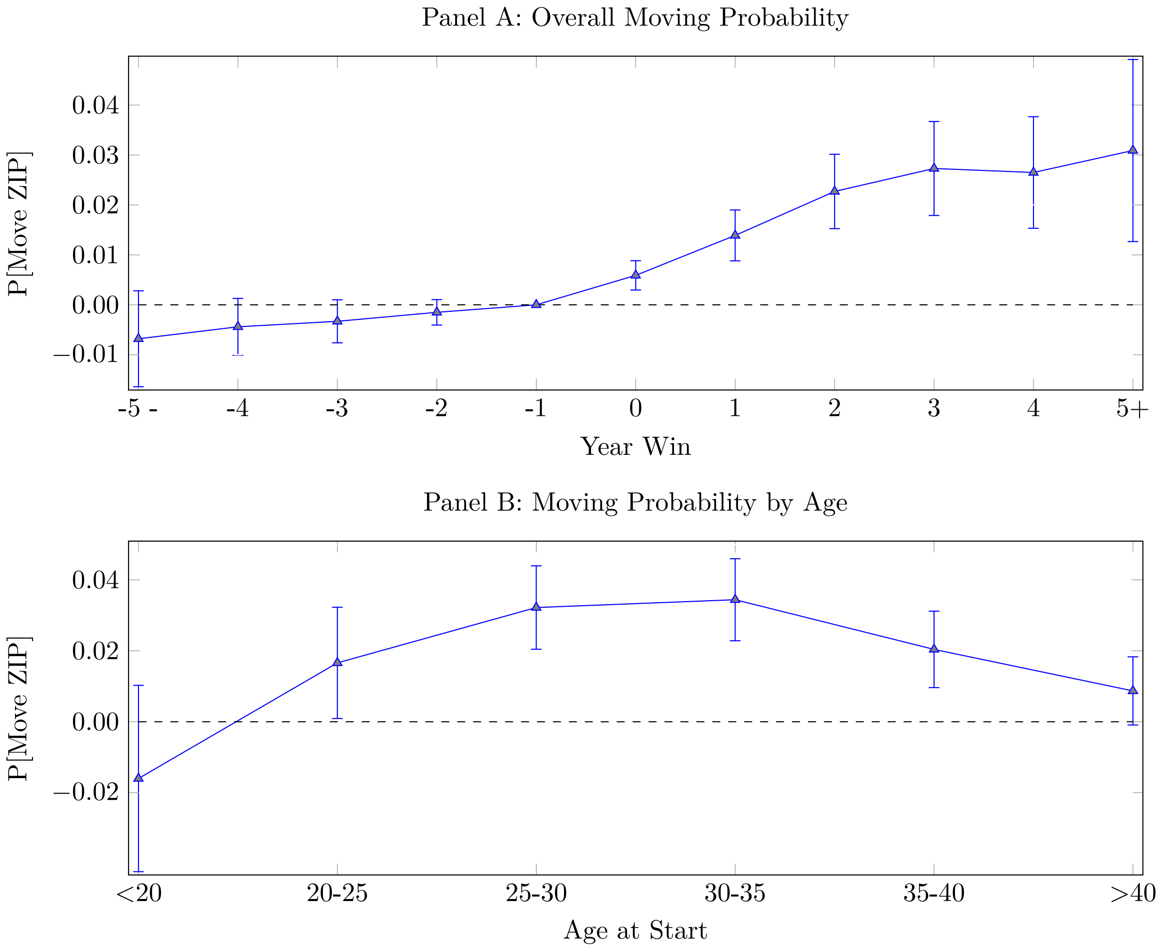
This figure depicts the dynamic treatment effects of winning a consórcio lottery on the probability of having children (in red) and the number of children (in blue) in the household by year t, estimated using the 2SLS specification in equation (8). The x-axis indicates the estimates for different cohorts of participants by age at the start of the consórcio. Participants below age 20 at the start of the group constitute 1% of the sample, 20-25-year-olds – 6%, 25-30-year-olds – 13%, 30-35-year-olds – 16%, 35-40-year-olds – 15%, and above age 40 – 49%. 95 percent confidence intervals are also plotted for each estimate. The table at the bottom depicts the mean values for each dependent variable by age group at the start of the group.

Figure 4: **Complete Fertility by Age Group**



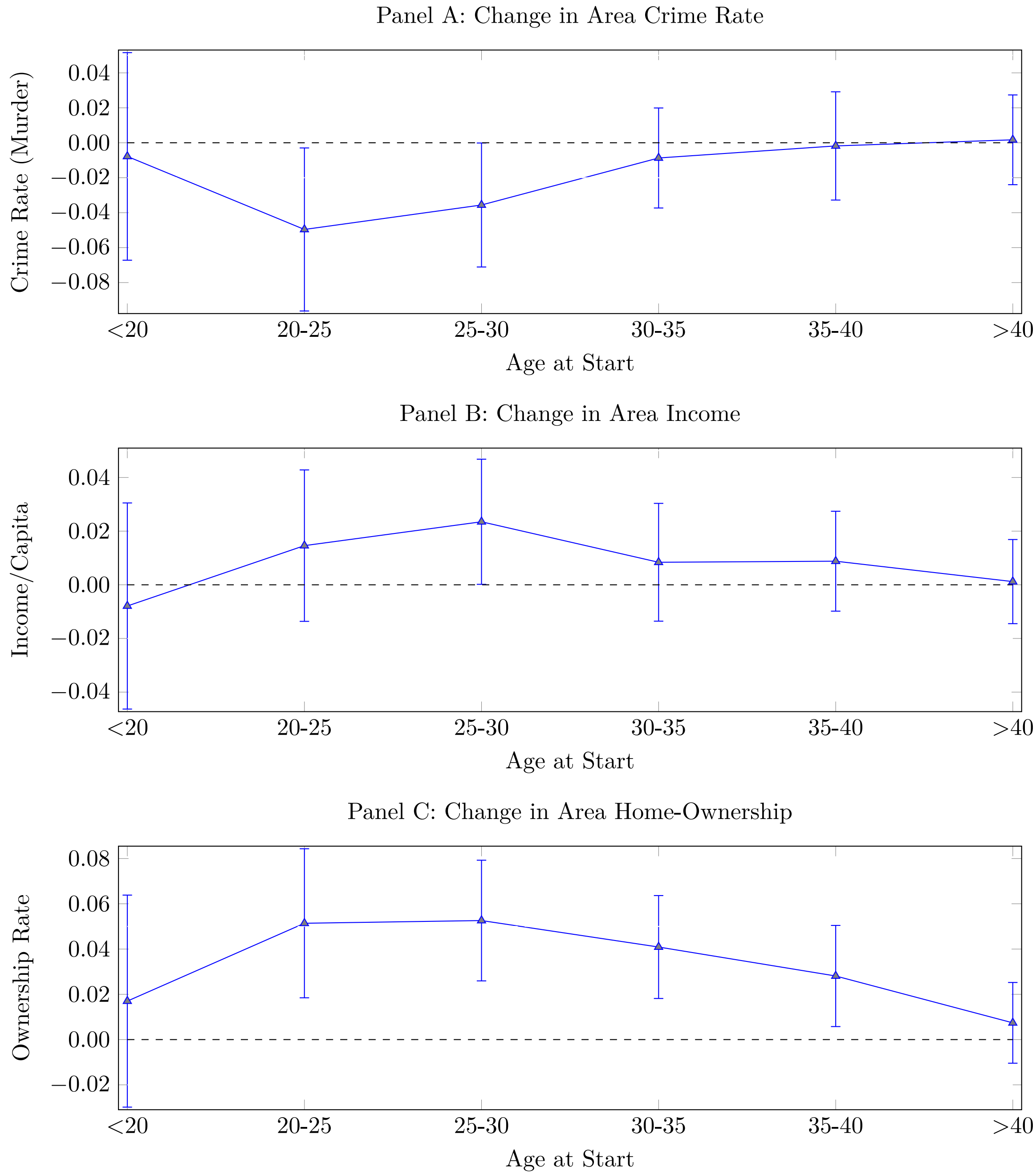
This figure illustrates the impact of delayed housing access on lifetime fertility for different age groups. The y-axis shows the ratio of missing children to observed children, while the x-axis represents the number of years between joining the consórcio and winning the housing lottery. Each line corresponds to a different age group at the time of joining the consórcio: 20-24-year-olds (blue with triangles), 25-29-year-olds (red with diamonds), and 30-34-year-olds (gray with squares).

Figure 5: **Housing and Neighborhoods Changes**



This figure depicts the dynamic treatment effects of winning a lottery on the probability of having moved ZIP code by year t. Panel (a) shows the event study estimates (with 95 percent confidence intervals) using the 2SLS specification in equation (8). The x-axis shows years relative to the lottery win, with the omitted category being the year before the win (t = -1). Panel (b) presents heterogeneous effects by age at the time of lottery participation, with 95 percent confidence intervals plotted for each estimate.

Figure 6: **Housing and Neighborhood Characteristics**



This figure depicts how lottery winners' destination ZIP codes differ from their origin locations, with heterogeneous effects by age at the start of the consorcio group. Panel (a) shows the change in murder rate per 1,000 ppl between origin and destination ZIP codes in SP state, sorted into quartiles; panel (b) shows the change in income per capita, and panel (c) shows the change in home-ownership rates. All estimates use the 2SLS specification in equation (8) and include 95 percent confidence intervals. The x-axis indicates age groups at the start of participation, and the dashed horizontal line at zero represents no change between origin and destination characteristics.

Table I: **Descriptive Statistics**

Panel A: Consórcios	Mean	Median	Std.	
Groups	3,040			
Members per group	50.38	52	29.39	
Duration (months)	154.41	144	39.59	
Number of individuals	153,155			
Panel B: Individual Characteristics (means)	**Consórcio**	**Working-Age**	**Mortgage**	**MCMV**
Formal Employment	0.22	0.37	0.94	-
Salary (R$)	2,480	1,715	2,098	907
Age	40.5	33.20	36.3	38.1
Male	0.67	0.51	0.55	-
P[Children]	0.26	0.49	0.39	0.28
N Children	0.44	1.06	0.69	0.61
Panel C: Local and Individual Characteristics	**Mean**	**Median**	**Std.**	
WoodWalls$_{zip}$	0.07	0.06	0.05	
ExpBrickWalls$_{zip}$	0.06	0.00	0.11	
Ppl/Bedroom$_{zip}$	1.54	1.50	0.21	
Rent/Income$_{zip}$	0.15	0.15	0.029	
ParticipantInc$_i$	10.91	10.95	1.18	
Benefits$_i$	0.05	0.00	0.21	
FemaleIncShare$_i$	0.26	0.00	0.41	

Panel A shows descriptive statistics on the number of consórcio groups, the number of members per group, and the duration of the groups. Panel B compares characteristics across: (1) consórcio participants, (2) general working-age population, (3) mortgage holders, and (4) participants of *Minha Casa Minha Vida* (MCMV), Brazil's subsidized housing program for low-income households. Panel C includes summary statistics of the variables used in our heterogeneous treatment effect tests.

Table II: **Random Access to Housing Credit and Fertility**

	I	II
Dep. Var.:	P$[Children]_{it}$	$Number$ $Children_{it}$
Mean:	0.30	0.52
Panel A: First Stage win_{it}		
$win\ sim_{it}$	0.3127***	
	(0.0042)	
Panel B: Reduced Form		
$win\ sim_{it}$	0.0036**	0.0051***
	(0.0009)	(0.0016)
R^2	0.92	0.94
Panel C: IV		
win_{it}	0.0115***	0.0164***
	(0.0029)	(0.0051)
R^2	0.92	0.94
F-stat	90.92	132.27
Observations	2,909,945	2,909,945
Group-Time FE	yes	yes
Individual FE	yes	yes
Clustered SE	group	group

This table presents the results from the first-stage estimation in equation (6) in Panel A, the reduced form estimation in equation (7) in Panel B, and the IV estimation in equation (8) in Panel C. The dependent variables indicate whether individual i's household has any children (column I) and how many children they have (column II) by year t. The variable win_{it} ($win\ sim_{it}$) equals one from the year an individual receives (is predicted to receive) credit for housing purchase and zero before. Standard errors, clustered at the group level, are reported in parentheses. The table also includes individual and group-time fixed effects. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table III: **Completed Fertility**

	I	II
Dep. Var.:	P$[Children]_i$	$Number$ $Children_i$
Mean:	0.30	0.52
$Age :< 20 \cdot year\ win_i$	-0.0055	-0.0175
	(0.0073)	(0.0124)
$Age : 20 - 24 \cdot year\ win_i$	-0.0120***	-0.0218***
	(0.0037)	(0.0073)
$Age : 25 - 29 \cdot year\ win_i$	-0.0110***	-0.0189***
	(0.0019)	(0.0038)
$Age : 30 - 34 \cdot year\ win_i$	-0.0061***	-0.0096***
	(0.0016)	(0.0032)
$Age : 35 - 39 \cdot year\ win_i$	-0.0012	0.0028
	(0.0017)	(0.0034)
R^2	0.07	0.06
F-stat	9.92	10.33
Observations	49,861	49,861
Group FE	yes	yes
Birth FE	yes	yes
Clustered SE	group	group

This table presents the results of estimating the completed fertility effect of winning a consórcio lottery by age group. The dependent variable in column I is a dummy variable indicating whether an individual i's household has children, and in column II is the total number of children individual i's household has by 2020, the final period in our sample. The variable $year\ win_i$ represents the number of years (since joining the group) an individual takes to win the credit lottery, interacted with age group dummies. Age groups are defined based on the individual's age at the start of the consórcio. Standard errors, clustered at the group level, are reported in parentheses. The table includes group and birth time fixed effects. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table IV: **Heterogenous Treatment Effects: Housing Characteristics**

	I	II	III	IV	V	VI
Dep. Var.:		P[$Children$]$_{it}$			$Number\ Children_{it}$	
Mean:		0.30			0.52	
win_{it}	0.0080**	0.0091***	0.0081	-0.0025	0.0120**	-0.0791***
	(0.0032)	(0.0031)	(0.0078)	(0.0058)	(0.0055)	(0.0138)
$win_{it} * WoodWalls_{zip}$	0.0499***			0.2891***		
	(0.0176)			(0.0328)		
$win_{it} * ExpBrickWalls_{zip}$		0.0365***			0.0774***	
		(0.0103)			(0.0179)	
$win_{it} * Ppl/Bedroom_{zip}$			0.0021			0.0626***
			(0.0047)			(0.0085)
R^2	0.92	0.92	0.92	0.94	0.94	0.94
Observations	2,603,209	2,603,209	2,603,209	2,603,209	2,603,209	2,603,209
Group-Time FE	yes	yes	yes	yes	yes	yes
Individual FE	yes	yes	yes	yes	yes	yes
Clustered SE	group	group	group	group	group	group

This table reports the results from estimating equation (8) using 2SLS, where the treatment variable win_{it} and its interactions with housing quality measures are instrumented using the predicted lottery win ($win\ sim_{it}$) and its interactions. The dependent variable is a dummy indicating whether individual i's household has children by year t in columns I to III, and the number of children individual i's household has by year t in columns IV to VI. Housing quality measures include the fraction of households with wood walls ($WoodWalls_{zip}$), exposed brick walls ($ExpBrickWalls_{zip}$), and the average number of people per bedroom ($Ppl/Bedroom_{zip}$) at the zip code level. Standard errors, clustered at the group level, are reported in parentheses.

Table V: **Heterogenous Treatment Effects: Rental Savings**

	I	II	III	IV
Dep. Var.:	P[$Children$]$_{it}$		$Number\ Children_{it}$	
Mean:	0.30		0.52	
win_{it}	0.0108***	0.0108***	0.0141***	0.0141***
	(0.0030)	(0.0030)	(0.0053)	(0.0053)
$win_{it} * Renter_i$	-0.0171	-0.0414	-0.0063	-0.0672
	(0.0109)	(0.0682)	(0.0213)	(0.1331)
$win_{it} * log(rent_i)$		0.0034		0.0085
		(0.0092)		(0.0178)
R^2	0.91	0.91	0.94	0.94
Observations	2,909,945	2,909,945	2,909,945	2,909,945
Group-Time FE	yes	yes	yes	yes
Individual FE	yes	yes	yes	yes
Renter-Time FE	yes	yes	yes	yes
Clustered SE	group	group	group	group

This table presents the results from estimating equation (8) using 2SLS, where the treatment variable win_{it} and its interactions with rental expense measures are instrumented using the predicted lottery win ($win\ sim_{it}$) and its interactions. The dependent variable is a dummy indicating whether individual i's household has children by year t in columns I and II, and the number of children individual i's household has by year t in columns III and IV. $Renter_i$ equals one if the individual paid rent prior to winning a credit lottery. $log(rent_i)$ equals the log of the pre-treatment rental payment for renters and 0 for non-renters. Standard errors, clustered at the group level, are reported in parentheses.

Table VI: **Heterogenous Treatment Effects: Household Income**

	I	II	III	IV	V	VI
Dep. Var.:		$P[Children]_{it}$			$Number\ Children_{it}$	
Mean:		0.30			0.52	
win_{it}	0.1451***	0.0206	0.0113***	0.2507***	0.0983***	0.0144***
	(0.0171)	(0.0130)	(0.0029)	(0.0301)	(0.0240)	(0.0051)
$win_{it} * ParticipantInc_i$	-0.0126***			-0.0226***		
	(0.0015)			(0.0026)		
$win_{it} * HouseholdInc_i$		-0.0007			-0.0084***	
		(0.0012)			(0.0021)	
$win_{it} * Benefits_i$			0.0036			0.0406***
			(0.0045)			(0.0091)
R^2	0.89	0.91	0.92	0.94	0.94	0.94
Observations	1,164,491	1,572,193	2,603,209	1,164,491	1,572,193	2,603,209
Group-Time FE	yes	yes	yes	yes	yes	yes
Individual FE	yes	yes	yes	yes	yes	yes
Clustered SE	group	group	group	group	group	group

This table reports the results from estimating equation (8) using 2SLS, where the treatment variable win_{it} and its interactions with income measures are instrumented using the predicted lottery win ($win\ sim_{it}$) and its interactions. The dependent variable is a dummy indicating whether individual i's household has children by year t in columns I to III, and the number of children individual i's household has by year t in columns IV to VI. Income measures include the participant's income ($ParticipantInc_i$), household income ($HouseholdInc_i$), and a dummy for receiving government benefits ($Benefits_i$), all measured in the year before obtaining credit. Standard errors, clustered at the group level, are reported in parentheses.

Table VII: **Heterogenous Treatment Effects: Female Income Share**

	I	II
Dep. Var.:	$P[Children]_{it}$	$Number\ Children_{it}$
Mean:	0.30	0.52
win_{it}	0.0150***	0.0256***
	(0.0043)	(0.0075)
$win_{it} * FemaleIncShare_i$	-0.0056*	-0.0544***
	(0.0029)	(0.0049)
R^2	0.92	0.94
Observations	1,572,193	1,572,193
Group-Time FE	yes	yes
Individual FE	yes	yes
Clustered SE	group	group

This table presents the results from estimating equation (8) using 2SLS, where the treatment variable win_{it} and its interaction with the female income share are instrumented using the predicted lottery win ($win\ sim_{it}$) and its interaction. The dependent variable is a dummy indicating whether individual i's household has children by year t in column I, and the number of children individual i's household has by year t in column II. $FemaleIncShare_i$ represents the share of household income earned by the female partner measured before obtaining credit. Standard errors, clustered at the group level, are reported in parentheses.

Online Appendix: Housing and Fertility

<u>*For Online Publication Only*</u>

Bernardus van Doornik Dimas Fazio Tarun Ramadorai Jānis Skrastiņš

Online Appendix A: Extended Derivations

We start by solving the optimization model delineated in Section 2. The problem of the household is given by:

$$\max\ u(c,n,h,e) = log(c) + \beta \cdot log(h) + \delta \cdot log(n) + \delta\gamma \cdot log(e+\theta)$$
$$\text{s.t.:}$$
$$c + (p_h + r)\cdot h + p \cdot e \cdot n \leq (1-\phi n)w$$
$$\frac{h}{n} \geq q$$
$$c, n, h, e \geq 0$$

In this model, the household derives utility from consumption (c), quality-adjusted housing (h), the number of children (n), and children's human capital via education (e). $\beta, \delta > 0$ are parameters that represent how much households value housing and children, respectively. Child human capital is produced through parental investments in education per child, which raise children's human capital according to the investment technology $(\theta + e)^\gamma$, where γ captures the return to education investments and θ represents the intrinsic human capital children have without any parental investment. The parent earns a market wage w, and raising each child takes a fixed amount of time, ϕ. The price of education investment e is given by p, which can be thought of as a teacher's wage. The price of housing is p_h, which can be understood as the cost of utilities and maintenance. The term r represents rental costs for households that rent their housing. The parent's budget constraint, normalized to a time endowment of one, is determined by their wage, the time cost of raising children, and the cost of education investment. In addition to the budget constraint, we introduce a housing adequacy constraint, which ensures adequate housing per child based on the housing characteristics. In this constraint, q represents the housing adequacy parameter that varies with family-friendliness of the housing.

Before proving the propositions in Section 2, we first solve for the optimal c^*, n^*, h^*, e^*.

Proposition A.1: For binding housing adequacy constraints, optimal c, n, h, and e are given by:

$$c^\star = \frac{w}{1+\delta+\beta} \tag{A1}$$

$$e^\star = \frac{w\phi\gamma + \gamma p_h q - (1+\frac{\beta}{\delta})p\theta}{p(1-\gamma+\frac{\beta}{\delta})} \tag{A2}$$

$$n^\star = \frac{\delta}{1+\delta+\beta}\frac{(1-\gamma+\frac{\beta}{\delta})}{\left(\phi - \frac{p}{w}\theta + \frac{p_h}{w}q\right)} \tag{A3}$$

$$h^\star = q\frac{\delta}{1+\delta+\beta}\frac{(1-\gamma+\frac{\beta}{\delta})}{\left(\phi - \frac{p}{w}\theta + \frac{p_h}{w}q\right)} \tag{A4}$$

Proof: The Lagrangean of the household problem is given by:

$$\begin{aligned} \mathcal{L} &= log(c) + \beta \cdot log(h) + \delta \cdot log(n) + \delta\gamma \cdot log(e+\theta) \\ &+ \lambda \left[w(1-\phi n) - p_h h - c - pen\right] + \nu(h - qn) + \mu e \end{aligned}$$

Assuming an interior solution ($\mu = 0$) with the housing adequacy constraint binding ($\nu > 0$), we have the following first-order conditions

$$\frac{\partial \mathcal{L}}{\partial c} : \boxed{\frac{1}{c} = \lambda} \tag{A5}$$

$$\frac{\partial \mathcal{L}}{\partial e} : \boxed{\frac{\delta\gamma}{\theta + e} = \lambda pn} \tag{A6}$$

$$\frac{\partial \mathcal{L}}{\partial n} : \boxed{\frac{\delta}{n} = \lambda(w\phi + pe) + \nu q} \tag{A7}$$

$$\frac{\partial \mathcal{L}}{\partial h} : \boxed{\frac{\beta}{h} = \lambda(p_h + r) - \nu} \tag{A8}$$

Using the housing adequacy constraint with equality ($h = qn$), and combining the FOCs, we can derive the optimal solutions.

From equations (A7) and (A8), using $h = qn$:

$$\frac{\delta}{n} = \lambda(w\phi + pe) + \nu q$$

$$\frac{\beta}{qn} = \lambda(p_h + r) - \nu$$

$$\frac{\delta + \beta}{n} = \lambda(w\phi + pe + p_h q + rq)$$

Dividing the equation above by (A6):

$$\begin{aligned}
\frac{(\delta+\beta)}{\delta\gamma/(\theta+e)} &= \frac{(w\phi + pe + p_h q + rq)}{p} \\
(\delta+\beta)p(\theta+e) &= \delta\gamma(w\phi + pe + p_h q + rq) \\
(\delta+\beta-\delta\gamma)pe &= \delta\gamma(w\phi + (p_h + r)q) - (\delta - \beta)p\theta
\end{aligned}$$

Rearranging:

$$\Rightarrow \boxed{e^\star = \frac{w\phi\gamma + \gamma(p_h + r)q - (1 + \frac{\beta}{\delta})p\theta}{p(1 - \gamma + \frac{\beta}{\delta})}} \tag{A9}$$

From equations (A5) and (A6), we obtain a formula for consumption as a function of n and e:

$$c = \frac{pn(\theta + e)}{\delta\gamma} \tag{A10}$$

Using this formula in the budget constraint, together with equation (A9), leads, with some rearrangement of terms, to:

$$
\begin{aligned}
w(1-\phi n) &= c + pen + (p_h + r)h \\
\delta\gamma w(1-\phi n) &= pn\theta + pen(1+\delta\gamma) + \delta\gamma(p_h + r)qn \\
\delta\gamma w(1-\phi n) &= pn\theta + n\left[\frac{w\phi\gamma + \gamma(p_h+r)q - (1+\frac{\beta}{\delta})p\theta}{(1-\gamma+\frac{\beta}{\delta})}\right](1+\delta\gamma) + \delta\gamma(p_h+r)qn
\end{aligned}
$$

$$
\begin{aligned}
\delta w(1-\gamma+\frac{\beta}{\delta}) - w\phi n(1+\delta+\beta) &= -pn\theta\,(1+\delta+\beta) + (p_h+r)qn(1+\delta+\beta) \\
\delta w(1-\gamma+\frac{\beta}{\delta}) &= n(1+\delta+\beta)\,(w\phi - p\theta + (p_h+r)q)
\end{aligned}
$$

Thus:

$$
\boxed{n^\star = \frac{\delta}{1+\delta+\beta}\frac{(1-\gamma+\frac{\beta}{\delta})}{\left(\phi - \frac{p}{w}\theta + \frac{1}{w}(p_h+r)q\right)}} \tag{A11}
$$

Replacing $n^\star$ and $e^\star$ in equation (A10) leads to:

$$
\boxed{c^\star = \frac{w}{1+\delta+\beta}} \tag{A12}
$$

Finally, $h^\star$ is:

$$
\begin{aligned}
h^\star &= qn^\star \\
&= q\frac{\delta}{1+\delta+\beta}\frac{(1-\gamma+\frac{\beta}{\delta})}{\left(\phi - \frac{p}{w}\theta + \frac{p_h+r}{w}q\right)} \\
\Rightarrow &\boxed{h^\star = q\frac{\delta}{1+\delta+\beta}\frac{(1-\gamma+\frac{\beta}{\delta})}{\left(\phi - \frac{p}{w}\theta + \frac{p_h+r}{w}q\right)}} \qquad \text{(A13)}
\end{aligned}
$$

□

Online Appendix A.1: Propositions

Proposition 1. Improved housing efficiency increases the optimal number of children n^* of the household, that is $\frac{dn^*}{dq} < 0$.

Proof: From the solution of the optimal number of children $n^\star$ given in equation (A11), it is easy to see that:

$$\frac{\partial n^\star}{\partial q} = -\frac{(p_h + r)}{w} \cdot \frac{\delta}{1+\beta+\delta} \cdot \frac{(1-\gamma+\frac{\beta}{\delta})}{(\phi - \frac{p}{w}\cdot\theta + \frac{(p_h+r)q}{w})^2} < 0 \tag{A14}$$

□

Therefore, with lower q, $n^\star$ rises. Intuitively, more family-friendly housing designs (lower housing adequacy requirements per child) make it easier for households to accommodate larger families within the same housing space.

Proposition 2. For renting households, lower rental costs increase the optimal number of children n^*, that is $\frac{dn^*}{dr} < 0$.

Proof: From the solution of the optimal number of children $n^\star$ given in equation (A11), for households that rent their housing (r $>$ 0), we have:

$$\frac{\partial n^\star}{\partial r} = -\frac{q}{w} \cdot \frac{\delta}{1+\beta+\delta} \cdot \frac{(1-\gamma+\frac{\beta}{\delta})}{(\phi - \frac{p}{w}\cdot\theta + \frac{(p_h+r)q}{w})^2} < 0 \tag{A15}$$

□

Therefore, lower rental costs r increase $n^\star$ for renting households. Intuitively, reduced rental expenses relax the household budget constraint, enabling families to afford adequate housing for more children. Note that for homeowners, $r = 0$ and this effect operates through changes in homeownership costs p_h instead.

Proposition 3. The effects of improved housing access on fertility decrease with household income.

Proof: From the solution of the optimal number of children $n^\star$ given in equation (A11), we can calculate the cross-partial derivative with respect to $(p_h + r)$ and w:

$$\frac{\partial^2 n^\star}{\partial(p_h+r)\partial w} = \frac{\delta(1-\gamma+\frac{\beta}{\delta})q}{(1+\beta+\delta)w^2} \cdot \frac{2w\phi - p\theta + \frac{(p_h+r)q}{w}}{(\phi - \frac{p\theta}{w} + \frac{(p_h+r)q}{w})^3}$$

Since the numerator $2w\phi - p\theta + \frac{(p_h+r)q}{w} > \phi - \frac{p\theta}{w} + \frac{(p_h+r)q}{w} > 0$ (from the second-order condition), we have $\frac{\partial^2 n^\star}{\partial(p_h+r)\partial w} > 0$.

Similarly, for the housing adequacy parameter:

$$\frac{\partial^2 n^\star}{\partial q \partial w} = \frac{\delta(1-\gamma+\frac{\beta}{\delta})(p_h+r)}{(1+\beta+\delta)w^2} \cdot \frac{2w\phi - p\theta + \frac{(p_h+r)q}{w}}{(\phi - \frac{p\theta}{w} + \frac{(p_h+r)q}{w})^3} > 0$$

Since both cross-partial derivatives are positive, this means that $\frac{\partial n^\star}{\partial(p_h+r)}$ becomes less negative and $\frac{\partial n^\star}{\partial q}$ becomes less negative as w increases. Therefore, the effects of improved housing access (lower p_h+r or lower q) on fertility are attenuated for households with higher income levels. □

Proposition 4. When child-rearing responsibilities fall primarily on women, the effect of improving housing efficiency on fertility decreases as the female income share in the household increases.

Proof: Assuming that child-rearing responsibilities fall primarily on women, and that women's contribution to total household wage income is a fraction $k \in [0,1]$, the household's budget constraint becomes $c + (p_h + r) \cdot h + p \cdot e \cdot n \leq (1 - \phi \cdot n \cdot k) \cdot w$.

With the new budget constraint, the optimal number of children $n^\star$ is given by:

$$n^\star = \frac{\delta}{1+\delta+\beta} \cdot \frac{1-\gamma+\frac{\beta}{\delta}}{(k \cdot \phi - \frac{p}{w} \cdot \theta + \frac{(p_h+r)q}{w})}, \tag{A16}$$

which makes the partial derivative of $n^\star$ with respect to q be:

$$\frac{\partial n^\star}{\partial q} = -\frac{(p_h+r)}{w} \cdot \frac{\delta}{1+\delta+\beta} \cdot \frac{1-\gamma+\frac{\beta}{\delta}}{(k\phi - \frac{p}{w} \cdot \theta + \frac{(p_h+r)q}{w})^2} < 0 \tag{A17}$$

To show that an increase in the fraction of female income in the household k reduces the effect of improved housing efficiency on the number of optimal children, we take the cross-partial derivative with respect to k:

$$\frac{\partial^2 n^\star}{\partial q \partial k} = \frac{2 \cdot \phi \cdot (p_h+r)}{w^2} \cdot \frac{\delta}{1+\delta+\beta} \cdot \frac{1-\gamma+\frac{\beta}{\delta}}{(k \cdot \phi - \frac{p}{w} \cdot \theta + \frac{(p_h+r)q}{w})^3} > 0 \tag{A18}$$

□

Since the cross-partial derivative is positive, this means that $\frac{\partial n^\star}{\partial q}$ becomes less negative (closer to zero) as k increases. Therefore, higher female income share reduces the sensitivity of fertility to housing efficiency improvements.

Economic Interpretation: When women bear the primary child-rearing responsibility, a higher female income share increases the household's opportunity cost of having children. This reduces the fertility boost from improved housing efficiency despite the relaxed housing adequacy constraint. Intuitively, even when housing becomes more family-friendly (lower q), high-earning women face greater income loss from raising additional children, dampening the fertility response to housing improvements.

Online Appendix B: Model Extentions

Online Appendix B.1: Financial Income

Let us modify our model to explicitly account for different income sources:

$$Y = w \cdot L + r_A \cdot A$$

where Y is total income, w is the wage rate, L is labor supply, r_A is the return on assets, and A is the value of assets.

The budget constraint becomes:

$$c + p_h \cdot h + p \cdot e \cdot n \leq w \cdot (1 - \phi \cdot n) + r_A \cdot A$$

The optimal number of children now depends on both labor and passive income:

$$n^* = \frac{\delta}{1 + \delta + \beta} \cdot \frac{1 - \gamma + \frac{\beta}{\delta}}{(\phi - \frac{p}{w}\theta + \frac{1}{w}(p_h + r)q - \frac{r_A \cdot A}{w})}, \tag{B19}$$

This result reveals that the presence of financial assets ($A > 0$) increases the optimal number of children relative to the basic model where $A = 0$. The term $-r_A A/w$ in the denominator effectively reduces the opportunity cost of child-rearing, as it represents income that is not compromised by time allocated to children. Consequently, this extension of the model predicts that households with higher levels of passive income may opt for larger families.

Online Appendix B.2: Paid Childcare

This appendix extends our basic model to incorporate the option of paid childcare, which may be more accessible to high-income households.

We introduce the level of childcare effectively paid by the family as $\chi \in [0, \overline{\chi}]$ with $\overline{\chi} \leq 1$. The effective opportunity cost of child-rearing becomes:

$$\phi = (1 - \chi)\phi'$$

Here, ϕ' is defined as the opportunity cost of child-rearing when $\chi = 0$. As χ increases, the effective time cost ϕ decreases. The budget constraint is now given by:

$$c + p_h h + pen + p_\chi \chi n \leq (1 - (1 - \chi)\phi' n)w$$

With this budget constraint, the optimal number of children is now given by:

$$n^\star = \frac{\delta}{1 + \delta + \beta} \frac{(1 - \gamma + \frac{\beta}{\delta})}{\left(\phi' - \frac{p}{w}\theta + \frac{1}{w}(p_h + r)q + \left(\frac{p_\chi}{w} - \phi'\right)\chi\right)}$$

Note that n^* is negatively related to the price of childcare (p_χ). Moreover, n^* is positively related to the levels of childcare for $p_\chi < w\phi'$.

From the first order condition with respect to childcare χ, we find that:

$$p_\chi = \phi' w$$

This is a "knife's edge" condition. Under this condition with equality, χ^* can take any value from $[0, \overline{\chi}]$. If childcare costs (p_χ) are higher than the opportunity cost in monetary terms ($\phi' w$), then families would choose not to take any childcare ($\chi = 0$), and we would return to our original case (see Propositions 1 and 2). If childcare is less expensive than the opportunity cost, families would choose to maximize childcare services and set it to the maximum ($\overline{\chi}$). This would slightly change Propositions 1 and 2 of the paper as now

While this extension captures the option of paid childcare, it does not fundamentally alter our overall conclusions. The key relationships between income, fertility, and housing decisions remain consistent. Our model still shows how opportunity costs and resource allocation influence family choices, although the magnitude of some effects might be moderated by the use of paid childcare.

We note that since we do not have data on childcare costs for the families in our sample, we are not able to empirically test this model extension. Nevertheless, this theoretical exercise provides additional insight into how the availability of paid childcare might interact with our main findings.

Online Appendix B.3: Comparative Policy Analysis: Housing vs. Other Interventions

This appendix extends our model to compare the effects of housing policies on fertility with other potential interventions, specifically childcare subsidies and education cost increases.

Online Appendix B.3.1: Housing vs. Childcare Subsidies

We extend our model by defining the opportunity cost of child-rearing as $\phi = (1 - \chi)\phi'$, where χ represents the level of subsidized childcare. We then compare the partial derivatives of n^* with respect to p_h/s and χ:

$$\frac{\partial n^*}{\partial q} = -\frac{p_h + r}{w} \cdot \frac{\delta}{1+\beta+\delta} \cdot \frac{(1-\gamma+\frac{\beta}{\delta})}{(\phi - \frac{p}{w}\cdot\theta + \frac{1}{w}\cdot(p_h+r)\cdot q)^2}$$

$$\frac{\partial n^*}{\partial \chi} = \phi' \cdot \frac{\delta}{1+\beta+\delta} \cdot \frac{(1-\gamma+\frac{\beta}{\delta})}{(\phi - \frac{p}{w}\cdot\theta + \frac{1}{w}\cdot(p_h+r)\cdot q)^2}$$

The relative effect of housing costs to childcare subsidies is:

$$\left|\frac{\frac{\partial n^*}{\partial q}}{\frac{\partial n^*}{\partial \chi}}\right| = \frac{p_h + r}{\phi' \cdot w}$$

This result suggests that when $\phi' \cdot w < p_h + r$ (i.e., when households' intrinsic opportunity cost is low), the effect of reducing housing costs on fertility is stronger than that of increasing the availability of free childcare. This finding implies that in contexts where wages are relatively low, policies aimed at reducing housing costs or improving housing quality might be more effective in increasing fertility rates compared to policies focused on reducing childcare costs or other opportunity costs of child-rearing.

Online Appendix B.3.2: Housing vs. Education Cost Increases

We next compare the effects of housing costs and education costs on fertility. A similar policy was evaluated by Kim, Tertilt, and Yum (2024) that find that a tax on education increases fertility rates in Korea.

Let us first revisit the partial derivatives of n^* with respect to p_h/s and p:

$$\frac{\partial n^*}{\partial q} = -\frac{p_h + r}{w} \cdot \frac{\delta}{1+\beta+\delta} \cdot \frac{(1-\gamma+\frac{\beta}{\delta})}{(\phi - \frac{p}{w}\cdot\theta + \frac{1}{w}\cdot(p_h+r)\cdot q)^2}$$

$$\frac{\partial n^*}{\partial p} = \frac{\theta}{w} \cdot \frac{\delta}{1+\beta+\delta} \cdot \frac{(1-\gamma+\frac{\beta}{\delta})}{(\phi - \frac{p}{w}\cdot\theta + \frac{1}{w}\cdot(p_h+r)\cdot q)^2}$$

The relative effect of housing costs to education costs is:

$$\left|\frac{\frac{\partial n^*}{\partial (p_h/s)}}{\frac{\partial n^*}{\partial p}}\right| = \frac{p_h + r}{\theta}$$

This ratio suggests that when $\theta > p_h + r$, changes in education costs have a larger impact on fertility than equivalent changes in housing costs, and vice versa when $\theta < p_h + r$. This comparison suggests that the relative effectiveness of housing policies versus education policies in promoting fertility may depend on the level of intrinsic human capital (θ) in the population. In contexts where θ is low, policies targeting housing costs might be more effective, while in contexts with high θ, focusing on increasing education costs could yield better results.

These theoretical extensions offer intriguing insights into the comparative effects of different policy interventions on fertility rates. While our current study focuses primarily on housing interventions, for which we have robust empirical evidence, these extensions highlight potential avenues for future research. A comprehensive empirical analysis comparing the effects of housing policies, childcare subsidies, and education costs on fertility would require additional data beyond the scope of our current study. Such research could provide valuable guidance for policymakers seeking to address declining fertility rates through various interventions. We appreciate the thoughtful feedback that inspired these extensions, as it not only enhances our understanding of the complex factors influencing fertility decisions but also opens up promising directions for future investigations in this important area.

Online Appendix C: Credit Allocation in Consórcio Groups

In this section, we provide an example of an algorithm to illustrate the credit allocation procedure in consórcio groups and the implementation of our instrumental variable (IV) strategy.

Online Appendix C.1: Algorithm: Example

Each week, five five-digit numbers are drawn in Brazil's national lottery. While there are a large number of different algorithms used by different administrators, they all share the key feature that each participant has the same unconditional probability of winning the lottery at the start of the group.

The algorithm that we use for the example in this section uses the first of the five-digit numbers from the national lottery to determine the allocation of credit. The number is divided by the number of participants in the group and then the remainder is multiplied by the number of participants. For example, if the first five-digit number from the national lottery is 10084 and there are 250 participants in the group, the remainder from dividing 10084 by 250 is 0.336, which multiplied by 250 is 84. Thus, credit would be allocated to the participant with ticket number 84.[38]

If the individual with ticket number 84 has already been awarded credit in a previous round, the algorithm simply adds one to the initial result. In our example, this means that credit would be allocated to the holder of ticket number 85. If this participant has also been awarded credit before, the algorithm subtracts one from the initial result, which in our case would imply that ticket number 83 is awarded credit. The algorithm continues to add and

[38] If the remainder is zero, credit goes to the highest ticket number.

subtract two, then three, and so on, relative to the initial result, until a ticket number is selected that has not been awarded credit before.

Online Appendix C.2: Simulated Allocation

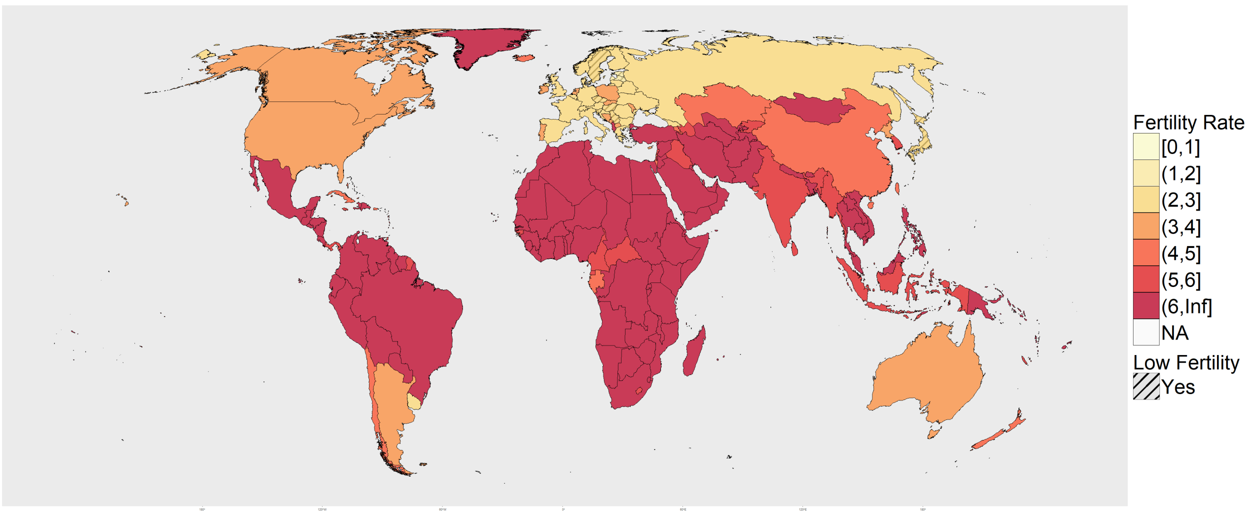
The majority of consórcio groups combine credit allocation through lotteries and auctions. The allocation of credit through auctions is a threat to our empirical analysis since, unlike for lotteries, the outcome of auctions is not random and is potentially endogenous with respect to fertility outcomes. For example, individuals with higher unobserved wealth or tighter family connections who are also potentially planning to have more children may be more likely to submit higher bids and therefore obtain credit for real estate purchases earlier. This source of endogeneity is not eliminated by limiting attention to lottery winners. Over time, individuals who obtain credit through auctions disappear from the pool of potential lottery winners. If auction winners systematically differ on important characteristics, the control group of non-winners is depleted of individuals with better labor market opportunities over time. This could lead to a bias in estimating the effect of obtaining credit for real estate purchases on fertility outcomes.

As a consequence, we resort to an instrumental variable strategy that simulates the allocation of credit in each consórcio group *as if* all credit is allocated through lotteries. To do so, we combine data on the outcome of the national lottery with data on the ticket numbers of all consórcio group participants and the algorithm used by a given group. This procedure allows us to simulate the allocation of credit within groups, as if only lotteries but no auctions were held. We restrict our analysis to groups for which we have information on the algorithm that they use.

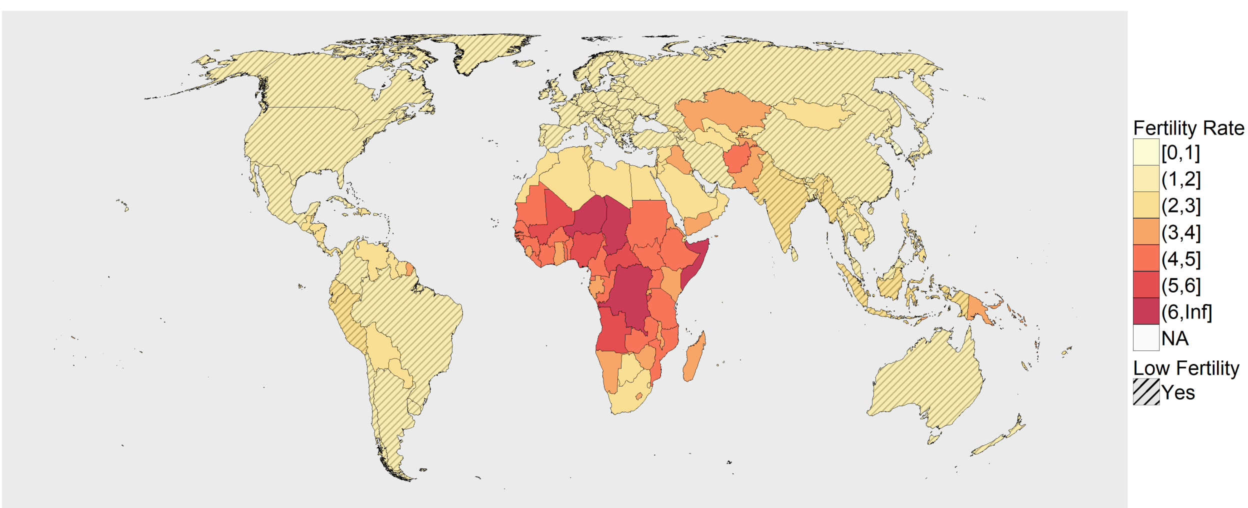
Next, we illustrate this procedure using a fictional example. Suppose that a group has 200 members and allocates credit to two members every period, one through a lottery and one through an auction. Suppose that in the first period the lottery winner is ticket number 25 and the auction winner is ticket number 60. In the next period, the lottery is won by ticket number 30 and the auction is won by ticket number 80. In the third period, the algorithm determines ticket number 60 as the winner of the lottery. However, since ticket number 60 obtained credit through the auction in the first period, the ultimate lottery winner in the real group is ticket 61. Hence, the presence of auctions has altered the order in which credit is allocated compared to an allocation based purely on lotteries. Instead, in the simulated group, the lottery winner would be ticket number 60, as the outcomes of auctions are ignored.

Thus, for the first three periods our instrument from the simulated lotteries would predict the lottery winners to be ticket numbers 25, 30, and 60, since these are the numbers that would have won the lottery if the group did not hold auctions. We simulate all lotteries for each group from the first to the last period and predict lottery winners through this procedure, which avoids distortions in the timing of lottery winners due to the presence of auctions.

Online Appendix D: Additional Tables and Figures



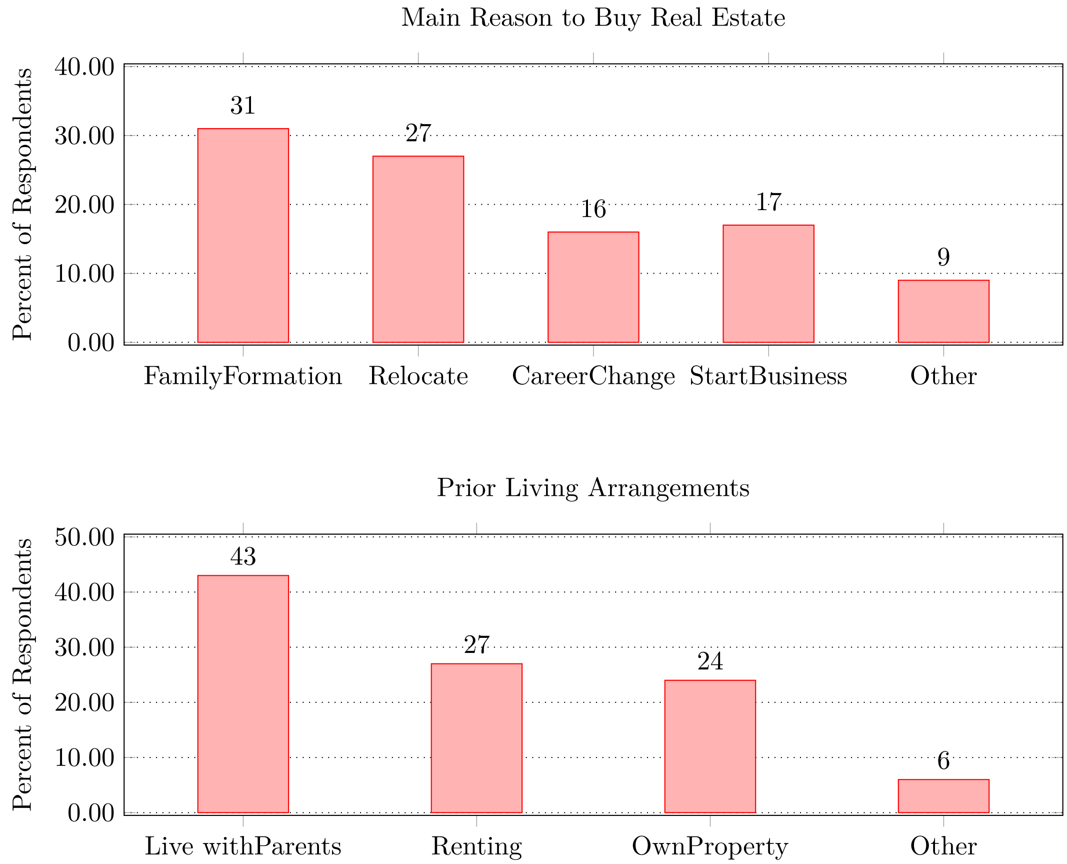
(a) Panel A: Fertility Rate in 1960



(b) Panel B: Fertility Rate in 2021

Figure A.1: This figure shows a map of the fertility rate worldwide in 1960 (Panel A) and 2021 (Panel B). This graph was taken from Our World In Data and the data source is Gapminder. Low fertility means the area has a fertility rate below the replacement rate of 2.1 children per woman. For more information, see `https://ourworldindata.org/fertility-rate`.

Figure A.2: **Survey Evidence**



This figure shows data from ABAC's 2024 internal survey of real estate consórcio participants aged 20-35 in Brazil. The top panel shows reasons for property purchase. The bottom panel displays living arrangements prior to obtaining housing via the consórcio. Sample includes all survey respondents who participated in real estate consortia.

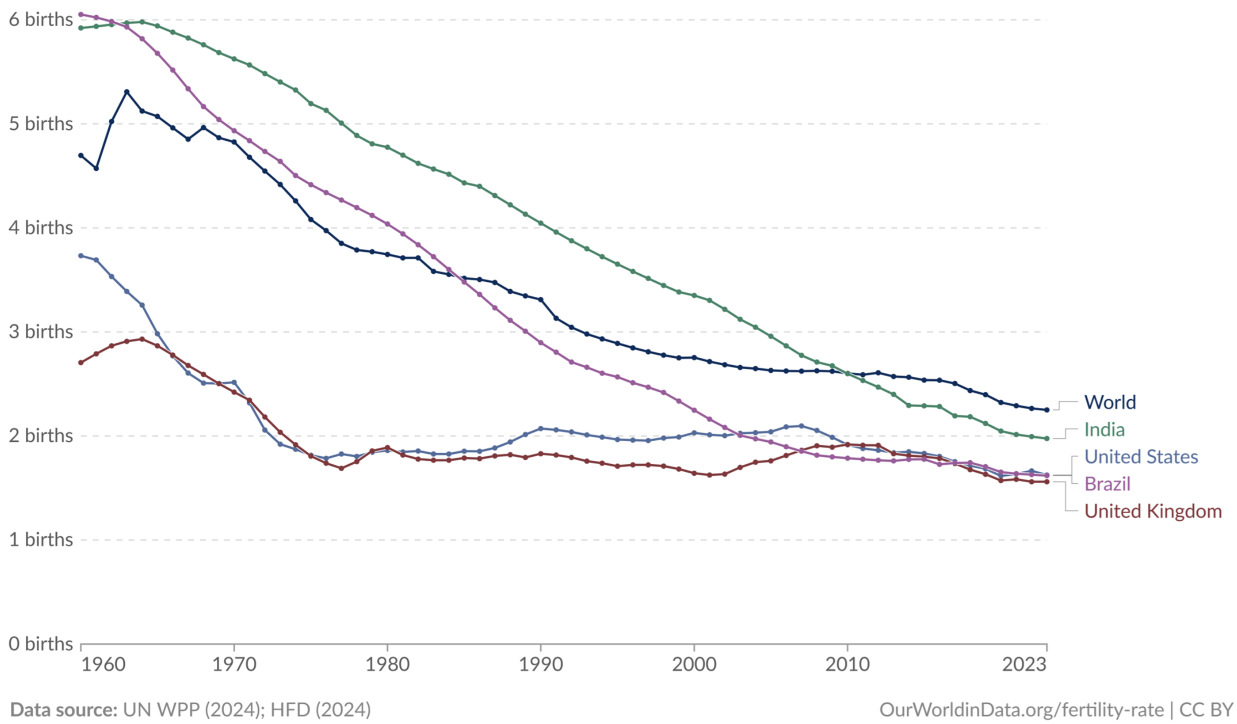
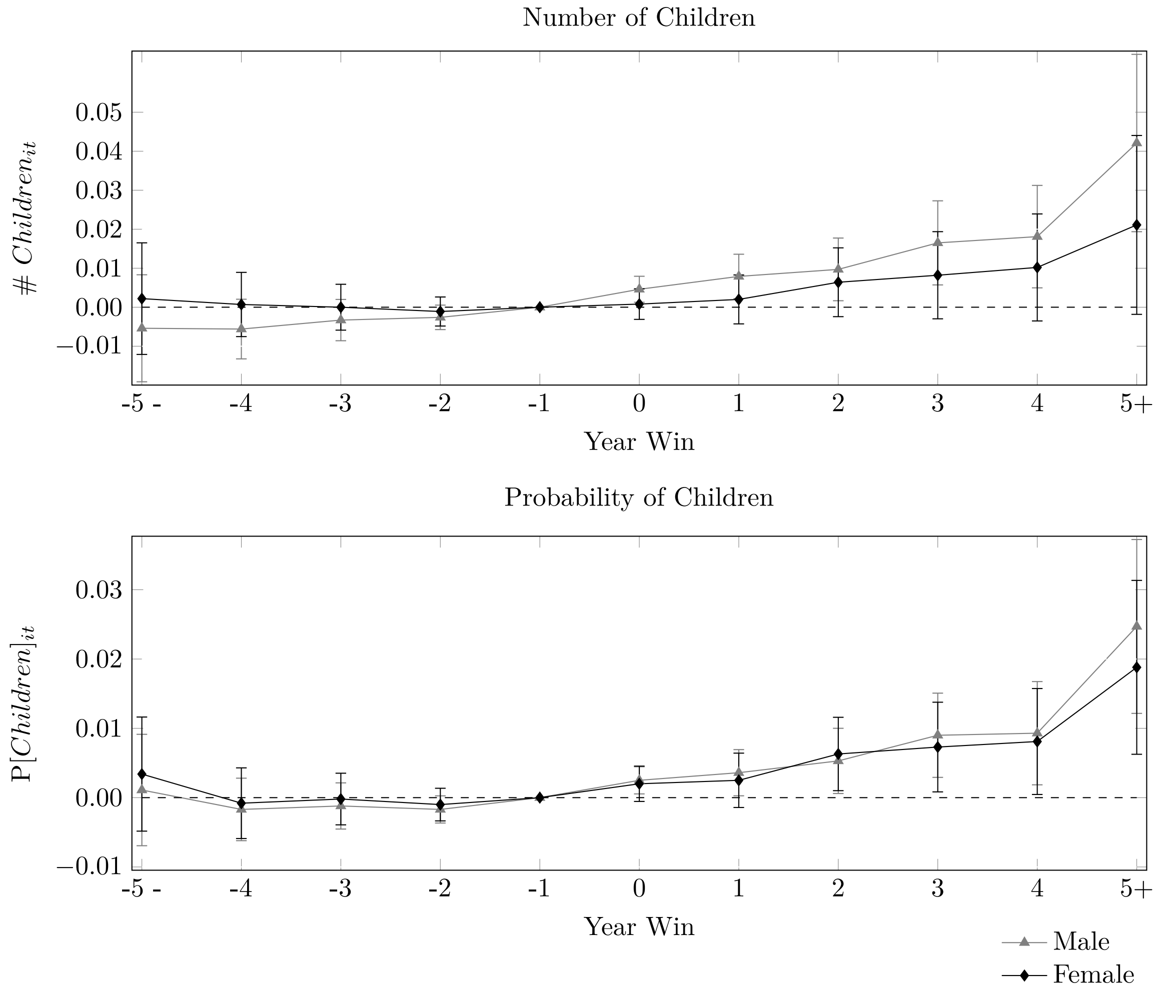


Figure A.3: This figure shows the total fertility rate across countries between 1960 and 2023. This graph was taken from Our World In Data and the data source is United Nations. For more information, see `https://ourworldindata.org/fertility-rate`.

Figure A.4: **Housing and Fertility: Gender Effects**



This figure depicts the dynamic treatment effects (with 95 perecent confidence intervals) of winning a consórcio lottery on the number of children (in the top panel) and the probability of having children (in the bottom panel) by year t, estimated using the 2SLS specification in equation (9). The x-axis shows years relative to the lottery win, with the omitted category being the year before the win (t = -1). Estimates for male participants are in gray, and for female participants in black.

Table A.1: **Variable Definitions**

Variable	Definition (Source)
Formal Employment Share	Share of individuals with formal employment contracts (RAIS)
Salary	Salary of individuals in formal employment contracts (RAIS)
Age	Age of individuals (Receita Federal)
Male	Categorical variable equal to 1 for male and 0 for female individuals (Receita Federal)
P[Children]$_{it}$	Dummy variable equal to 1 if individual i's household has at least one child by year t and 0, otherwise (Receita Federal)
Number Children$_{it}$	Number of children of individual i's household by year t (Receita Federal)
win$_{it}$	Categorical variable equal to 1 for those that win the consórcio and 0 otherwise (Consórcio)
win sim$_{it}$	Categorical variable equal to 1 for those that win the lottery and 0 otherwise (Consórcio)
WoodWalls$_{zip}$	Proportion of households with wood walls per zip code (Brazilian Census)
ExpBrickWalls$_{zip}$	Proportion of households with exposed brick walls per zip code (Brazilian Census)
Ppl/Bedroom$_{zip}$	Average number of people per bedroom in a household per zip code (Brazilian Census)
Rent/Income$_{zip}$	Ratio between rent expenses and income per zip code (Brazilian Census)
ParticipantInc$_i$	Participant's income (RAIS)
HouseholdInc$_i$	Household's income (RAIS)
Benefits$_i$	Categorical variable equal to 1 if receives social benefits, and 0 otherwise (Cadastro Unico)
FemaleIncShare$_i$	Female income share in the household (RAIS and Receita)

Table A.2: **Heterogeneous Treatment Effects: Housing and Demographics**

	I	II
Dep. Var.:	$\text{P}[Children]_{it}$	$Number\ Children_{it}$
win_{it}	0.1492***	0.1746***
	(0.0232)	(0.0397)
$win_{it} \cdot Ppl/Bedroom_{zip}$	0.0021	0.0566***
	(0.0080)	(0.0134)
$win_{it} \cdot Renter_i$	0.0038	0.0029
	(0.0240)	(0.0392)
$win_{it} \cdot ParticipantInc_i$	-0.0131***	-0.0225***
	(0.0016)	(0.0028)
$win_{it} \cdot FemaleIncShare_i$	-0.0179***	-0.0552***
	(0.0034)	(0.0055)
R^2	0.88	0.92
Observations	1,055,127	1,055,127
Group-Time FE	yes	yes
Individual FE	yes	yes
Renter-Time FE	yes	yes
Clustered SE	group	group

This table reports the results from estimating the effects of lottery wins on child-related outcomes, considering housing characteristics and demographics. The dependent variable is $\text{P}[Children]_{it}$ (probability of individual i's household having children by year t) in column I, and $Number\ Children_{it}$ (number of children of individual i's household by year t) in column II. Treatment variables include the main effect (win_{it}) and its interactions with the average number of people per bedroom ($Ppl/Bedroom_{zip}$) at the zip code level, whether the individual paid rent prior to winning a credit lottery ($Renter_i$), the participant's income measured in the year before obtaining credit ($ParticipantInc_i$), and the share of household income earned by the female partner measured before obtaining credit ($FemaleIncShare_i$). Standard errors, clustered at the group level, are reported in parentheses. The table includes individual and group-time fixed effects. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.