Escaping Violent Death: Access to Credit and Female Mortality*

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Abstract

This paper assess the link between access to credit for investment in individual mobility and mortality. Exploiting random variation in access to credit dedicated to investment in a motorcycle through credit lotteries in a sample of about one million individuals, we find that access to credit decreases mortality rates by 4.1 percent. This effect is driven by women, who experience an 18 percent decline in mortality. Female mortality mainly declines as a result of fewer fatal assaults during evening hours in both public spaces and domestic settings. This is consistent with individual mobility allowing women to avoid dangerous public spaces and evade domestic violence.

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"Violence against women is a global public health problem of epidemic proportions, affecting hundreds of millions of women and requiring urgent action."

— World Health Organization (2021)

1 Introduction

The World Health Organization estimates that violent death is one of the top three causes of death for individuals between 15 and 60 years of age in 2019 (World Health Organization, 2020), explaining about 20 percent of deaths. Globally, one in three women experiences violence during their lifetime (World Health Organization, 2021), reaching up to 76% in Ethiopia and Peru (Garcia-Moreno et al., 2005). Violence against women has significant short-, medium- and long-term effects on the physical and mental well-being of women, children and families, and serious socio-economic consequences (Carlson, 2000; Huth-Bocks, Levendosky, and Semel, 2001; Campbell, 2002; Koenen et al., 2003; Aizer, 2011; Devries et al., 2013; Carrell and Hoekstra, 2010). While numerous policies, such as extra policing and better education (Ellsberg et al., 2015; Jewkes, Flood, and Lang, 2015; Michau et al., 2015), have been put in place to reduce violence against women, there is a lack of understanding of the underlying social conditions and economic frictions that cause violent deaths of women (García-Moreno et al., 2015; Angelucci and Heath, 2020; Blair and Jassal, 2022).

In this paper, we assess the role of access to credit dedicated to investment in individual mobility in affecting mortality. Access to credit for investment in individual mobility may affect mortality through multiple channels, for example, access to individual mobility can improve economic outcomes (Doornik et al., 2024) or increase female empowerment in household and social settings (Manser and Brown, 1980; McElroy and Horney, 1981; Tauchen, Witte, and Long, 1991; Dugan, Nagin, and Rosenfeld, 1999; Pollak, 2005; Aizer, 2010; Bertrand, Kamenica, and Pan, 2015; Buller et al., 2018). In addition, it may enable individuals to evade exposure to violent crime by avoiding dangerous public spaces.

Identifying how access to credit for investment in individual mobility affects mortality is challenging. Access to credit results from endogenous decisions, which depend on characteristics that may be correlated with other relevant variables. For example, unobservable characteristics such as economic opportunities and physical or mental health may jointly determine access to credit and mortality. To overcome these challenges, we exploit data on participants in a group-lending mechanism in Brazil, Consorcio, which generates random time-series variation in access to credit tied to the purchase of a motorcycle through credit lotteries. Consorcios are a wide spread group-lending mechanism to finance durable goods

in Brazil with more than 6.7m participants in a given year. We focus on motorcycle groups, which typically comprise credit-constrained individuals seeking to invest in individual mobility.[1] Every month, participants in a consorcio group make identical contributions, which are then allocated to a subset of participants as credit designated for motorcycle purchase. Recipients of credit are determined through lotteries and auctions. When allocating credit through lotteries, consorcios 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 continue their contributions until everybody has been awarded credit.

Our empirical design builds on Doornik et al. (2024) who also exploit time-series variation in access to credit through credit lotteries in consorcios. We exploit the random timing of access to credit dedicated to motorcycle purchase 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 (group-time fixed effects).[2] This design controls for selection by and into a particular group. Moreover, the fact that participants in a consorcio group do not share social ties and do not live in geographic proximity mitigates concerns about multiplier or other general equilibrium effects that may differentially affect treated and untreated individuals (Cai and Szeidl, Forthcomming; Breza and Kinnan, 2021).

Most groups allocate credit through lotteries and auctions. The choice to participate in auctions could be related to other variables that affect mortality. To resolve potential endogeneity concerns related to auctions, we implement an instrumental variable strategy. The contractual design of consorcios, combined with our data, allow us to simulate all groups *as if* all credit were allocated through lotteries. Specifically, since we know the algorithm that a 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 the actual lottery winners (see Section 4.2 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 first assess how access to credit dedicated to investment in mobility affects mortality. We observe a decrease in mortality by 0.65 deaths per 1,000 people (4.1 percent relative to the mean) after individuals obtain credit for investment in a motorcycle relative to participants in the same group who did not yet obtain credit. When we separately estimate the effect

[1] One-third of motorcycles in Brazil are sold through consorcios (ABAC, 2017). From 2009 to 2016, more than 10 million individuals (6.6 percent of working-age population) participated in a motorcycle consorcio.

[2] 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, 2024; de Chaisemartin and D'Haultfoeuille, 2020; Goldsmith-Pinkham, Hull, and Kolesar, 2022).

for men and women, we find that the decline in mortality following access to credit is driven by women for whom the decline in mortality is 18 percent. We observe no pre-treatment trends in mortality before winning a credit lottery for either gender. In addition, we find that half of the decline in mortality for women occurs immediately after obtaining credit for investment in a motorcycle with an additional decline in mortality in the long-run from four years or more after obtaining credit.

To understand the channels through which access to credit for investment in individual mobility affects mortality, we examine the circumstances of all deaths. While female mortality declines due to both external and internal causes, the reduction in mortality from external causes is stronger. Among external causes, a decline in fatal assaults is the primary explanation for the decline in mortality for women after gaining access to credit. In particular, we observe a strong decline in female mortality from assaults in public spaces in the evening hours. We also observe a somewhat smaller decline in female mortality from assault at home, also in the evening hours. In terms of internal causes, we find that access to credit reduces female deaths from respiratory diseases. Interestingly, when we split up the results by causes of death, we observe effects for men as well. Specifically, we observe a decline in mortality from assault at home in the evening hours. However, these benefits in terms of reduced mortality for men are offset by an increase in mortality from traffic accidents involving motorcycles.

These results allow us to narrow down the potential channels through which access to credit for investment in individual mobility may affect mortality. The decline in fatal assaults against women in public spaces is consistent with access to a motorcycle allowing women to avoid dangerous spaces, including public transportation. Using public transportation exposes riders, especially women, to elevated risk of robbery or assault in Brazil (U.S. Department of State, 2024; Moreira and Ceccato, 2021). Even if a woman is exposed to the same public space, such as a dangerous road or neighborhood, she may be less exposed to assault risk as a motorcycle rider than as a cyclist or pedestrian. The decline in mortality from assault at home for both genders could be related to the fact that access to individual mobility can improve household income (Doornik et al., 2024). Higher household income has been linked to less domestic violence due to a relaxed budget constraint (Buller et al., 2018) or female empowerment within households (Manser and Brown, 1980; Pollak, 2005).[3] In addition, access to individual mobility may simply allow an individual to escape conflict.

The drop in mortality from respiratory diseases could be explained by lower exposure to spaces in which respiratory diseases spread most easily, such as crowded public transporta-

[3]Another potential channel could be that gaining access to a motorcycle allows individuals to move to safer areas. However, we do not find any evidence of individuals becoming more likely to move to a new address following access to a motorcycle.

tion (Xu, Connell McCluskey, and Cressman, 2013; Guo et al., 2023). Gaining access to a motorcycle as an alternative mode of transportation allows individuals to reduce exposure to such spaces. Higher income and mobility may also have general positive health effects by giving individuals access to better nutrition or better health-care (e.g., better doctors or broader geographic reach).

The increase in mortality from traffic accidents after gaining access to credit for investment in a motorcycle for men is consistent with motorcycles being a dangerous and vulnerable mode of transportation (Constant and Lagarde, 2010) and men taking more risk when riding a motorcycle than women. The increase in fatal traffic accidents offsets the decline in mortality through other channels leading to a net zero effect of access to credit for investment in a motorcycle on male mortality.

Our findings relate to a growing literature in medicine, economics, and sociology, which examines the determinants of assaults and domestic violence, especially against women, which is pervasive and more prevalent in developing countries (Anderson and Ray, 2010; Doepke, Tertilt, and Voena, 2012; Jayachandran, 2015, 2021).[4] Examples include the interplay between domestic violence and female bargaining power within a household (Aizer, 2010; Anderberg et al., 2015; Hidrobo, Peterman, and Heise, 2016; Haushofer et al., 2019), households' financial condition (Angelucci, 2008; Bobonis, González-Brenes, and Castro, 2013; Heath, Hidrobo, and Roy, 2020; Sanin, 2023; Bhalotra et al., 2024), policing (Miller and Segal, 2019; Sukhtankar, Kruks-Wisner, and Mangla, 2022), emotional cues (Card and Dahl, 2011), extractive violence and male backlash (Bloch and Rao, 2002; Luke and Munshi, 2011; Heath, 2014), and violence against women at work (Adams-Prassl et al., 2023). Our findings suggest that access to individual mobility allows women to mitigate their exposure to assault risk in both public sand domestic settings as well as to infectious diseases.

Our paper also relates to the literature on the effects of access to credit by highlighting the importance of credit constraints as a factor limiting women's ability to evade violent death. While Pronyk et al. (2006) find that credit in combination with vocational and gender education leads to a decline in domestic violence, they cannot differentiate between the effect of education and credit. While credit and transfer programs typically target women based on the view that they are more likely to be credit constrained than men (Pitt and Khandker, 1998), randomized-control trials across a diverse set of settings and countries document modest or no effects of extending credit to low-income households on various economic outcomes (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

[4]Excellent survey papers include Heise, Garcia-Moreno et al. (2002), Jewkes (2002), Capaldi et al. (2012), Devries et al. (2013), Gibbs, Jacobson, and Kerr Wilson (2017), and Buller et al. (2018).

et al., 2024), including intimate partner violence (Hashemi, Schuler, and Riley, 1996; Schuler et al., 1996; Hadi, 2000; Koenig et al., 2003; Ahmed, 2005; Pronyk et al., 2006; Bajracharya and Amin, 2013; Gibbs, Jacobson, and Wilson, 2017). Our results suggest that facilitating women's access to credit for investment in individual mobility has important implications for reducing female mortality. To the best of our knowledge, our paper provides the first evidence on the importance of credit constraints as an important impediment for reducing (violent) death.

The insights from our analysis also relate to the literature examining economic implications of individual mobility. Heise and Porzio (2022) suggest that removing spatial frictions in Germany leads to aggregate productivity gains. Doornik et al. (2024) find that both the extensive margin effects (employment rates) and the intensive margin effects (salaries) of mitigating mobility constraints are economically large, and individuals with access to individual mobility earn significantly higher salaries. In addition, Bryan, Chowdhury, and Mobarak (2014) find positive consumption effects of cash grants for migration. These insight are supported by recent evidence in Banerjee, Duflo, and Sharma (2021) that persistent long-term effects on labor income from a cash grant program in West Bengal are tied to migration to more distant urban centers.

2 Institutional Design

In this section, we describe consorcios, how they allocate credit, show descriptive statistics for motorcycle consorcios in Brazil, and provide a brief overview of physical violence statistics against women in Brazil.

2.1 Consorcios

This section provides a detailed description of consorcio groups and the way they allocate credit designated for the purchase of durable goods.

Basic Features

Consorcios are a financial product in which participants pool funds to save towards the purchase of durable goods. Consorcio groups are typically administered by the finance division of a manufacturer who provides the good, a bank, or a specialty finance company. The administrator is in charge of marketing the consorcio, selecting participants, managing payments, and enforcing contracts. The administrator is compensated for these services through an administrative fee levied on all participants. Screening of applicants is virtually

non-existent and it is easy for anyone with a social security number in Brazil to sign up and participate. Prospective participants are provided with several pieces of information when selecting a group. They know the identity of the administrator, the price of the good, the number of months for which the group will operate, and the target number of participants. All participants contribute identical pre-determined payments at regular intervals, typically monthly. These payments are adjusted for inflation. The monthly payments also cover the administrative fee and establish a guarantee fund that covers losses from defaults of individual participants.[5] All participants are required to continue their monthly contributions, including those who have received credit from the group. The group continues until all participants have received credit. Due to the organization of the group through a central and independent administrator, personal connections between consorcio participants are uncommon and participants in the same group are not known to each other. Enforcement relies on physical collateral generated by the durable good purchased through the group.

Credit Allocation

All participants start out as savers making equal contributions to the group. Every month some participants receive credit from the group. Which members receive credit in a given month is decided using two mechanisms: lotteries and auctions. The relative numbers of lotteries and auctions vary by group. By law, at least one good has to be allocated by lottery each period.

Lotteries are based on the national lottery in Brazil, which is broadcast on TV. Each participant receives a ticket number at the start of the group. Based on an algorithm, which is contractually 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 each participant has the same unconditional probability of winning the lottery at any point in time. A detailed description of an algorithm is provided in Appendix A.1.

In credit auctions, participants bid a fraction of the total value of the good. Rather than a higher aggregate payment, bids move payments forward, akin to making a higher down payment on the loan given by the group. Future contributions are adjusted accordingly. For example, if the value of a good is $5,000 with monthly contributions of $100 and a participant bids 40 percent, they would pay $2,000 immediately and would cease making monthly payments 20 months before the end of the group.

[5] In most groups a fraction of the payments is used to insure the good against damage to preserve its value as collateral.

Defaults

After obtaining credit from either a lottery or an auction, the good is purchased and becomes the property of the group. The good serves as physical collateral and can be seized if payments are late.[6] Participants cannot sell the good to somebody else without the approval of the administrator to ensure that the good is not transferred to somebody who is a high credit risk to the group. If a participant defaults before receiving credit, their past payments are retained by the group until they win a lottery. Once they win a lottery, their funds are released instead of credit being allocated. However, defaulted participants receive only a fraction of their previous payments since default carries a contractually specified penalty of, on average, about 40 percent of the payments for motorcycle groups.[7]

Due to this contractual design, defaults of participants before receiving credit do not affect the required payments of other participants. However, defaults after receiving credit impose costs on the group if the collateral value of the good is not sufficient to recover the full amount of credit that is owed to the group. The resulting losses are first covered by the guarantee fund, which is designed to be sufficiently generous to make a collapse of the group highly unlikely. If losses exceed the capacity of the guarantee fund, administrators usually absorb the losses. In practice, losses from defaults virtually never exceed the capacity of the guarantee fund. At the termination date of the group, any remaining funds in the reserve fund are split equally and repaid to the participants.

Aggregate Statistics

Consorcios are widespread in Brazil. In 2015, consorcios had 6,705,673 participants, and about half of them were in motorcycle consorcios. The 3,407,678 motorcycle consorcio participants are equivalent to 2.25 percent of the working age population or 6.82 percent of formally employed individuals in Brazil. 444,636 individuals, or 0.29 percent of the working-age population obtained a motorcycle through a consorcio group in 2015 alone.

The average motorcycle value across all groups is USD 2,837. Average monthly payments amount to about 3 percent of the value of the motorcycle. These payments cover the costs of the motorcycle, an average administrative fee of 16.84 percent of the value of the motorcycle, and a guarantee fund to cover losses. The average duration of a consorcio group is 48.4 months. The share of motorcycles allocated through lotteries is 36.71 percent with the rest allocated through auctions. Consistent with consorcio groups not relying on social ties among participants, the average group comprises 284 participants from 153 different municipalities

[6] Consorcios register all collateral under the fiduciary lien (Alienação fiduciária) which allows for out of court settlement in the event of default. As a result, collateral can be recovered quickly.

[7] For details, see Doornik et al. (2023).

in 17 different states (out of 27). Thus, on average fewer than two participants in the same group are from a given municipality.

Not all participants obtain a motorcycle. 23 percent of participants exit the group before they obtain credit due to missed payments. Participants who exit before obtaining a motorcycle have their payments returned after a deduction of an average penalty of 40 percent. An additional 16.42 percent of participants default after receiving credit, in which case the motorcycle may be seized by the group to cover outstanding payments. If the liquidation value of the motorcycle is higher than the outstanding payments, non-defaulted participants keep the difference.

2.2 Physical Violence against Women in Brazil

In Brazil, every 14 seconds a women falls victim to physical violence (Fórum Brasileiro de Segurança Pública, 2023b) and about 40% of women have experienced physical violence against them in their lifetime (Garcia-Moreno et al., 2005). 73.7% of assaults are conducted either by their former or current partner. Only 54% of assaults are done at victims' homes. In addition, 46.7% of women have ever experienced a sexual assault and 28.9% report being psychologically abused (Fórum Brasileiro de Segurança Pública, 2023b). 64% of women in Brazil believe that Brazil is a very sexist country (Instituto de Pesquisa DataSenado, 2023).

According to data from the World Health Organization (WHO),[8] in 2019 Brazil was ranked 25th by the number of women killed relative to the population, in a ranking of 183 countries. There are 5.8 homicides of women per 100,000 people. For comparison, the U.S. ranks 86th with 2.2 female homicides per 100,000 people. The homicide rate is higher for women aged 18 to 44 years (72%), and among non-white women with kids (Fórum Brasileiro de Segurança Pública, 2023a).[9] 84% of female homicide victims knew their attacker with more than half of the killings carried out with the use of a bladed weapon (Fórum Brasileiro de Segurança Pública, 2023a).

3 Data

The data for this paper comes from two main sources. Data on consorcios is from the Sistema de Administração de Grupos/Cotas de Consorcio (SAG) database, which is maintained by the Banco Central do Brasil (BCB). Information on deaths is from the publicly available mortality information system (Sistema de Informações sobre Mortalidade) from the Ministry

[8] https://apps.who.int/gho/data/view.main.VIOLENCEHOMICIDEv

[9] https://www.ipea.gov.br/atlasviolencia/arquivos/artigos/9350-223443riatlasdaviolencia2023-final.pdf

of Health.[10] 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 consorcios provides information on the administrator, participants, the good being allocated, and the dates when credit is awarded to participants. The BCB has been collecting data on all consorcio groups since October 15, 2008, including consorcios that started earlier, but were still ongoing. The earliest starting date of a consorcio group in our sample is January 2006 and the sample ends in December 2020. For our empirical analysis, information about the algorithms through which consorcio groups translate the national lottery draw into a number that matches the ticket number of a participant is required. This information is not readily available in the database. We hand-collect data from as many administrators as possible and verify the algorithms in the data.

The data for the causes of death provide detailed information on the nature of the death according to the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10).[11] The database provides detailed information for both internal and external causes. It also includes such information as the location of death, whether medical assistance was provided, whether an autopsy was performed, and who reported the death. We match the mortality data with the administrative population registry on the date of birth, the date of death, gender, and the deceased person's municipality of residence. This results in about 87 percent unique matches. We omit the causes of death for the observations that do not result in a unique match. Consistent with the sample period for consorcios, we use data for the period from 2003 to 2020.

The final sample for our analysis comprises all groups for which we can collect the algorithm used to translate the national lottery number into a number that matches the ticket number of a participant, and our algorithm correctly predicts at least one lottery winner. Our sample comprises all lottery winners for each of these groups. Table 1 provides descriptive statistics for our sample. Panel A provides descriptive statistics for consorcio groups and Panel B for participants. The data contains 15,339 consorcio groups that allocate motorcycles through auctions and random lotteries between 2006 and 2020. The sample of members of these groups who win a lottery leaves us with an average group size of 62 participants, with a median of 49 participants. Thus, the total number of participants our sample is 948,155. The average group lasts for 44 months, with a median of 39 months.

The average annual propensity to die across all participants in motorcycle consorcios is 0.08%. This compares to an average annual death rate of 0.06% in the working-age pop-

[10]The data can be downloaded at `https://opendatasus.saude.gov.br/dataset/sistema-de-informacao-sobre-mortalidade-sim-1979-a-2019`.

[11]`https://icd.who.int/browse10/2019/en`

ulation. During the whole sample period about 1.6% of consorcio participants die. About two-thirds of deaths are explained by internal causes and a third by external causes. The average annual propensity to die from external and internal causes are 0.04% and 0.03%, respectively. When split by gender, about 1 percent of female and 2 percent of male participants die during the sample. The annual propensity for a female and male participant to die are 0.05% and 0.1%. 44% of participants have a formal job with average monthly income of BRL 1,271 (around 400 USD). This compares to an average salary of BRL 1,715 in the working-age population. The average consorcio participant is similar to the average person in the population along many characteristics, such as the propensity to own a business or the industries they are employed in. Notable differences include gender, with consorcio participants being about twenty percentage points more likely to be male.

4 Empirical Analysis

This section presents our empirical analysis to assess the effects of access to credit for investment in individual mobility on mortality.

4.1 Consorcios

Exploiting time-series variation in credit allocation in consorcios implies the following specification to assess the relationship between access to credit for investment in individual mobility and mortality

$$Death_{it} = \alpha_i + \alpha_{gt} + \beta \cdot win_{it} + \epsilon_{it}, \quad (1)$$

where i denotes individuals, g denotes consorcio groups, and t denotes time. $Death_{it}$ is a dummy variable that takes the value of zero if an individual is alive and one in the year they die. The dummy variable win_{it} takes the value of one for individuals who obtain credit through a 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 thereby controls for sample composition effects. Group-time fixed effects (α_{gt}) control for selection by and into a specific group.

As described in Section 2.1, 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 have not obtained credit through auctions, which may reflect characteristics correlated with mortality risk. As a result, endogenous selection into the lottery pool over time could

bias the estimate of β in equation (1).

4.2 Instrument

To overcome the selection problem, we apply the instrumental variable approach in Doornik et al. (2024). Our data on participants' ticket numbers and historical national lottery numbers enables us to simulate credit allocation as if there were no auctions. This allows us to identify which participants would have received credit in a given month if a group allocated all credit though lotteries without selection into the lottery pool over time. For each group, we translate national lottery numbers into ticket numbers based on the group's algorithm. Thus, we obtain the schedule of credit allocation as if all credit were allocated through lotteries. Due to the presence of auctions in real-world groups, the instrument is not perfectly correlated with winning a lottery. For example, an individual predicted to win the lottery may have replaced a previous auction winner in a different period.

We begin our analysis by documenting that the simulated lotteries are a strong predictor of obtaining credit by estimating the following first-stage

$$win_{it} \quad = \quad \alpha_i + \alpha_{gt} + \beta \cdot win\ sim_{it} + \epsilon_{it}, \tag{2}$$

where $win\ sim_{it}$ is a dummy variable that takes the value of one from the year an individual is predicted to obtain credit based on the simulated lotteries and zero before. Since $win\ sim_{it}$ is based on the outcomes of random lotteries, it is orthogonal to ϵ_{it}, conditional on comparing participants in the same group.

We present the results in Table 2, Panel A. The results show that being predicted a winner in simulated lotteries is associated with a 14.34 percentage point higher probability of being the winner of an actual lottery. Since the simulated lotteries are based on the same lottery numbers and algorithms as the actual lotteries, the instrument is strong with an F-statistic of 280,109.

Next, we estimate the reduced form equation

$$Death_{it} \quad = \quad \alpha_i + \alpha_{gt} + \beta \cdot win\ sim_{it} + \epsilon_{it}, \tag{3}$$

where all variables are defined as before.

The results are reported in Panel B. We estimate a reduction in mortality rates by 0.0094 percentage points. The reduced form estimates can be interpreted as the mortality effects of winning a credit lottery with the probability given in the first stage.

To obtain estimates for mortality effects of an individual winning a credit lottery, we estimate equation (1) using a two-stage least square specification where win_{it} is instrumented

with predicted lottery outcomes $win\ sim_{it}$. All variables are defined as before. The results are reported in Panel C. Since the estimation is just identified, the second stage estimates are equivalent to scaling the reduced form estimates with the corresponding first-stage. Access to credit for investment in a motorcycle reduces mortality by 0.0654 percentage points, which is equivalent to a 4.1 percent reduction in mortality. Separately estimating the effect of winning a credit lottery on mortality for men and women, we find that the decrease in mortality is driven by women (column II). Specifically, the female mortality declines by 0.1568 pp or 18 percent relative to the mean death rate among women.

Exploiting information for the causes of death as categorized by the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) (Table A.1), we split the causes of death into internal and external factors in columns III and IV. We find that for women mortality rates decline for deaths caused by both external and internal causes by 0.0738 pp (58% relative to the mean) and 0.0572 pp (10% relative to the mean), respectively.

To assess the presence of pre-treatment trends and examine the time-series evolution of changes in mortality around access to credit for investment in a motorcycle, we estimate a dynamic version of the the reduced-form equation

$$Death_{it} \quad = \quad \alpha_i + \alpha_{gt} + \sum_{s=-5, s\neq -1}^{5} \beta_s \cdot win\ sim_{it}^{s} + \epsilon_{it}, \tag{4}$$

where the variables $win\ sim_{it}^{s}$ are dummy variables taking the value of one from s years after an individual is predicted to win a lottery. We omit the year before an individual is predicted to win a lottery, which is equivalent to normalizing to zero in the year before being predicted to win a lottery. We separately pool the years from 5 to 10 years before individuals are predicted to win a lottery, and the years from 5 to 10 years after individuals are predicted to win a lottery into one estimate, respectively. To separately assess the effect of obtaining access to credit for investment in individual mobility for men and women, we interact the independent variables in equation (4) with a factor variable, representing the gender – male or female – of a participant i.

The results are reported in Figure 1. The black solid line depicts the effect for the full sample. We observe a small and mostly insignificant drop in mortality after individuals are predicted to win a credit lottery, which increases somewhat in the long run five and more years after predicted to receive credit. Importantly, we observe no pre-treatment trends before individuals are predicted to win a credit lottery, as expected given the randomness of access to credit through lotteries.

Before proceeding, we verify that our staggered difference-in-differences estimates are not biased as a result of variation in treatment effects across units over time. An active literature in econometrics documents that short-term effects may be overweighted when the treatment effect is not constant over time for the same unit (see, e.g., Goodman-Bacon 2021 and Borusyak, Jaravel, and Spiess 2024) 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, 2024; de Chaisemartin and D'Haultfoeuille, 2020; Goldsmith-Pinkham, Hull, and Kolesar, 2022). In our setting, this would occur if treatment effects for earlier and later lottery winners in the same group were different. To support the validity of our estimates, we apply the methodology developed in Sun and Abraham (2021), which is robust to heterogeneous treatment effects across individuals over time. We include the estimates with the application of the Sun and Abraham (2021) methodology to Figure 1 (dashed gray line). The estimates with and without the application of the Sun and Abraham (2021) methodology are almost identical. This shows that heterogeneous treatment effects across units over time are not a concern in our setting.

We next estimate the dynamic effects by gender. We observe an immediate drop in mortality for women after being predicted to win a credit lottery (red) with an additional decline in mortality in the long-run. For men (blue), we observe no significant decline in mortality after being predicted to win a credit lottery. If anything, male mortality rates become somewhat elevated, which explains the zero effect for the full sample, as men comprise 75 percent of the sample. Together, these results suggest that the drop in mortality is driven by women.

To quantify the effect of access to individual mobility of mortality, we estimate a 2 two-stage least sqaures version of equation 4, where we use the simulated lotteries ($win\ sim_{it}^{s}$) as an instrument for the actual lottery results (win_{it}^{s}):

$$Death_{it} \quad = \quad \alpha_i + \alpha_{gt} + \sum_{s=-5, s\neq -1}^{5} \beta_s \cdot win_{it}^{s} + \epsilon_{it}. \tag{5}$$

The results are reported in Figure 2.[12] We find that female mortality declines by 0.0886 pp (10% relative to mean female mortality) in the first year following credit access, suggesting immediate benefits from accessing motorcycle financing. After four years the effect more than doubles to 0.21 pp (24% relative to mean female mortality rate), suggesting some benefits occurring over longer-term. Male mortality stays mostly flat following credit access.

[12]Since the IV estimates are based on the same variation as the reduced form estimates, robustness of the reduced form estimates to heterogeneity in treatment effects across units over time implies that the IV estimates are robust to the same type of heterogeneity.

Since we rely on an instrumental variable strategy, our estimates are local average treatment effects for individuals targeted by the instrument. Specifically, our estimates apply to consorcio participants who obtain credit for motorcycle purchase through lotteries. Consorcio participants are a selected group of individuals. Our estimates apply to this group and may differ for the general population. By revealed preferences, consorcio participants expect to benefit from access to individual mobility, 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 for investment in individual mobility will be beneficial for them, but are unable to invest in individual mobility, because they are credit constrained. The high participation rate in motorcycle consorcios in Brazil suggests that the combination of seeking to invest in individual mobility and credit constraints applies to a significant share of the population. Finally, 16.42% of participants default on their payments after they receive credit and lose access to the motorcycle. These individuals are only partially treated.

4.3 Causes of Death

Next, we narrow down the set of potential channels through which access to credit for investment in individual mobility may affect mortality. To do so, we examine which causes of death explain the decline in mortality after individuals obtain access to credit, as well as the times and locations in which mortality declines. We conclude the discussion by outlining the set of potential channels consistent with the empirical findings.

4.3.1 External Causes

We start by examining changes in different types of external causes of death after individuals obtain credit in Table 3, Panel A. We find that among external causes, the decline in mortality for women is mainly due to assault (column I). We also observe a significant decline in injuries & poisoning (column II), which is somewhat harder to interpret, since the potential sources of the injuries and poisoning are manifold. Thus, this category could be related to several other categories, such as assault or suicide. We find no significant effects for suicide (column III), traffic and non-traffic accidents (columns IV and V), or other external causes (column VI). For men, we observe a decline in mortality from injuries & poisoning (column II), but also a large increase in mortality from traffic accidents (column IV). This increase in male deaths in traffic accidents offsets any decline in male mortality from other causes.

To sharpen the evidence, we split up the classifications more granularly. Our data also provides information on the location and time of death. We examine the location and time of fatal assaults in Panel B. We find that female mortality rates from assault decline both at home (column I) and in public spaces (column II), with the effect being stronger in public

spaces. In terms of timing, we find that the effect is concentrated in the evening hours from 4pm to 10pm (column V), with no detectable effects in other time windows: morning (6 am - 10 am), work hours (10 am to 4 pm), and night (10 pm to 6 am). For men, we also find a small decline in fatal assaults at home (column I), also concentrated in the evening hours (column V).

Finally, we break down fatal accidents into the mode of transportation involved (Panel C). We find that the increase in mortality among men is mainly attributed to an increase in fatal accidents while operating a motorcycle (column II). For women, there is no significant change in mortality associated with traffic accidents for any type of vehicle.

4.3.2 Internal Causes

Next, we examine changes in mortality from internal causes by splitting the internal causes of death into the five most common categories in Table 4. We find that the decline in mortality from internal causes is mainly driven by a decline in mortality from respiratory diseases such as influenza and pneumonia (column II). This effect is statistically significant only for women. We do not observe a meaningful decline in causes related to other infectious and parasitic diseases (e.g., cholera or sepsis), circulatory (e.g., myocardial infarction commonly known as heart attack) or digestive (e.g., fibrosis and cirrhosis of liver) systems (columns I, IV, and V, respectively) and neoplasms that include both benign and malignant tumors (column III). For women, we additionally observe a significant decline in mortality from other internal causes beyond the five main causes of death from internal diseases (column VI).

4.4 Potential Channels

Finally, we provide a discussion of potential channels through which access to individual mobility may affect mortality based on the results described above.

Assault on Women in Public Spaces The largest contributor to the decline in female mortality following access to individual mobility are fatal assaults in public spaces, concentrated in the evening hours. This finding is consistent with access to a motorcycle allowing women to avoid dangerous spaces, such as public transportation. Public transportation exposes travelers to elevated risk of robbery or assault in Brazil (U.S. Department of State, 2024), which is particularly problematic for women (Moreira and Ceccato, 2021). Furthermore, even if a woman continues to be exposed to the same public space, such as a dangerous road or neighborhood, she may be less exposed to assault risk as a motorcycle rider in contrast to as a cyclist or pedestrian. Since about a third of domestic violence happens outside

victim's home in Brazil,[13] part of the assault in public space is likely to be related to domestic violence.

Assault at Home For both genders, we find that mortality from assault at home declines after obtaining access to a motorcycle. One potential channel could be that gaining access to a motorcycle allows individuals to move to safer areas, either as a result of higher income or because the motorcycle allows individuals to commute longer distances (Doornik et al., 2024). However, exploiting time-series information on postal codes of participants' residence, we do not find that women are more likely to move to another zip code after they win a credit lottery (Table A.2).

Instead, the results are more consistent with intra-household bargaining models or relaxed financial constraints. For example, higher household income may relax financial constraints reducing instances of domestic conflict (Buller et al., 2018). Access to a motorcycle and higher income can also increase an individual's bargaining power in intra-household conflicts, leading to lower risk of experiencing domestic violence (Manser and Brown, 1980; Pollak, 2005). The fact, that we observe the strongest effects in evening hours is less consistent with exposure theories of individuals experiencing lower exposure to domestic violence because of obtaining a job, since this would predict a decline in domestic assault during working hours (Dugan, Nagin, and Rosenfeld, 1999).

Traffic Accidents We find that access to a motorcycle leads to an increase in male mortality due to traffic accidents. This increase is predominantly driven by fatal accidents involving motorcycles. This is consistent with motorcycles being a risky and vulnerable mode of transportation (Constant and Lagarde, 2010) and men taking more risk when riding a motorcycle than women. With respect to male mortality, the increase in mortality from motorcycle accidents offsets other channels such as domestic assaults that can reduce mortality rates.

Respiratory Diseases With respect to internal causes of death, we mainly find a drop in mortality from respiratory diseases,such as influenza and pneumonia. Respiratory diseases spread most easily in crowded spaces, such as different modes of public transportation (Xu, Connell McCluskey, and Cressman, 2013; Guo et al., 2023). Gaining access to a motorcycle as an alternative mode of transportation allows individuals to reduce exposure to spaces in which infectious respiratory diseases spread.

[13] https://forumseguranca.org.br/wp-content/uploads/2023/03/visiveleinvisivel-2023-relatorio.pdf

General Health Effects For women, we also observe a decline in mortality from other diseases. While none of our results specifically supports this channel, it is conceivable that access to individual mobility and related income gains may affect general health outcomes, for example through better nutrition. Relatedly, motorcycles may also enable individuals to access better medical care by being able to access to healthcare in a broader geographic area.

5 Conclusion

In this paper, we find that access to credit for investment in a motorcycle leads to a decline in mortality by 4.1 percent relative to the mean. This effect is driven by women for whom mortality declines by 18 percent. Among external causes of death, the decline in mortality is mainly due to fewer fatal assaults in public spaces or at home in the evening hours. For internal causes of death, we find that access to credit reduces female mortality rates due to fewer deaths from respiratory diseases.

The decline in fatal assaults against women in public spaces is consistent with access to a motorcycle allowing women to avoid dangerous spaces, including public transportation. Using public transportation exposes riders, especially women, to elevated risk of robbery or assault in Brazil (U.S. Department of State, 2024; Moreira and Ceccato, 2021). In addition, women may be less exposed to assault risk as a motorcycle rider than as a cyclist or pedestrian. The declince in mortality from assault at home for both genders could be related to the fact that access to individual mobility can improve household income (Doornik et al., 2024). Higher household income has also been linked to less domestic violence due to a relaxed budget constraint (Buller et al., 2018) or female empowerment within households (Manser and Brown, 1980; Pollak, 2005). The drop in mortality from respiratory diseases could be explained by lower exposure to spaces in which respiratory diseases spread most easily, such as crowded public transportation (Xu, Connell McCluskey, and Cressman, 2013; Guo et al., 2023). Together these findings suggest that facilitating access to credit can reduce mortality rates for women, in particular when it is tied to investment in individual mobility. Further research is required to further narrow down the channels through which access to individual mobility affects female mortality.

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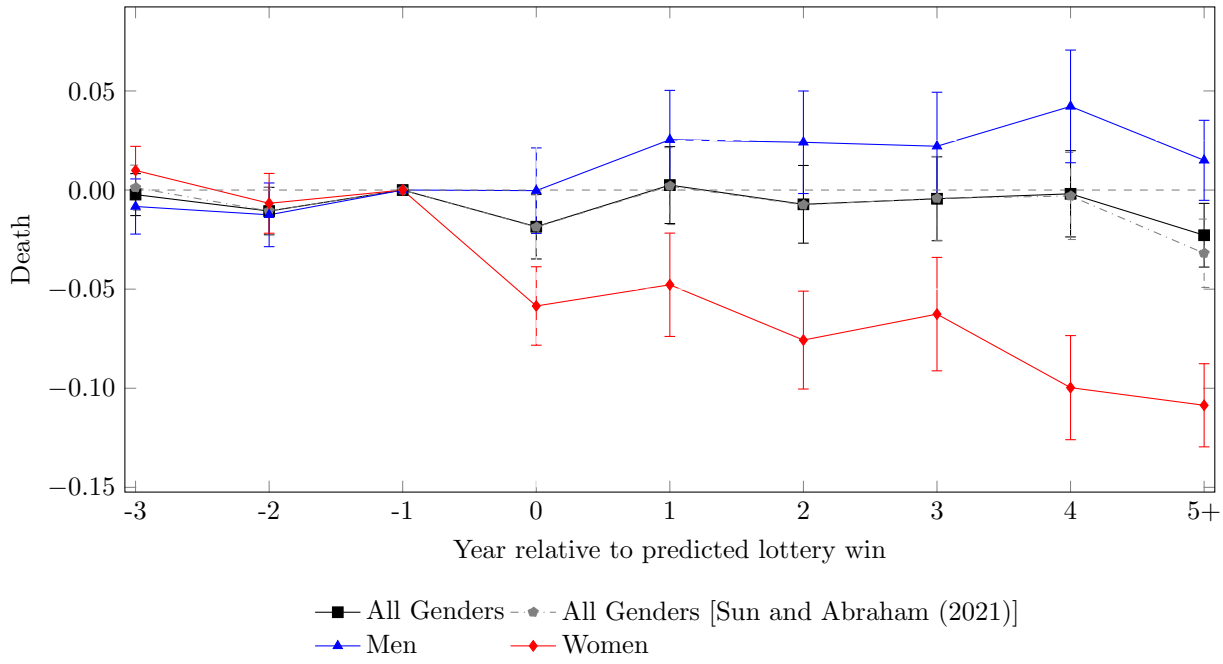
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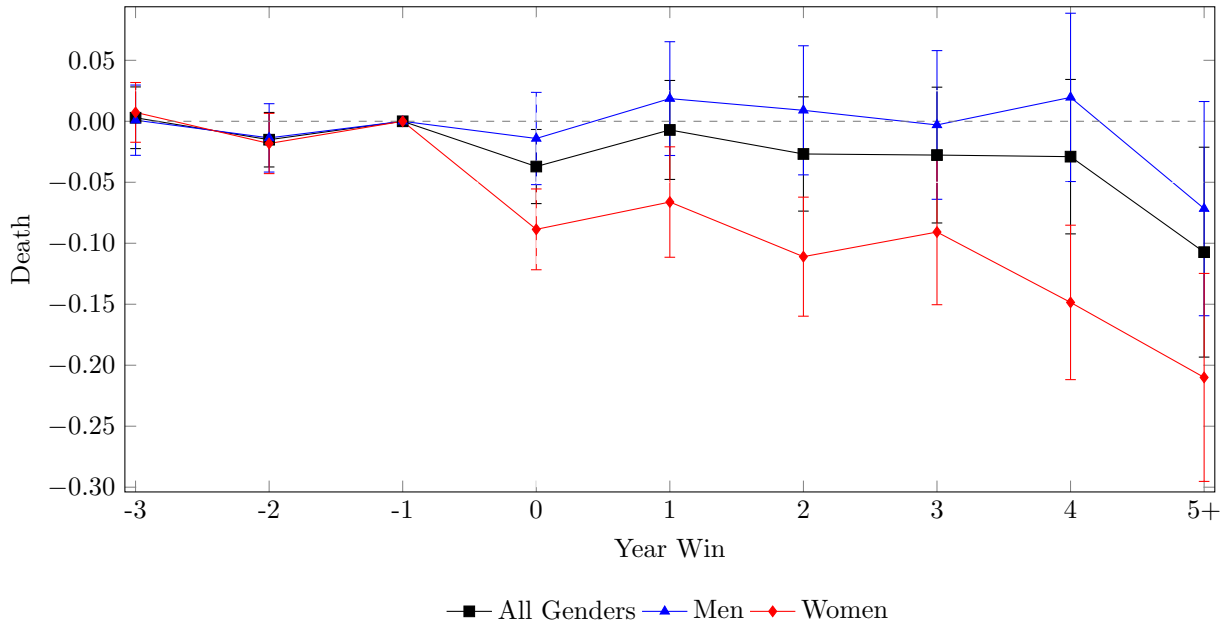
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Figure 1: **Access to Credit and Mortality - Reduced Form Estimates**



This figure depicts the estimates of the dynamic treatment effect from the reduced-form equation (3) with 95 percent confidence bounds. The values on the x axis are multiplied by 100. $Death_{it}$ is a dummy variable that equals one if individual i dies in year t and zero if individual i is alive. The black line depicts the estimates for all genders, the gray line depicts the estimates for all gender with the Sun and Abraham (2021) methodology, the blue and red lines depict the estimates for men and women, respectively.

Figure 2: **Access to Credit and Mortality - IV Estimates**



This figure depicts the estimates of the dynamic treatment effect from the IV equation (5) with 95 percent confidence bounds. The values on the x axis are multiplied by 100. $Death_{it}$ is a dummy variable that equals one if individual i dies in year t and zero if individual i is alive. The black line depicts the estimates for all genders, the blue and red lines depict the estimates for men and women, respectively.

Table 1: **Descriptive Statistics**

Panel A: Consorcios	Mean	Median	Std.	
Groups	15,339			
Members per group	61.93	49.00	39.38	
Duration (months)	43.83	39.00	17.15	
Number of individuals	948,155			
Panel B: Individual Characteristics (means)	**Overall**	**Male**	**Female**	**Working-Age**
Formal Employment Share	0.44	0.46	0.41	0.37
Salary	1,819	1,503	1,956	1,715
Age	44.99	44.64	45.16	36.59
Male	0.74			0.51
Death rate (per 1,000 ppl)	15.79	19.14	8.82	12.46
External cause	5.10	6.92	1.29	4.86
Internal cause	7.65	8.54	5.80	6.13

Panel A provides descriptive statistics on the number of consorcio groups, the number of members per group, the duration of the groups, and the number of individuals. Panel B depicts descriptive statistics for consorcio participants and the working-age population in Brazil.

Table 2: **Access to Credit and Mortality**

	I	II	III	IV
Dep. Var.:	$Death_{it}$		$External_{it}$	$Internal_{it}$
Mean:	1.58%		0.51%	0.76%
Panel A: First Stage win_{it}				
$win\ sim_{it}$	0.1434***			
	(0.0008)			
Panel B: Reduced Form				
$win\ sim_{it}$	-0.0094**			
	(0.0045)			
R^2	0.088			
Panel C: IV				
win_{it}	-0.0654**			
	(0.0315)			
$win_{it} * male_i$		-0.0319	0.0001	-0.0270
		(0.0322)	(0.0191)	(0.0227)
$win_{it} * female_i$		-0.1568***	-0.0738***	-0.0572**
		(0.0305)	(0.0169)	(0.0223)
R^2	0.088	0.088	0.093	0.087
F-stat		280,109		
Observations	17,952,022	17,952,022	17,952,022	17,952,022
Group-Time FE	yes	yes	yes	yes
Individual FE	yes	yes	yes	yes
Clustered SE	group	group	group	group

This table depicts the results from the first-stage estimation in equation (2) in Panel A, the reduced form estimation in equation (3) in Panel B, and the IV estimates from equation (1) in Panel C where lottery outcomes win_{it} are instrumented with the predicted lottery outcomes $win\ sim_{it}$. The dependent variable is a dummy variable that equals one if individual i dies (columns I and II), dies from an external cause (column III) or an internal cause (column IV) in year t and zero if individual i is alive. The estimates are multiplied by 100. The variable win_{it} ($win\ sim_{it}$) takes the value of one from the year an individual wins (is predicted to win) a credit lottery and zero before. Standard errors are reported in parentheses. The bottom of the table provides information on fixed effects and the clustering of standard errors. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3: **External Causes of Death**

	I	II	III	IV	V	VI
Panel A: External Causes of Death						
Dep. Var.:	Assault	Injury & Poisoning	Suicide	Accidents		Other External Causes
				Traffic	Non-Traffic	
Mean:	0.17%	0.03%	0.03%	0.22%	0.05%	0.02%
$win_{it} * male_i$	-0.0133	-0.0122**	-0.0016	0.0276**	-0.0013	0.0010
	(0.0106)	(0.0062)	(0.0047)	(0.0132)	(0.0028)	(0.0037)
$win_{it} * female_i$	-0.0392***	-0.0188***	-0.0043	-0.0073	-0.0033	-0.0009
	(0.0093)	(0.0056)	(0.0045)	(0.0116)	(0.0024)	(0.0035)
R^2	0.093	0.089	0.090	0.095	0.090	0.089
Observations	17,952,022	17,952,022	17,952,022	17,952,022	17,952,022	17,952,022
Panel B: Location and Time of Assault						
	Location		Time			
Dep. Var.:	Home	Public	Morning	Day	Evening	Night
Mean:	0.02%	0.07%	0.01%	0.04%	0.04%	0.04%
$win_{it} * male_i$	-0.0076***	-0.0024	-0.0005	-0.0005	-0.0131***	0.0027
	(0.0029)	(0.0071)	(0.0033)	(0.0042)	(0.0050)	(0.0052)
$win_{it} * female_i$	-0.0089***	-0.0139**	-0.0034	-0.0048	-0.0181***	-0.0024
	(0.0027)	(0.0062)	(0.0028)	(0.0036)	(0.0045)	(0.0046)
R^2	0.092	0.093	0.093	0.089	0.092	0.094
Observations	17,952,022	17,952,022	17,952,022	17,952,022	17,952,022	17,952,022
Panel C: Traffic Accidents						
Dep. Var.:	Bicycle	Motorcycle	Car	Heavy Transport		
Mean:	0.01%	0.10%	0.05%	0.01%		
$win_{it} * male_i$	0.0003	0.0184**	0.0031	-0.0000		
	(0.0014)	(0.0090)	(0.0033)	(0.0023)		
$win_{it} * female_i$	-0.0005	0.0019	0.0012	-0.0007		
	(0.0012)	(0.0078)	(0.0030)	(0.0021)		
R^2	0.095	0.093	0.092	0.092		
Observations	17,952,022	17,952,022	17,952,022	17,952,022		
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 depicts the results from equation (1) estimated via 2SLS where win_{it} and its interactions are instrumented with predicted credit outcome ($win\ sim_{it}$) and its interactions. The F-stat is 280,190. The dependent variable is a dummy variable that equals one if individual i dies in year t and zero if individual i is alive. The cause of death is listed at the top of the respective column. The estimates are multiplied by 100. The variable win_{it} takes the value of one from the year an individual wins a credit lottery and zero before. Morning is defined between 6am and 10am, Day is defined as between 10am and 4pm, Evening is defined as between 4pm and 10pm, and Night is defined as between 10pm and 6am. Standard errors are reported in parentheses. The bottom of the table provides information on fixed effects and the clustering of standard errors. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4: **Internal Causes of Death**

	I	II	III	IV	V	VI
Dep. Var.:	Infectious and Parasitic Diseases	Respiratory System	Neoplasms (incl. cancer)	Circulatory System	Digestive System	Other Internal Causes
Mean:	0.10%	0.24%	0.12%	0.20%	0.04%	0.07%
$win_{it} * male_i$	-0.0123	-0.0172	-0.0019	0.0088	0.0033	-0.0077
	(0.0078)	(0.0123)	(0.0090)	(0.0118)	(0.0052)	(0.0064)
$win_{it} * female_i$	-0.0122	-0.0250**	0.0026	-0.0100	-0.0002	-0.0124**
	(0.0079)	(0.0122)	(0.0095)	(0.0110)	(0.0049)	(0.0061)
R^2	0.087	0.086	0.086	0.088	0.086	0.086
Observations	17,952,022	17,952,022	17,952,022	17,952,022	17,952,022	17,952,022
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 depicts the results from equation (1) estimated via 2SLS where win_{it} and its interactions are instrumented with predicted credit outcome ($win\ sim_{it}$) and its interactions. The F-stat is 280,190. The dependent variable is a dummy variable that equals one if individual i dies in year t and zero if individual i is alive. The cause of death is listed at the top of the respective column: column I – Infectious and Parasitic diseases (ICD 01), column II – Diseases of respiratory system (ICD 10), column III – Neoplasms benign (not cancer) and malignant (cancer) (ICD 02), column IV – diseases of circulatory system (ICD 09), column V – diseases of digestive system (ICD 11), column VI – all other categories. The estimates are multiplied by 100. The variable win_{it} takes the value of one from the year an individual wins a credit lottery and zero before. Standard errors are reported in parentheses. The bottom of the table provides information on fixed effects and the clustering of standard errors. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Appendix A. Credit Allocation in Consorcio Groups

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

Appendix A.1. Algorithm: Example

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

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 takes the remainder is multiplies by the number of participants. For example, if the 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.[14]

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 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.

Appendix A.2. Simulated Allocation

The majority of consorcio 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 labor market outcomes. For example, individuals with better labor market opportunities are more likely to submit higher bids and therefore obtain credit for motorcycle purchase 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, such as

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

better labor market opportunities, 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 motorcycle purchase on labor market outcomes.

As a consequence, we resort to an instrumental variable strategy that simulates the allocation of credit in each consorcio 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 consorcio 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.

Table A.1: **Variable Definitions**

Variable	Definition
Death	Indicator variable of whether a person dies.
External	External cause of death: ICD chapters 19 to 22.
Assault	External cause of death, ICD Chapter 20, X85-Y09.
Injury & Poisoning	External cause of death, ICD Chapter 19.
Suicide	External cause of death, ICD Chapter 20, X60-X84.
Traffic Accidents	External cause of death, ICD Chapter 20, V01-V99.
Bicycle	External cause of death, ICD Chapter 20, V10-V19.
Motorcycle	External cause of death, ICD Chapter 20, V20-V39.
Cars	External cause of death, ICD Chapter 20, V40-V49.
Heavy Transport	External cause of death, ICD Chapter 20, V50-V79.
Non-traffic Accidents	External cause of death, ICD Chapter 20, W00-X59.
Other External Causes	External causes not listed above.
Internal	Internal cause of death: ICD chapters 1 to 18.
Infectious and Parasitic Diseases	Internal cause of death, ICD Chapter 1.
Neoplasms	Internal cause of death, ICD Chapter 2.
Respiratory System	Internal cause of death, ICD Chapter 10.
Circulatory System	Internal cause of death, ICD Chapter 9.
Digestive System	Internal cause of death, ICD Chapter 11.
Other Internal Causes	Internal causes not listed above.

Variable definitions are based on International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10), also available at `https://icd.who.int/browse10/2019/en`.

Table A.2: **Access to Credit and Relocation**

	I
Dep. Var.:	P[Move ZIP]
Mean:	18%
$win_{it} * male_i$	-0.0004
	(0.0034)
$win_{it} * female_i$	-0.0141***
	(0.0035)
R^2	0.713
Observations	4,070,803
Group-Time FE	yes
Individual FE	yes
Clustered SE	group

This table depicts the results from equation (1) estimated via 2SLS where win_{it} and its interactions are instrumented with predicted credit outcome ($win\ sim_{it}$) and its interactions. The dependent variable equals one if an individual i changes the home postal code (CEP) relative to the start of the group, and zero otherwise. The variable win_{it} ($win\ sim_{it}$) takes the value of one from the month an individual receives (is predicted to receive) credit for motorcycle purchase and zero before. Standard errors are reported in parentheses. The bottom of the table provides information on fixed effects and the clustering of standard errors. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.