Public Pensions and the Strategic Timing of Formal Employment

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Abstract

Public pensions may influence labor supply throughout the lifecycle. In this paper, we exploit pension eligibility regulations to study how pension programs impact retirement and earlier-in-life labor supply decisions. Our context is Ecuador, where a worker's eligibility age depends on the number of years they have contributed to the social security system. First, we use large-scale administrative data to document spikes in retirement at the pension eligibility ages of 60, 65, and 70. Next, we show how the increases in retirement at each of these eligibility ages are consistent with economic incentives and driven by different groups of people who begin working in the formal labor market at different ages. Finally, we use survey data and a regression discontinuity design to investigate whether eligibility rules influence earlier-in-life decisions about when to begin working in the formal sector. We find a discontinuous increase in transitions to formal work at age 50, consistent with forward-looking people timing their entrance to the formal sector to minimize contributions to the social security system while maintaining eligibility for benefits. Additional analyses on mechanisms shed light on the potential paths workers can take to facilitate these informal-to-formal transitions; the results suggest a key role for family firms.

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1 Introduction

Public pensions are among the largest government programs in both developed and developing countries. These programs typically collect contributions from current workers to pay old-age benefits to former workers. Several of their features—benefit eligibility ages, implicit and explicit taxes on earnings, and work history requirements— may influence labor supply throughout the lifecycle. While a large literature finds that pensions influence retirement and labor supply at older ages (Gruber and Wise, 1999; Blundell et al., 2016), evidence on earlier-in-life labor supply responses is comparatively scarce.

Yet understanding whether pensions induce earlier, forward-looking labor supply responses is important for the design of social security systems and for projecting effects of pension reforms on government budgets. On the one hand, a core assumption of lifecycle models used to analyze social security is that people are forward-looking (French, 2005; French and Jones, 2012). On the other hand, labor supply elasticities are likely smaller during prime working years, and people may have limited knowledge of pension programs (Gustman and Steinmeier, 2005; Chan and Stevens, 2008; Liebman and Luttmer, 2015). It could be that these factors limit any forward-looking responses to pension incentives.

Investigating the extent to which public pensions influence earlier labor supply is especially important for program design in developing countries. In these settings, many people face trade-offs about whether to work formally, pay income taxes, and contribute to social insurance, or to work informally, receive under-the-table compensation, and avoid taxes and contributions to the social security system. Public pensions influence these trade-offs by providing old-age benefits to those who work formally and contribute to the system for a sufficiently long period. These programs may therefore influence decisions about whether, and when, to work formally versus informally.

In this paper, we study how the parameters of public pension systems influence both retirement timing and earlier-in-life, strategic decisions about when to work in the formal sector. Our analysis focuses on pension eligibility regulations in Ecuador, where roughly two out of three workers are informal. The pension system in Ecuador is a defined benefit, pay-as-you-go system that provides access to benefits for workers after they reach specified ages. Importantly, a worker's eligibility age depends on the number of years they have worked in the formal sector and contributed to the system. Workers can claim benefits at 60 if they have 30 years of contributions, at 65 if they have 15 years of contributions, and at 70 if they have 10 years of contributions. We exploit discontinuous changes in incentives that arise because of these age-based eligibility thresholds to study how the pension program impacts (i) the timing of retirement and (ii) the timing of transitions into formal work earlier in life.

Our analysis proceeds in three steps. In the first step, we use administrative data from the social security administration in Ecuador, the Instituto Ecuatoriano de Seguridad Social, to study how reaching pension eligibility ages influences retirement. We find large spikes in benefit claiming and retirement right at 60, 65, and 70. Similarly, we find large spikes in the number of contribution-years right at 30, 15, and 10. Taken together, these spikes suggest that many people contribute the minimum number of years required to unlock pension benefits and then claim those benefits and retire when they are first eligible to do so.

In the second step, we assess the link between these discontinuous increases in retirement and earlier labor supply decisions. We first use a simple model of retirement to show how retirement incentives in Ecuador depend on the age at which workers begin their careers in the formal sector. The key idea is that the pension program creates strong disincentives to work formally after reaching eligibility ages, and therefore people who begin their careers earlier become eligible for benefits and experience these disincentives earlier. In particular, the regulations imply that many who begin formal work earlier face strong incentives to retire at 60, whereas many who begin formal work later face incentives to retire at 65 or 70. Next, guided by the model, we use a regression discontinuity (RD) design to estimate discontinuous increases in retirement at the eligibility ages for groups who started working formally at different ages. Consistent with the economic incentives, we find that people who begin working formally at younger ages drive the increases in retirement at 60, whereas people who begin working formally at older ages drive the spikes at 65 and 70.

Our analysis of these retirement responses complements existing evidence from several other countries. Despite important differences in institutions across settings, most papers find that pension eligibility ages strongly influence retirement decisions (de Carvalho Filho, 2008; Staubli and Zweimüller, 2013; Manoli and Weber, 2016; Seibold, 2021; Nakazawa, 2022; Dolls and Krolage, 2023; Deshpande et al., 2024; García-Miralles and Leganza, 2024). Our findings corroborate this general takeaway and emphasize how the economic incentives attached to the eligibility ages in Ecuador are likely key drivers of the increases in retirements that we document.

In the third step, we study how the pension eligibility rules affect earlier-in-life decisions about when to work in the formal sector. On the one hand, the program creates incentives to work long enough in the formal sector to unlock pension benefits in retirement. On the other hand, workers may value the benefits of informal work, such as increased flexibility or the ability to avoid social insurance contributions and taxes. We thus might expect some workers to time their entrance to the formal labor market (i) to gain access to benefits right when they retire but also (ii) to minimize the number of years they make contributions to the system.

To investigate whether this type of strategic behavior occurs, we use survey data and a regression discontinuity design to estimate the causal effects of reaching critical ages earlier in life on the decision to work in the formal labor market. Specifically, we test for discontinuous increases in the probability of transitioning to the formal sector at 30 (in anticipation of contributing to the system for 30 years and unlocking benefits at 60), at 50 (in anticipation of contributing to the system for 15 years and unlocking benefits at 65), and at 60 (in anticipation of contributing for 10 years and unlocking benefits at 70). Crucially, our survey data allow us to observe and track workers across sectors, which make this analysis feasible.

We find clear evidence of a discontinuous increase in the likelihood of transitioning to the formal sector at 50. This evidence is consistent with forward-looking workers timing their participation in the formal labor market to contribute for the minimum 15 years before unlocking pension benefits at 65, and it provides support to the idea that some people do respond to pension-induced incentives earlier in life. Our baseline RD point estimate indicates a 1.8 percentage point increase in the probability that a worker transitions from not working formally to being employed in the formal sector. This estimate is sizable. When compared to the mean, it represents a 21% increase, because overall transitions to the formal sector around that age are not particularly common. When compared to the baseline probability of being affiliated with social security just before 50, which is 38%, our estimate of the increased flow into the formal sector corresponds to a 4.7% increase. We then show that this increase is primarily explained by people transitioning from informal to formal work, as opposed to non-employed people obtaining new formal jobs.

In contrast, we find no evidence of increases in transitions to formal employment right at 30, in anticipation of making continuous contributions to the social security system for 30 years and unlocking benefits right at 60. We also do not find evidence of increases transitions to formal employment at 60, which would involve entering the formal workforce quite late, in anticipation of contributing for 10 continuous years at advanced ages before unlocking benefits at 70. Taken together, the results suggest that the time horizon over which one is making decisions is an important factor in shaping earlier-in-life labor supply decisions in response to public pension incentives.

We conclude the third step of our analysis by exploring mechanisms. How are some informal workers able to facilitate transitions to the formal sector right at 50? Formal jobs may be difficult to obtain. Moreover, from the perspective of the firm, hiring a formal worker involves additional costs in the form of employer social insurance contributions. These factors can complicate the ability of workers to time transitions to the formal sector.

One possibility is that changing occupations allows workers to more easily switch sectors. However, we find no evidence of a discontinuous increase occupation-specific tenure at 50, which suggests people work the same type of job, but formally instead of informally. A natural hypothesis is that this type of occupation-preserving transition is driven by self-employed people who can more easily formalize their business activities, strategically formalizing to qualify for pension benefits. However, we find no evidence of increased transitions from working informally to working formally as a self-employed person.

It is thus likely that the results are explained by informal employees becoming formal employees, either by updating their contract status with their firm or by switching firms. While we cannot observe the specific firms at which people work, we investigate heterogeneity by the type of firm people worked at previously and document two key findings. First, we find increases in transitions to formality from informal work at formal firms (those registered with the tax authority), but we find no evidence of increases in transitions from informal work at informal firms. Second, we find large increases in transitions to formality for people who live with a family member who owns a formal firm, which we interpret as a proxy for whether the person works at a family firm. In contrast, we find no evidence of an increase for people who do not live with an owner of a firm and no evidence of an increase for people who live with the owner of an informal firm.

Overall, the body of evidence on mechanisms points to a particularly viable route through which people can time transitions to the formal labor market in response to public pension rules: they can change their contractual status at a family firm from informal to formal. This type of transition allows workers to work formally long enough to unlock pension benefits while minimizing the number of contributions made to the system. It also occurs in a workplace where, due to family connections, employer and employee objectives are more likely to be aligned and the firm is more likely to have incentives to cooperate with its workers.

Our paper relates to two broad literatures. The first studies how public pensions impact labor supply.[1] Most reduced-form work in this area analyzes retirement, but there is an emerging literature on earlier labor supply decisions. In the context of more developed economies, several recent papers estimate anticipatory employment responses to pension reforms (Hairault et al., 2010; Gelber et al., 2016; Engels et al., 2017; Geyer and Welteke, 2021; Haller, 2022; French et al., 2022; Artmann et al., 2023; Carta and De Philippis, 2024). In contexts like ours, where large informal labor markets change the opportunity costs of formal employment, there is less evidence. Becerra (2023) and Becerra (2024) show that composite reforms reducing pension benefit generosity lead to more informal employment earlier in life, and Lauletta and Bergolo (2023) find little evidence that partially privatizing the social se-

[1] See Gruber and Wise (1999), Krueger and Meyer (2002), Blundell et al. (2016), and Coile (2016) for reviews.

curity systems in Uruguay impacted employment among younger workers. Finally, Khanna et al. (2024) find that the expansion of a non-contributory, rural pension program with work requirements in Brazil leads to increases in labor supply for newly-covered married females, including both those close to retirement ages and those much younger.

The second literature studies the determinants of informal and formal work in low and middle-income countries (Ulyssea, 2020). The most related papers analyze how government programs affect employment in formal and informal sectors. Evidence indicates that cash transfers (Bosch and Schady, 2019; Garganta and Gasparini, 2015; Cruces and Bérgolo, 2013), unemployment insurance (Bosch and Esteban-Pretel, 2015; Gerard and Gonzaga, 2021), and health insurance (Bosch and Campos-Vazquez, 2014) influence decisions about how much to work in each sector. However, less is known about the effects of social security programs. Joubert (2015) takes a structural approach and shows that mandatory pension contributions encourage informal work, and Hernandez (2024) shows that increases in payroll taxes for pension benefits and health insurance reduce formal work.

Our paper connects these two literatures and provides novel evidence on how pension eligibility age regulations impact strategic and forward-looking earlier-in-life transitions to the formal labor market. To our knowledge, we are the first to document this type of behavioral response to pension programs.[2] While previous work often casts informal and formal work as substitutes, our results emphasize how pensions can lead people to combine informal and formal work so that they minimize social insurance contributions throughout their careers while ensuring access to retirement benefits later in life.

We also provide new evidence on the mechanisms that give rise to these informal-to-formal transitions. Our finding that underscores an important role for informal work within formal firms connects to other research highlighting the intensive margin of informality (Ulyssea, 2020) and under-the-table payments (Feinmann et al., 2022), and our finding that family firms may help workers time transitions connects to other research that underscores how individuals leverage family ties in other settings, such as a way to obtain public sector jobs (Riaño, 2021).

The rest of this paper is structured as follows. Section 2 overviews our setting. Section 3 describes our data. Section 4 documents spikes in retirement at pension eligibility ages. Section 5 analyzes how retirement decisions depend on earlier-in-life labor supply decisions. Section 6 analyzes how the public pension program impacts earlier-in-life transitions to formal employment. We conclude in Section 7.

[2]These responses that we document complement other work that highlights different types of strategic responses to pensions, namely the strategic reporting of earnings due to benefit formulas (Kumler et al., 2020; Dean et al., 2024).

2 Setting and Policy Environment

2.1 Labor Markets in Ecuador

Ecuador is an upper middle-income country with roughly 17 million inhabitants. In 2023, per-capita income was USD 16,062 (adjusted for purchasing power). Its economy is diversified, with manufacturing, commerce, and oil extraction being the largest sectors (Central Bank of Ecuador, 2022).

Despite low unemployment rates of around 4% over the past 10 years, informal jobs—those not subject to labor laws, income taxes, or social protections—are widespread, accounting for about 60% of total employment (Elgin et al., 2021).[3] Informality is more common among those with lower education levels, but even 15% of university graduates work as informal salaried employees, or self-employed workers (a common proxy for informal work). Informality spans various sectors and is more prevalent in smaller firms (Canelas, 2019).

One important difference between working formally and informally involves income taxes. The income tax system in Ecuador is administered at the individual level. Income from formal work is subject to a progressive tax schedule with nine income brackets and corresponding marginal tax rates ranging from 0% to 35%, and employers can withhold income taxes from the wages and salaries of their employees. Another important difference involves social insurance contributions and eligibility for the public pension program, a topic we turn to next.

2.2 The Old Age Pension System in Ecuador

Like in many countries, the retirement system in Ecuador is anchored by a public, defined benefit pension program. The old-age pension provides retirement benefits to former workers. Contributions to the system are mandatory for salaried dependent workers; employees contribute 9.35% of their earnings to the social insurance system and employers contribute 11.15%. Self-employed individuals can voluntarily enroll with the system as independent workers as long as their businesses are registered with the tax authority. In that case they must contribute 17.6% of their salary.[4]

To be eligible to claim pension benefits, a retiree must have contributed to the system for a sufficient period and meet a corresponding age requirement. With 40 years of contributions, benefits can be claimed at any age. With 30 years of contributions, benefits can be claimed

[3]For reference, over 61% of the global employed population work informally (Bonnet and Chen, 2019).

[4]As opposed to the case of dependent workers in which the employer withholds the worker's contributions (9.35%) and makes a contribution on their behalf (11.15%), independent workers are in charge of making direct payments to IESS.

as early as 60. With 15 years of contributions, benefits can be claimed at 65, and with 10 years of contributions, benefits can be claimed at 70.

Monthly benefit amounts are determined by earnings histories. A retiree's monthly benefit is equal to a percentage of their average monthly earnings over their 5 highest years of earnings. This percentage, or replacement rate, is 43.75% for 5 years of contributions, and it increases by 1.25% for each of the next 30 years of contributions. For example, a worker with 35 years of contributions would receive monthly benefits that amount to 43.75 + (1.25)(30) = 81.25% of their average monthly earnings. For the next 5 additional years of contributions, the replacement rate increases, but not linearly. For 36 years of contributions, the rate is 83.25%. It is 86.05% for 37 years of contributions, 89.70% for 38 years, and 94.30% for 39 years. For 40 years of contributions, the replacement rate is 100%. For each extra year of contributions above 40, the rate increases linearly by 1.25% again. Benefits are paid monthly, and there are two bonus payments in December of each year as well, so beneficiaries receive a total of 14 payments.

Importantly, there are no additional adjustments to benefits for claiming later than one is eligible. For instance, if a person begins contributing to the system at 30 and contributes for 30 years, they will be eligible to claim benefits as early as 60. If they wait to claim until 62, their monthly benefits will be greater because of the two additional years of contributions (and perhaps even more so if those additional years are two of the person's five highest-earning years), but their pension wealth will decrease because they are simply forgoing two years of benefits and there is no adjustment in monthly benefits from the two-year delay in claiming. Similarly, anyone who unlocks eligibility at 65 forgoes one year of benefits for each year that they work past 65. Note that this setup contrasts with social security systems like the one in the U.S., where people experience increases in benefits for delaying claiming past their full retirement age.

Finally, while a person can continue to work (formally) after claiming pension benefits, their benefits are suspended during this time, and they must resume making contributions to the system. Moreover, a person cannot receive pension benefits and work for their previous employer during their first year of receiving benefits.

3 Data

We use three datasets to conduct our analyses. Two are made up of administrative records that we obtained from the Social Security Administration in Ecuador, the Instituto Ecuatoriano de Seguridad Social (IESS). The other dataset consists of nationally representative survey data. The advantage of the administrative data is that they have large sample sizes and accurate information about pension contributions and benefits for formal workers. The disadvantage is that they do not contain information on informal workers. The advantage of the survey data is that they allow us to observe both formal and informal workers, which is necessary for our analysis of earlier-in-life labor supply.

3.1 Administrative Records on Current Pension Beneficiaries

One of our administrative datasets contains anonymized records on the universe of individuals receiving benefits from IESS as of December 2022. This cross-sectional dataset includes information on 738,021 individuals who received either old-age pensions, disability benefits, or family benefits due to a deceased pensioner. We exclude from the dataset records of individuals who receive either of the latter two benefits and do not receive old-age pension benefits. The resulting sample size is 531,258. In addition, we exclude the 12% of pensioners covered by special pension programs for members of the military, public school teachers, and some rural organizations. This additional restriction results in an analysis sample of 460,041 individuals receiving IESS old-age pension benefits. We use these data to document how many people claimed their benefits at various ages.

3.2 Administrative Records on Current and Former Workers

Our second administrative dataset contains anonymized records on the universe of people who have ever contributed to the Social Security system, starting in 2001 and ending in 2022. The sample consists of 6,582,162 individuals. This cross-sectional dataset therefore includes information about pension contributions for formal workers, both those who contributed in the past and are currently retired as well as those who are still working and contributing. Specifically, for each individual, we observe the date that they made their first contribution, the date they made their final contribution, the cumulative number of contributions made to the system, and demographic characteristics like gender and date of birth. We use these data to analyze retirements from the formal sector and contributions to the social security system. Crucially, unlike our other administrative dataset, this one is not a sample of only people who have already claimed their pension benefits.

3.3 Nationally Representative Survey Data

The administrative records provide high-quality information on people who worked formally and contributed to the pension system. However, as discussed above, informal work is widespread in Ecuador and is not captured by administrative records on social security contributions.

We therefore complement the administrative data with nine years of nationally representative employment surveys, which allow us to study formal and informal workers. We use data from the Ecuadorian National Survey of Employment and Unemployment (ENEMDU) that span 2008 to 2016.[5] The survey is conducted quarterly in a rotating panel format with four observations per household. Specifically, a household is initially interviewed for two consecutive quarters, then leaves the sample for two quarters, and finally reenters the sample for two consecutive quarters.

The survey contains a good deal of information on demographic characteristics for all members of the household and on employment, including information on whether an individual is affiliated with the social security system or whether they work informally. In addition, it includes self-reported information about the employers of individuals in the survey, such as whether the employer is registered with the tax authority, which we use as a proxy for employer formality.

3.4 Summary Statistics

Appendix Table A1 reports summary statistics for each of these three datasets. Panel (a) reports statistics for our dataset on people who ever contributed to the pension system. It shows that 41% of these people are women. It also shows that the average age an individual starts contributing to IESS is 25 and that 89% of affiliates contribute to IESS through their employers as salaried employees. The remaining individuals contribute as independent workers (e.g., self-employed workers or contractors).

Panel (b) reports statistics for our dataset on people who have claimed their pension benefits. It shows that the average pensioner unlocked benefits at age 64 but claimed benefits at age 66. The average pensioner retired after contributing for 332 months (27 years).

Finally, panel (c) reports statistics for our survey dataset. It shows that 30% of working age adults are affiliated to IESS, mostly as salaried workers. The employment rate is 61%, most workers work informally without contributing to IESS (36% of adults in working age and 60% of employed individuals), and most workers work for firms that are not registered with the tax authority.

[5] We focus on this period for two reasons. First, there were changes in the data collection process after 2016. Second, using later survey rounds cover periods of severe economic disruptions such as the COVID-19 Pandemic and the rise of gang-related activity and homicide rates in coastal areas of Ecuador in 2020.

4 The Effects of Reaching Pension Eligibility Ages on Retirement

We begin by analyzing the effects of pension eligibility ages on pension claiming and retirement. The pension program creates strong disincentives to work after becoming eligible for pension benefits because (i) benefits are withheld from people who continue to work and (ii) benefits are not adjusted for delaying claiming. The policy-specified eligibility thresholds of 60, 65, and 70 mean that these disincentives to work will change discontinuously for many workers as they reach these ages and unlock benefits.

Moreover, these disincentives to work are strengthened by the relatively generous replacement rate formula. People with long earnings histories have replacement rates approaching 100% of earnings from their highest-earning years. For example, consider a person who works from age 20 to 60. At 60, this person will have worked 40 years, making them eligible to claim benefits immediately with a replacement rate equal to 100% of their average earnings over their 5 highest-earning years. This person could work one more year, until 61, and earn a wage, but the opportunity cost of doing so (their forgone benefits) is substantial. They could instead choose to not work and still earn 100% of the average of their highest wages.

Figure 1 illustrates the influence of pension eligibility ages on pension benefit claiming and retirement. Panel (a) plots the empirical distribution of pension claiming ages. The underlying sample consists of people in our administrative dataset covering the universe of pensioners as of December 2022. The graph shows the share of people who received their first pension benefits at various ages. The spikes at 60, 65, and 70 are striking. Many people claim their pension benefits right at the statutory eligibility ages. Specifically, 19% of pensioners claimed benefits at 60, 17% did so at 65, and 6% did so at 70.

Panel (b) plots the empirical distribution of retirement ages. The underlying sample consists of people in our administrative dataset on current and former workers, those who made a contribution to the Social Security system between 2001 and 2022. We use information on the date of a person's final contribution to IESS to define retirement. The final contribution date should correspond to the retirement date for people who are retired, but for people still working in December 2022, their age when they make their final contribution in the data will be their age as of December 2022. Therefore, to try to isolate retirement ages for potential retirees, we define an individual in these data to be retired if they (i) were at least 55 years-old by December 2022 and (ii) did not make a contribution during the two years preceding December 2022.[6] Consistent with a tight link between claiming pension benefits

[6] We choose age 55 because that would be the pension eligibility age for an individual who started working formally at 15 (the minimum working age) and worked continuously for 40 more years. One caveat of our approach is that under our definition a person that has not retired but has not been formally employed for 2 years would be classified as retired.

and retiring, we also observe large spikes in retirement right at 60, 65, and 70.[7]

In addition to the existence of the spikes, their relative magnitudes are noteworthy. There are almost as many people who claim benefits at 65 as who claim at 60. Given the strong work disincentives after reaching pension eligibility, a natural question is whether the workers who claim benefits later delayed claiming after becoming eligible, or if they claimed at later ages because that is when they first unlocked eligibility.

Figure 2 sheds some light on this question. The sample underlying the figure consists of people in our administrative dataset on pensioners. The graph plots the empirical distribution of contribution-years, defined as the total number of years a person has contributed to IESS. It shows large spikes in contribution-years at 10, 15, and 30, which are the number of years of contributions required to unlock pension benefits at 70, 65, and 60, respectively. This pattern is consistent with the idea that many people contribute just enough years to become eligible to claim benefits at the eligibility ages. It also might suggest that the people who make up the spikes in claiming at 65 and 70 are not people who were eligible earlier and forfeited benefits by delaying claiming, but are instead people with shorter work histories who become eligible right at 65 or 70.

Overall, this analysis suggests that pension eligibility ages influence the timing of retirement. It also raises important questions about (i) how the retirement incentives depend on when people enter the formal workforce and (ii) whether the pension program influences earlier-in-life decisions about when to begin careers as formal workers. In the next two sections, we investigate these questions.

5 The Link between Retirement Timing and Earlier Labor Supply

To provide a deeper analysis of the effects of pension eligibility ages, we assess how retirement responses are linked to earlier-in-life labor supply. To ground this analysis, we use a benchmark model of retirement. The model highlights how retirement incentives from the pension program depend on the age at which one begins to work formally.

5.1 A Benchmark Model of Retirement

We consider a static model of lifetime consumption and retirement that abstracts from uncertainty, from discount and interest rates, and from the informal sector. The basics of the model are standard and follow previous papers in the retirement literature (e.g. Brown,

[7] In Appendix Figure A1 we plot the distribution of retirement probabilities dropping the 55-year-old requirement. Doing so increases the share of individuals that appear retired at earlier ages, but still enables us to see large spikes in retirement right at 60, 65, and 70.

2013; Manoli and Weber, 2016); what is notable about our approach is that we write down the model in a way that emphasizes that formal careers may begin at different times for different workers.

Consider people who begin formal work at $t = S$ and live until $t = T$. For now, suppose that S is exogenous. For a given S, people maximize lifetime utility by choosing lifetime consumption, C, and when to retire, $t = R$. Let lifetime utility be

$$U(C, R) = u(C) - \Gamma R, \tag{1}$$

where u is concave and Γ is a constant that reflects disutility of work. People earn an exogenous wage (w_F) that is subject to social insurance contributions from working in the formal sector (κ) and income taxes (τ). They also receive old-age benefits, $B(S, R)$, that depend on how many contributions they make to the system and therefore when they begin working and when they retire. The lifetime budget constraint is thus

$$C = w_F(1 - \tau)(1 - \kappa)(R - S) + B(S, R). \tag{2}$$

Lifetime consumption is the sum of lifetime wages and public pension wealth.

Individuals choose their retirement age R taking S as given to maximize (1) subject to (2). The first-order conditions yield the following familiar result for optimal retirement:

$$u'(C)(w_F(1 - \tau)(1 - \kappa) + B'(S, R)) = \Gamma, \tag{3}$$

where $B'(S, R)$ is the derivative of B with respect to R.

Equation (3) shows that people should work until the marginal benefit of doing so equals the marginal cost. The left-hand side is the marginal benefit of retiring later: additional earnings plus the change pension wealth from retiring later, converted to utility units. The right-hand side is the marginal cost of retiring later: additional disutility from work.

5.2 Retirement Incentives

This simple model helps us understand retirement incentives. Suppose people have different preferences for leisure and that Γ is smoothly distributed across people. Then, if the return to work, $w_F(1-\tau)(1-\kappa)+B'(S, R)$, is linear, we would expect to see a smooth distribution of retirement ages. However, the pension rules discussed above highlight how $B'(S, R)$ is nonlinear.

To illustrate this point, Figure 3 plots stylized pension wealth profiles. Importantly, pension wealth in practice depends on R and S. The graph therefore plots pension wealth against retirement ages for the same worker with different values of S.[8]

The spikes in pension wealth are due to the person working formally long enough such that they reach the minimum number of contribution-years required to unlock pension benefits starting at either 60, 65, or 70. The smooth increases in pension wealth as R increases are due to increases in the replacement rate from working longer and contributing more years. The declines in pension wealth after the eligibility ages are due to the person working past the age they are first eligible for the pension and thus forfeiting benefits.

First, consider the solid gray line, which depicts pension wealth if the person begins formal work at 20. Working 10 years and retiring at 30 discontinuously increases pension wealth because it results in benefits from 70 until T. Likewise, there are discontinuous increases at 35 and 50 because working 15 years unlocks benefits starting at 65 and working 30 years unlocks benefits starting at 60. Pension wealth is maximized by retiring at 60. Working additional years results in additional 1.25% increases in the replacement rate, but it also means forfeiting years of benefits for which the worker is eligible.

The dashed gray line reveals a similar pension wealth profile if the person begins formal work at 30, but the location of the spikes is different because the worker started working formally later. Notably, people who begin formal work between 20 and 30 maximize pension benefits by retiring at 60 because these people will have contributed for 30 years and will have thus unlocked benefits when they reach 60.

Next, consider the solid black line, which corresponds to the person beginning formal work at 35. There is a spike in pension wealth at 45 for unlocking benefits at 70 and a spike at 50 for unlocking benefits at 65, but there is no third spike due to unlocking benefits at 60 because this person would have to work past 60 to satisfy the requirement of contributing for 30 years. The earliest this person can become eligible for benefits is thus 65, which is also the retirement age that maximizes their pension wealth. If they work until 65, they will have contributed for 15 years and will be eligible for benefits, so working longer translates to forgone benefits and decreases in pension wealth.

Likewise, the dashed black line depicts the case for the worker beginning formal work at 50, which also leads to maximum pension benefits by retiring at 65. Similar to the logic above, all people who begin working formally between 35 and 50 maximize pension wealth by retiring at 65. They will have started contributing early enough to be eligible for benefits at 65 (and thus working past 65 results in decreases in pension wealth), but they will have

[8]To make the dollar amounts somewhat informative, we calculate pension wealth for a worker with a monthly wage of $1,360 (roughly the average) who will die with certainty at $T = 80$ (roughly equal to life expectancy). We also use a simplified version of the replacement rate formula that accounts for the initial 43.75% replacement rate for contributing at least 5 years and the 1.25% increases for working additional years, but that ignores the non-linear increases in the replacement rate between 35 and 40 years of contributions.

started late enough such that they are not eligible at 60 (and thus working before 65 results in increases in pension wealth through the replacement rate channel without the decreases due to forgoing years of benefits).

Finally, consider the dotted black line, which depicts the case for a person who begins working formally at 60. Working 10 years, until 70, leads to a discontinuous increase in pension wealth and unlocks immediate eligibility for benefits, and working past 70 translates to reductions in pension wealth. People who begin working formally between 55 and 60 also experience disincentives to work past 70, as these people would not have worked long enough to be eligible for benefits at 60 or 65, but would unlock benefits at 70.

Of course, there are other cases not depicted in the figure. Different starting ages translate to similar-shaped pension wealth profiles, but with spikes and declines in pension wealth at different retirement ages. For instance $S = 31$ translates to spikes in pension wealth at 41 (from contributing 10 years), 46 (from contributing 15 years), and 62 (from contributing 30 years), and pension wealth is maximized at 62 (when the worker first becomes eligible to claim benefits). The same logic applies to cases with $S \in [32, 34]$. Similarly, $S = 51$ translates to spikes at 61 and 66 and pension wealth that is maximized by retiring at 66.

Overall, the figure emphasizes a key feature of the pension program. The specified eligibility ages and contribution-years requirements make it such that many workers will obtain maximum benefits by retiring right at 60, 65, or 70, and that the disincentives to work past these ages depend on how long a person has worked in the formal sector.

5.3 Identification Strategy for Studying the Heterogeneous Effects of Reaching Pension Eligibility Ages

To quantify the effects of these retirement incentives, we use a regression discontinuity (RD) design. We test for discontinuous changes in the probability of retiring right around each of the pension eligibility age cutoffs, and we assess how these changes vary with when a worker joined the formal workforce and began making contributions to the social security system.

5.3.1 Analysis Sample and Key Variables

To construct our analysis sample, we begin with all individuals in our administrative dataset on people who have ever contributed to the social security system as of December 2022. We exclude observations corresponding to deceased individuals for two reasons. First, we cannot compute current age for these individuals, which is a key input in our regression discontinuity analyses. Second, including deceased individuals would overestimate our definition of retirement in the case of individuals who died at least two years before December 2022. Our resulting analysis sample contains a cross-sectional dataset with observations on 6,323,252 unique individuals.

We then define three subgroups of interest, guided by our benchmark model. First, we study individuals who started contributing to social security between 20 and 30, for whom we expect to see larger retirement responses when they reach 60. Second, we study individuals who started contributing between 35 and 50, for whom we expect to see larger responses at 65. Third, we study individuals who started contributing between 55 and 60, for whom we expect to see larger responses at 70.

5.3.2 Estimating Equations

For each of these subgroups, we estimate equations of the following form:

$$Retirement_i = \alpha + \beta \cdot 1[Age_i \geq c] + \gamma \cdot f(Age_i - c) + \delta \cdot 1[Age_i \geq c] \cdot f(Age_i - c) + \epsilon_i, \quad (4)$$

where $Retirement_i$ is the probability that individual i did not contribute to social security for at least 2 years as of December 2022, Age_i is the age in months of the individual in December 2020 (which is 2 years before the records in our data stop), the running variable, c, is the retirement age cutoff with $c \in \{60, 65, 70\}$, $f(Age_i - c)$ is a flexible function of the distance between the running variable and the cutoff, and ϵ_i is an error term. The coefficient of interest is β, which captures the average impact of reaching pension eligibility ages on retirement decisions for individuals with ages around the cutoffs.

In our baseline regression specification, we use triangular weights, a quadratic polynomial in the running variable, and a 60-month bandwidth around each cutoff. We assess the robustness of our estimates to these choices after presenting the results.

5.3.3 Assessment of Validity

The identifying assumption is that other factors that influence retirement do so smoothly as people reach pension eligibility ages. To provide some assessment on the validity of this assumption, we carry out two standard analyses.

First, we analyze the density of the running variable, age in months. Because people cannot change their age, we anticipate traditional concerns about manipulation to be unlikely. Still, for each group, Appendix Figure A2 plots the histogram of the running variable and density estimates based on second-order polynomials around each retirement age cutoff. We conclude that there is no evidence of problematic discontinuities in the density of the running variable.

Second, we test for discontinuities in gender, the only covariate in our administrative data, which should not change discontinuously as people reach pension eligibility age. Reassuringly, we estimate equation (4) using gender as the outcome variable and find no evidence that reaching pension eligibility ages impact gender (see Appendix Figure A3).

5.4 Results: Heterogeneous Effects of Reaching Pension Eligibility Ages

We begin with a standard RD graphical analysis. For each subgroup and for each pension eligibility age cutoff, we plot binned means of the outcome variable (retirement) against the running variable (age in months) for people around the cutoffs. We then superimpose on these graphs regression lines from estimating separate quadratic trends in the running variable for observations on either side of the cutoffs.

Figure 4 presents these graphs. Panel (a) corresponds to the age-60 cutoff, panel (b) corresponds to the age-65 cutoff, and panel (c) corresponds to the age-70 cutoff. Within each panel, the left-hand-side graph is for people who began contributing to the social security system between 20 and 30, the middle graph is for people who began contributing between 35 and 50, and the right-hand side graph is for people who began contributing between 55 and 60.

First, consider the age-60 cutoff in panel (a). There is a clear and discontinuous increase in the probability of retiring for individuals who entered the formal workforce and started contributing to the social security system between 20 and 30. In contrast, the other graphs show that the probability of retirement evolves smoothly through the age 60 cutoff for people who began working formally later in life and who therefore are not eligible for pension benefits at 60.

Next, consider the age-65 cutoff in panel (b). The graphs show clear and discontinuous increases in retirement for both people who started working between 20 and 30 and for people who started working between 35 and 50. These groups of workers began working formally early enough to accumulate long enough contribution histories to be eligible for pension benefits at 65. Note that our theoretical framework assumes that individuals work continuously until retirement, which is what delivers the clear prediction for increases in retirement at 65 for the middle group of workers who begin contributing between 35 and 50. However, in practice, workers may not work continuously for a number of reasons, and therefore some of the workers who began contributing even earlier may not have enough contribution-years to retire at 60, which could explain the increase in retirement at 65 for those who begin their formal careers between 20 and 30.

Finally, consider the age-70 cutoff in panel (c). The graphs reveal little evidence of an increase in retirement at 70 for those who began their formal careers between 20 and 30 and strong evidence of an increase in retirement for those who began their formal careers later. The pattern is particularly stark for those who made their first contribution to the social security system between 55 and 60. Overall, the graphs in this panel are consistent with the disincentives to delay retirement past eligibility ages. People who begin their formal careers in their 20s and accumulate more than 15 years of contributions will become eligible for benefits—and experience incentives to retire—before 70.

To quantify these effects and assess the statistical significance of the findings, we turn to the regression analysis. Table 1 displays results from estimating equation (4). Specifically, the table presents point estimates for each cutoff and each subgroup. Each panel in the table corresponds to a different cutoff, and each column corresponds to a different subgroup.

Consistent with the RD figures, panel (a) shows that there is a statistically significant 11.3 percentage point increase in the probability of retiring at 60 for people who began working in the formal sector between 20 and 30. This increase represents a 33% increase compared to the mean for those who are marginally younger than 60. In contrast, we find no evidence of discontinuous increases in retirement at 60 for those who started their formal careers later.

Panel (b) shows statistically significant increases in the probability of retiring at 65 that amount to 12.9 percentage points (22.9%) for those who began formal work between 20 and 30 and 14.1 percentage points (28.1%) for those who began formal work between 35 and 50.

Finally, panel (c) shows greater increases in retirement at 70 for those who began formal work later in life. The point estimates indicate 3.6 percentage point (4.3%), 9.1 percentage point (12.9%), and 20.4 percentage point (45.4%) increases in retirement at 70 for those who began formal work between 20 and 30, 35 and 50, and 55 and 60, respectively.

5.4.1 Robustness

These regression results are robust to alternative specifications. In Appendix Figure A4, we show robustness to bandwidth and polynomial choices. For each polynomial choice (1st to 3rd order) we plot coefficients estimated using different bandwidths. In Appendix Table A2, we assess the robustness of the estimates to including gender and month-of-birth as controls, to dropping triangular weights, and to using an MSE-optimal bandwidth following Calonico et al. (2019). Our baseline point estimates are reasonably stable and our takeaways do not appear sensitive to these specification choices.

Overall, our RD analysis indicates that the pension eligibility ages in Ecuador are key drivers of retirement. Moreover, it underscores the impact of the incentives built in to the system that link retirement decisions later in life to when individuals entered the formal workforce earlier in life.

6 The Effects of Pension Eligibility Rules on Earlier Labor Supply

Thus far, our analyses take the age of entrance to the formal labor force as given. However, the pension program may also affect labor supply earlier in life. In this section, we empirically test if this is the case.

Specifically, we analyze how the pension eligibility rules impact earlier labor supply decisions about when to work in the formal sector. In developing country contexts like ours, the existence of a public pension for workers with sufficiently long formal work histories can influence not just formal retirements, but also earlier-in-life decisions about when to work formally versus informally.

6.1 Economic Framework

We use our benchmark model of retirement to highlight how the pension program influences the trade-offs people face related to formal versus informal work. Consider the same setup as before, except now workers begin their career as an informal worker at time $t = 0$, choose to switch to formal employment at time $t = S$, and choose to retire at time $t = R$.[9] Let wages earned in the informal sector be w_I, which are not subject to social insurance contributions or income taxes.

If the disutility of working in the formal sector is the same as the disutility of working in the informal sector, then lifetime utility remains as described before. The key change is to the lifetime budget constraint, which now can be written as

$$C = Sw_I + (R - S)w_F(1 - \tau)(1 - \kappa) + B(S, R). \tag{5}$$

With a career in the informal sector before the formal sector, lifetime consumption is the sum of (i) lifetime earnings in the informal sector, (ii) lifetime earnings in the formal sector, and (iii) pension wealth.

This setup illustrates the key trade-off workers face. All else equal, working informally longer on the margin leads to more (tax-free) informal wages, w_I, but less formal wages, $w_F(1 - \tau)(1 - \kappa)$, and less pension wealth through the replacement rate channel.

In practice though, there are many factors outside the scope of this simple framework that could be important for workers to consider. For example, on the one hand, there may be additional benefits to working formally long enough to unlock some pension wealth because people face uncertain longevity and pensions provide insurance against living too long.

[9] Of course, this way of modeling careers is a simplification. In practice, there are likely transitions in and out of informality and some people may begin their working lives in the formal sector before switching to the informal sector.

On the other hand, there may be additional drawbacks to working formally. For example, liquidity constraints can lead workers to put additional value on avoiding social insurance contributions or avoiding income tax payments. Still, there are other factors to consider. Evidence from Ecuador and Uruguay suggests that receiving government benefits like cash transfers may reduce engagement in the formal sector amid concerns that the government would revert these benefits based on their formal income (Bosch and Schady, 2019; Cruces and Bérgolo, 2013). Formal sector jobs may also simply be harder to obtain, as they often require more investments in education (Ulyssea, 2020). In the case of Ecuador, employers also contribute to social security on behalf of their employees, which increases the relative cost of hiring a worker formally. Informal jobs may also have perks of their own as they may offer flexibility (Berniell et al., 2021). More broadly, labor legislation may create incentives to hire workers informally (Besley and Burgess, 2004). Overall, one could think about all of these additional factors as being captured by κ and influencing the relative returns to working formally versus informally.

Based on this setup, when do we expect people to enter the formal workforce? If people value the pension program, and especially access to benefits as soon as they retire, then they have incentives to start working in the formal sector as soon as possible and to work just long enough to unlock benefits at eligibility ages. But if people also value working in the informal sector, they can time their entrance to the formal sector such that they contribute the minimum number of years required to unlock pension benefits. We therefore test whether people are discontinuously more likely to enter the formal labor market at age (i) 30, in anticipation of contributing 30 years before unlocking benefits at 60, (ii) 50, in anticipation of contributing exactly 15 years before unlocking benefits at 65, and (iii) 60, in anticipation of contributing for 10 years before unlocking benefits at 70.

6.2 Preliminary Graphical Evidence

Figure 5 provides suggestive graphical evidence that indeed some people time their entrance to the formal labor force based on how many years they plan to contribute. Each graph plots the distribution of age at first contribution to the social security program for three different groups of people. Panel (a) corresponds to those who contributed for exactly 30 years before retiring from the formal labor force, panel (b) corresponds to those who contributed for exactly 15 years, and panel (c) corresponds to those who contributed for exactly 10 years. For each group, there is significant mass around age 20, consistent with the idea that many begin to work formally after completing their education.

However, strikingly, there are also significant spikes in the distributions elsewhere. For people who retired with exactly 30 years of contributions and are thus eligible for pension benefits at 60, there is a large spike right around age 30. For people who retired with exactly 15 years of contributions and are thus eligible for benefits at 65, there is a large spike around 50. For people who retired with 10 years of contributions and are thus eligible for benefits at 70, there is a spike around 60. Appendix Figure A5 provides another look at the distributions of age at first contribution, using a more granular monthly-level age measure that is not rounded up to yearly ages. We observe large spikes in initial contributions around monthly ages 360, 600 and 720, which correspond to ages 30, 50, and 60, respectively.

These spikes are consistent with the predictions above and with the idea that some individuals time their entrance to the formal labor market such that they can contribute the minimum number of years required before retiring once they reach pension eligibility.

6.3 Identification Strategy: Regression Discontinuity Design

To study the causal effects of the pension eligibility regulations on entrances to the formal labor market, we use a regression discontinuity design to test whether there are discontinuities in transitions to the formal workforce at earlier critical ages. To carry out this analysis, we use survey data, which have two advantages. First, crucially, the data contain information on the formally employed, informally employed, and non-employed. Second, the survey is a rotating panel that follows individuals over time. These two features allow us to study transitions in work status from one survey wave to the next.

6.3.1 Analysis Sample and Key Variables

To construct our analysis sample, we begin with all person-wave observations in our survey data between 2008 and 2016. Then, because household and person identifiers in the data are sometimes reused after many survey waves, we take a few data cleaning steps to ensure that we can accurately identify observations of unique individuals over time.

First, we construct unique individual-level identifiers by concatenating region, household, and person identifiers. This step yields 2,116,850 observations corresponding to 1,382,227 individuals.[10] Next, because people are surveyed for a maximum of four waves (i.e. quarters) by design, we check whether there are any individual identifiers for which we appear to have more than four observations. In these cases, we assign new individual identifiers to observations that appear in the subsequent survey waves. Then, to reduce the likelihood that an individual identifier is erroneously assigned to more than one person, we drop observations of people whose age appears to decrease over time or whose sex assigned at birth changes over time. These restrictions yield a sample of 2,072,495 observations on 1,364,433 unique

[10]On average, an individual is observed in 2.6 survey waves.

individuals. Finally, we exclude observations of individuals younger than 15, who cannot legally work for a formal firm. The final sample contains 1,469,795 observations on 967,451 working-age individuals.

To implement our RD design, we leverage the panel dimension of the survey data to construct our variables of interest, and we collapse the data to a person-level cross section. Specifically, for each person in our analysis sample, we define the running variable as the age of the individual during the first survey wave that the individual is present in the data, and we define various outcome variables that capture transitions to the formal workforce. We define a person as being in the formal workforce if they are affiliated with IESS. Our primary outcome of interest is an indicator variable for transitioning to formal employment. It equals one if the individual was not in the formal workforce during their initial survey wave but was in the formal workforce in one of their subsequent survey waves. We also study additional transition outcomes that are similarly defined, but that capture transitions to the formal workforce from either informal employment or from non-employment.

6.3.2 Estimating Equations

We estimate equations of the following form:

$$Transition_i = \alpha + \theta \cdot 1[Age_i \geq c] + \gamma \cdot f(Age_i - c) + \delta \cdot 1[Age_i \geq c] \cdot f(Age_i - c) + \mu_t + \epsilon_i, \quad (6)$$

where $Transition_i$ is an outcome variable for transitioning to the formal workforce, Age_i is the age in years of person i during their initial survey wave, $1[Age_i \geq c]$ is an indicator variable for being older than the age cutoff of interest, c, $f(Age_i - c)$ is a flexible function of the distance between the running variable and the age cutoff, μ_t denotes survey-year fixed effects, and ϵ is an error term. The coefficient of interest is θ, which captures the average impact of reaching one of the age cutoffs on transitions to the formal workforce for individuals around that cutoff.

Our theoretical framework and our preliminary graphical analysis suggest that strategic timing of transitions to the formal sector should occur when people turn 30, 50, and 60. Because our running variable is age during a person's initial survey wave and our outcomes are defined using the subsequent survey waves, we define the age-at-initial-survey-wave cutoffs as 29, 49, and 59. We are thus testing for discontinuous changes in transitions to the formal workforce for people who reach the critical ages during the subsequent survey waves used to define the transition outcomes.

In our baseline specification, we estimate equation (6) using triangular kernels and the survey sampling weights for each person's initial survey wave. We include a quadratic polynomial in age, use a 10 year bandwidth around each side of the cutoff, and use robust standard errors. As before, we assess the robustness of our estimates to these choices after presenting the results.

6.3.3 Assessment of Validity

Similar to our previous RD design, the identifying assumption is that other factors that influence transitions to the formal workforce do so smoothly as people reach these early critical age cutoffs. To assess the validity of this assumption, we carry out three analyses.

First, we analyze the density of the running variable, age in years. Appendix Figure A6 presents a histogram of age in the survey data and density estimates using quadratic polynomials around each cutoff. The density of the running variable appears to evolve smoothly through the cutoffs.

Second, we test for discontinuities in covariates. Compared to the administrative data, the survey data contain more information on demographics and thus allow us to look at more covariates. Appendix Table A3 reports differences in demographic characteristics around the age cutoffs. Only 2 out of 30 comparisons are statistically significant at the 5% level. In both cases, the differences are small and relate to the probability of having completed university education. To ensure that our results are not driven by these differences, we conduct a robustness check that includes controls and report the results in Appendix Table A4.

Third, we test for differences in survey attrition around each cutoff, which are reported in the bottom row of each panel in Appendix Table A3. We do not observe evidence of differential attrition around the early age cutoffs.

6.4 Results: Effects of Reaching Earlier Critical Ages on Formal Employment

We begin with a graphical analysis. Figure 6 plots RD graphs that show how the probability of transitioning to formal employment evolves around each of the early critical ages. Panels (a), (b), and (c) correspond to the transitions at 30, 50, and 60, respectively.

Panel (b) shows a visually clear, discontinuous increase in the probability of transitioning to the formal workforce at 50. To the left of the cutoff, the probability of transitioning hovers around 9 percent, but this probability increases at the cutoff and then continues to rise afterwards. In contrast, panels (a) and (c) show little to no evidence of discontinuous changes in the probability of transitioning to the formal workforce at 30 and 60.

Table 2 presents the corresponding regression results. Column (2) indicates a 1.8 percentage point increase in the probability of transitioning to the formal workforce at age 50. The estimate is statistically significant at the 5 percent level, and it translates to a large, 21% increase compared to the mean of the outcome variable for individuals just below the cutoff. These transitions to formal work also represent a 4.7% increase when compared to the overall probability of being affiliated with social security, which is 38% just below the cutoff. Consistent with the graphical evidence, the point estimates for transitions at 30 and 60, in columns (1) and (3), respectively, are smaller in absolute magnitude and are not statistically distinguishable from zero.

These results indicate that the pension program induces some people to time their transitions to working in the formal labor market. The findings are consistent with the contribution-minimizing incentives influencing transitions to the formal labor market at age 50, but not much earlier in the lifecycle (at 30) or later (at 60). While there could, of course, be many possible explanations for these patterns, one potential reason for why we do not observe discontinuities at 30 could be because of greater uncertainty about the ability to work continuously for 30 years in the formal sector. It may be more difficult to time transitions to the formal sector in anticipation of retiring exactly 30 years in the future. Similarly, as for the lack of evidence supporting increases in transitions at 60, it could be that timing transitions at older ages is also challenging because of uncertainty regarding the ability to work continuously. For instance, increasing health risks at older ages may make people less sure they can continuously work formally and make contributions to the system until 70.

Next, we unpack these transitions to formal work at age 50 by investigating whether workers tend to transition to the formal sector from non-employment or informal employment. To do so, we study two additional outcomes: (i) an indicator variable that takes the value of one for workers who were working informally (defined as working but not affiliated with IESS) during their initial survey wave and working formally during a subsequent survey wave, and (ii) an indicator variable that takes the value of one for workers who were not employed during their initial survey wave and working formally during a subsequent wave.

Table 3 displays the point estimates and Appendix Figure A7 presents the RD graphs. The results suggest the transitions to formal work are primarily explained by transitions out of the informal sector and not from non-employment. The point estimates indicate a statistically significant 1.4 percentage point increase in the likelihood of transitioning from informal work to formal work (column 1) and a 0.3 percentage point increase in the likelihood of transitioning from non-employment to formal work that is not statistically significant (column 2). The point estimate for informal-to-formal transitions thus accounts for 77% of the overall increase in the probability of transitioning to formality at age 50.

Overall, the results are consistent with forward-looking behavioral responses to the pension program for some and emphasize the trade-off between earnings in the informal sector and earnings in the formal sector with access to public pension benefits.

6.5 Mechanisms

How do workers facilitate these transitions to the formal sector? Formal jobs may be more difficult to obtain than informal jobs. Moreover, firms must make contributions to social security on behalf of their formal employees, which increases the costs of hiring a formal worker compared to an informal worker. Both of these factors would be expected to complicate strategic transitions to formality for workers. In this section, we conduct additional analyses to shed light on how some workers make the transitions.

6.5.1 Exploring Paths to Formal Employment

One possibility is that people make these transitions by switching occupations. Some occupations might be more accommodating of switches to the formal sector than others. To investigate this hypothesis directly, we use a variable in the survey data that records the number of years an individual has performed their current occupation as an outcome. We compute average tenure excluding data from the first survey wave. One caveat is that we only observe tenure for individuals who were employed at baseline. With this caveat in mind, column (1) in Table 4 shows no evidence of a discontinuity in this measure of occupational tenure, which provides one piece of evidence against the idea that the transitions are facilitated by people switching occupations.

The evidence thus suggests that people are performing the same job, but doing so formally instead of informally. There are three ways in which this can happen. First, entrepreneurs or self-employed individuals may formalize their activities by starting to contribute to social security as independent workers.[11] Second, workers may continue to perform the same occupation at the same firm, switching their contractual status from informal to formal. Third, workers may perform the same occupation but at a different registered (formal) firm.

We can test the first mechanism directly. We leverage information on the type of affiliation to IESS to compute two different outcomes: (i) the probability of transitioning to the formal sector as an employee and (ii) the probability of transitioning to the formal sector as a self-employed worker who is self-affiliated with IESS. Columns (2) and (3) in Table 4 report the effects of reaching age 50 on these outcomes, and Appendix Figure A10 displays the corresponding RD graphs. Column (2) of the table shows a statistically significant effect for transitions as an employee. Column (3) shows a positive, but not statistically significant, effect for transitions as a self-employed worker. The point estimate in column (2) suggests

[11] As discussed in Section 2, an individual can contribute to IESS as an independent worker as long as they are registered with the tax authority. In this case, the individual contributes 17.6% of their monthly earnings. This type of arrangement is present in other settings too, like the U.S., where the self-employed also contribute to social security.

that transitions to formality as employees account for 64% of the effect on overall transitions from informal to formal work at age 50. Overall, these results do not support the idea that the main results are primarily driven by entrepreneurs formalizing their businesses activities, but rather that employees are able to change their formality status.

We next analyze the extent to which the adjustment happens among workers that switch their mode of contract within the same firm or among workers switching to formal firms. While we are unable to test these two hypotheses directly because we cannot identify the specific firms at which people work, we can analyze effects based on the types of firms that workers transitioning to the formal sector were at previously.

Specifically, we use self-reported information on whether the firms at which individuals work are registered with the tax authorities and test for discontinuous changes in the probability of transitioning to the formal sector for informal workers who worked initially at unregistered (informal) versus registered firms. Columns (4) and (5) of Table 4 present the point estimates, and Appendix Figure A11 presents the RD graphs. The results indicate that the probability of transitioning to formal employment from informal work at a registered firm increases by 1 percentage point at age 50. This estimate thus accounts for 71% of the overall effect on transitions to formal employment. In contrast, we find no evidence of a discontinuous change in the probability of transitioning to formal employment from working informally at an unregistered firm.

The patterns thus far indicate that workers transition to the formal sector by continuing to work in the same occupation and by continuing to work at formal firms, but formally instead of informally. While this type of switch may help workers minimize contributions to the social security system, it requires firms to be willing to facilitate these switches as well. We therefore suspect that workers who are better situated to negotiate the terms of their contracts with their employers will be more able to time transitions to formal employment.

To investigate this idea, we explore the role of family firms, where closer relationships between workers and employers may increase worker bargaining power and where incentives of workers maximizing utility and incentives of employers maximizing profits may be more aligned. To proxy for whether a person works at a family firm, we use information in the survey on whether an individual lives in the same household of the owner of a formal or informal firm. We then examine heterogeneous responses along these dimensions.

Figure 7 presents the results. Panel (a) displays RD estimates from estimating equation (6) where the outcome is the probability of transitioning from informal work at a registered firm to formal work. Each point estimate corresponds to a different subsample, either (i) people who live in the same household as an owner of a formal business registered with the tax authorities, (ii) people who live in the same household as an owner of an informal business that is not registered with the tax authorities, or (iii) people who do not live in the same household as an owner of a business. The results indicate substantially larger effects for individuals who live with owners of registered firms. The point estimate for this subsample is statistically different from the one corresponding to individuals who live with owners of unregistered businesses (p-value = 0.036) and from the one for individuals who do not live with business owners (p-value = 0.027). Interestingly, we find no evidence of effects for individuals who do not live with business owners or who live with owners of unregistered businesses. These estimates suggest that the main results are unlikely to be explained by households owning businesses per se. Instead, strategic transitions to formal employment seem to occur in firms where employers and employees have incentives to cooperate.

One alternative possibility is that workers switch from some other unregistered firm to a relative's formal firm. Panel (b) of Figure 7 suggests that this pathway is unlikely. It displays point estimates for the same three groups, but where the outcome is the probability of transitioning from informal work at an unregistered firm to formal work. We find no evidence of increases in these transitions for any of the groups.

6.5.2 Who are the Workers at Family Firms?

The results indicate that some, but not all, types of workers are able to time forward-looking transitions to formal employment in response to pension incentives. Who are these workers at family firms that may be able to switch from informal to formal employment right when it is advantageous to do so?

Appendix Table A6 reports summary statistics for individuals around age 50. Column (1) reports statistics for all individuals, columns (2) and (3) focus on individuals who live with owners of registered and unregistered businesses, respectively, and column (4) focuses on individuals who do not live with business owners. We note three interesting patterns.

First, individuals living with owners of registered businesses are more likely to be women, married, and married to a business owner, compared to the other groups. These statistics suggest that the large effects that we find for individuals living with owners of registered businesses are driven by women. This pattern is thus broadly consistent with findings like the *added worker* effect (Lundberg, 1985), in the sense that we appear to find evidence consistent with the labor supply of married women being relatively more sensitive to their economic circumstances.

Second, individuals living with owners of registered businesses are more likely to have a university degree. This statistic might underscore the importance of being able to learn and understand the intricacies of the public pension system before being able to respond to the resulting incentives. Third, these individuals have higher household incomes. This statistic suggests that these people may be the ones facing higher income tax rates and thus stronger incentives to time their entrance to formality to avoid income taxes.[12]

Overall, these patterns suggest that the costs and benefits of timing formal employment in response to pension incentives are heterogeneous, which may explain why it is a particular subgroup who appears to exhibit forward-looking behavior.

6.6 Robustness of Estimates

We conduct several robustness checks. For simplicity, we focus on our main results on overall transitions to formality.

First, we report the results from alternative regression specifications. In Appendix Table A4, we report results from specifications that include a rich set of demographic controls, that drop the triangular kernels, and that use an MSE-optimal bandwidth (Calonico et al., 2019). In Appendix Figure A8, we further show that the results are robust to a combination of alternative polynomial degrees and different bandwidths, in particular to narrower ones. Reassuringly, our results are broadly robust to alternative specification choices.

Second, we assess the importance of using sample weights. Our main specification uses survey weights from the first time an individual is observed in the data. However, survey weights change in subsequent waves to correct for non-response rates. Appendix Table A5 reports the robustness of the estimates to changes in how we use the survey weights. Panel (a) reproduces our main estimates, panel (b) reports results from alternatively using survey weights from the final wave in which the person is observed, panel (c) reports results from averaging the survey weights across waves, and panel (d) reports results from not using any survey weights. The magnitudes of the point estimates are similar when we use weights in panels (a), (b), and (c), but the key estimate for transitions at 50 is smaller and not statistically significant when we do not use survey weights at all. One potential explanation for this pattern could be that, without survey weights, the subgroups that are more likely to transition at 50 represent a relatively smaller share of the sample. To investigate this idea, Appendix Figure A12 replicates the subgroup analysis in Figure 7 with and without using weights. Reassuringly, we observe the same patterns with either approach.

[12]In addition, individuals living with owners of registered business live in households with a lower demand for care, suggesting that they may face less additional frictions that can limit the ability to respond to incentives.

7 Conclusion

In this paper, we use administrative and survey data from Ecuador to provide new evidence on how public pensions impact retirement and earlier labor market outcomes. First, we document spikes in retirement at the pension eligibility ages of 60, 65, and 70. Next, we use a simple model to show how the incentives to retire at each of the eligibility ages depend on how long a person has contributed to the system, and we find that the increases in retirement at the eligibility ages are indeed driven by different groups of people who began working formally at different ages. Finally, we study how the pension program impacts earlier-in-life transitions to the formal sector. We find clear evidence of a discontinuous increase in informal-to-formal transitions at 50, consistent with forward-looking people timing their participation in the social security system to minimize contributions while still becoming eligible for benefits at one of the eligibility ages. Additional evidence on mechanisms highlights a role for family firms in helping workers to facilitate these transitions.

Our paper has implications for public pension policy in developing countries. First, our analysis of retirement reinforces a key takeaway from the broader literature that eligibility ages influence labor market exits, and our theoretically-grounded investigation into heterogeneity supports the idea that these retirements at pension eligibility ages in Ecuador are linked to strong disincentives to work from rules that limit the gains from delaying benefit claiming. Weakening these types of disincentives may encourage working at older ages. Second, our analysis of earlier-in-life labor market outcomes uncovers an additional way that pension eligibility ages can influence labor supply. Our finding of strategic transitions to the formal sector indicate that the work history requirements attached to pension eligibility influence not just the timing of when formal careers end, but also when they begin. More generally, our results highlight how pension programs can indeed influence earlier labor supply decisions of forward-looking people many years before typical retirement ages.

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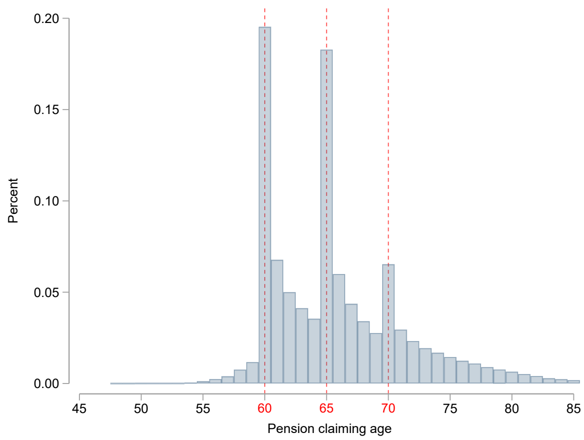
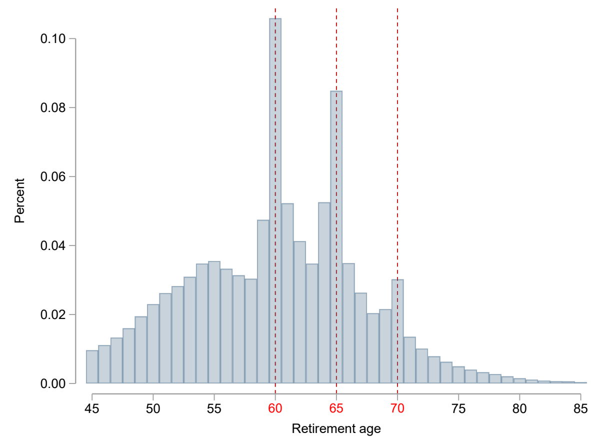
Figures and Tables



(a) Pension Claiming



(b) Retirement

Figure 1: Distributions of Pension Claiming Ages and Retirement Ages

Notes: This figure plots the distributions of pension claiming ages and retirement ages. Panel (a) plots pension claiming ages. The underlying sample consists of people in our administrative records covering the universe of pensioners as of December 2022. Panel (b) plots retirement ages. The underlying sample consists of people in our administrative records covering the universe of contributors to the social security system between 2001 and 2022 who were 55 or older in December 2022. We define one of these older individuals as retired if they did not make a contribution to the system for the two years preceding December 2022.

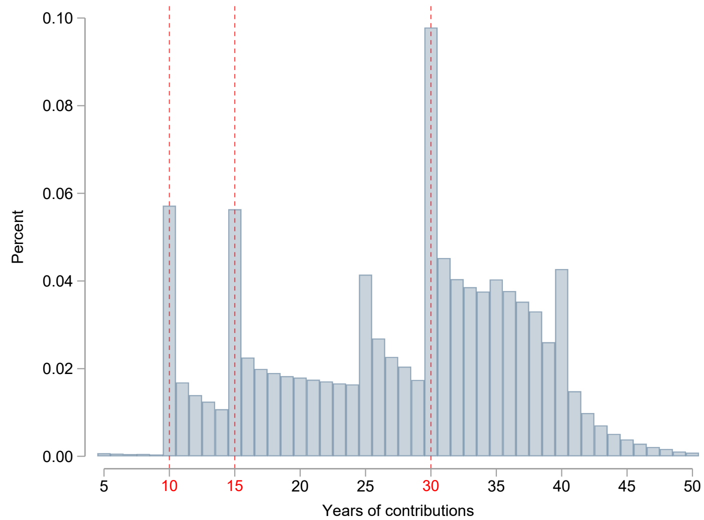


Figure 2: Distribution of Contribution-Years

Notes: This figure plots the distribution of the number of contributions to the social security system (in years) for individuals receiving old-age pension benefits.

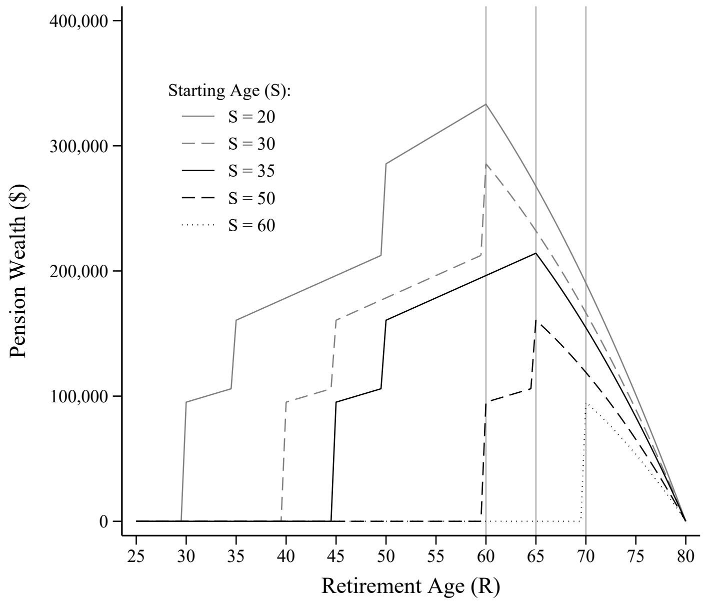
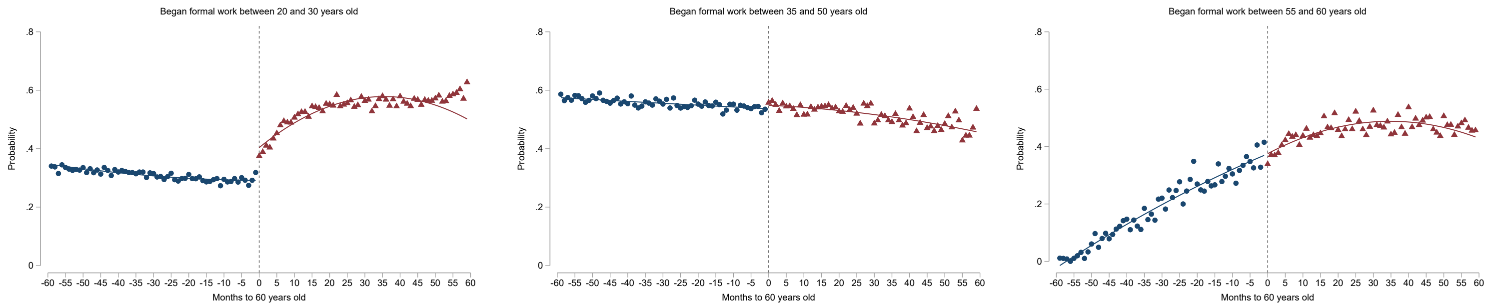
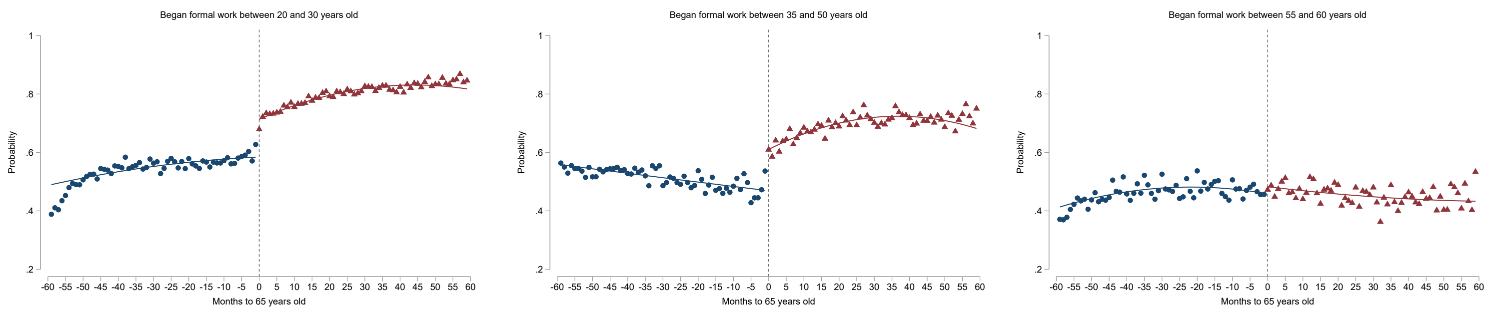


Figure 3: Pension Wealth Profiles by Age of Initial Contribution

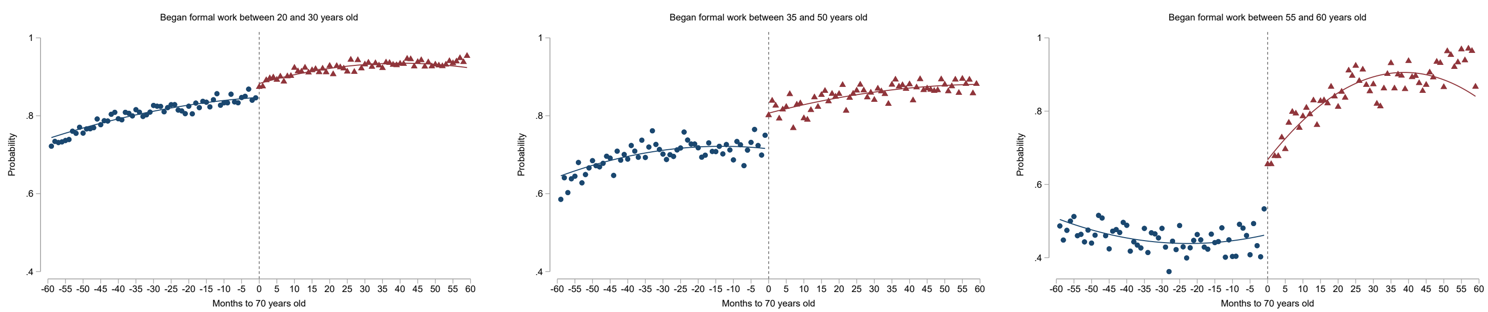
Notes: This figure plots stylized pension wealth profiles by the age at which one begins their formal career. The x-axis is retirement age, R. The y-axis is pension wealth, measured in U.S. dollars. The various lines correspond to a person who starts working in the formal sector at different ages, S.



(a) Retirement around age 60



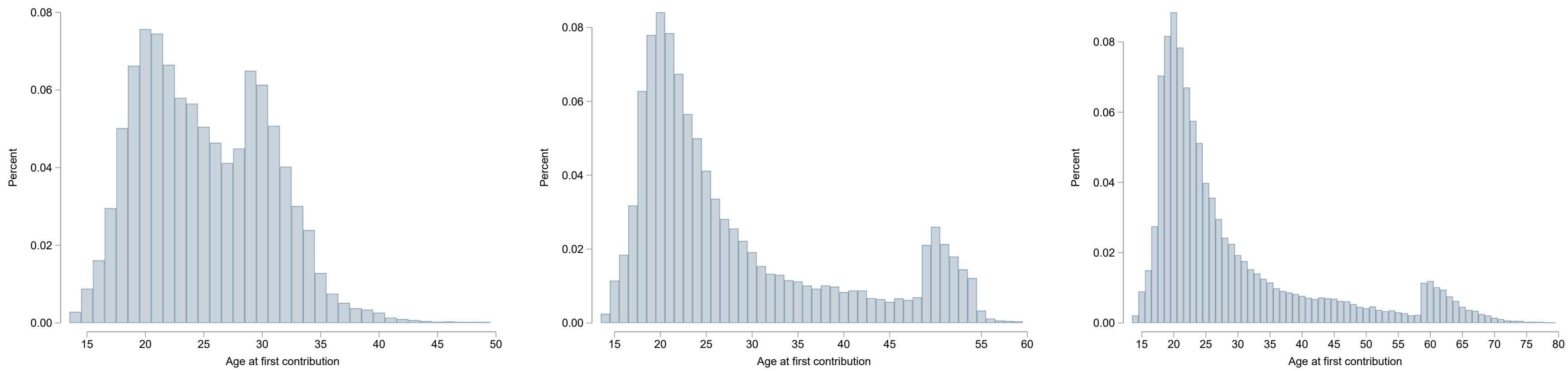
(b) Retirement around age 65



(c) Retirement around age 70

Figure 4: Effects of Reaching Pension Eligibility Ages on Retirement, by Age of Initial Contribution

Notes: This figure reports means of the probability of retiring by distance (in months) to each pension eligibility age cutoff and by age of entry into the formal labor force. Panels (a), (b), and (c) correspond to the different eligibility ages. Within a panel, each graph corresponds to a different group of people who began formal employment at different ages. The solid lines represent quadratic fits of the outcome as a function of the distance to the cutoff.



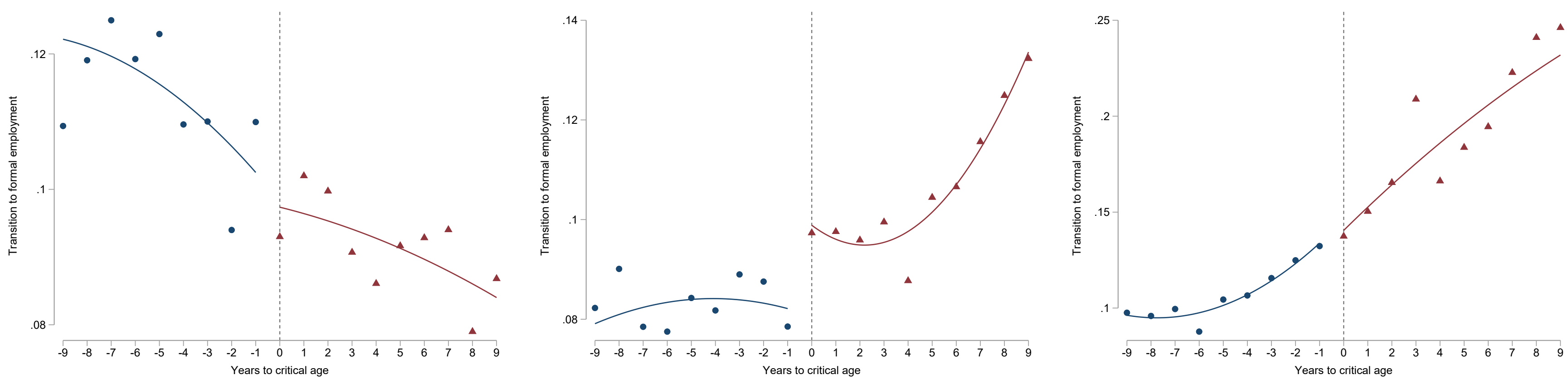
(a) 30 years of contributions

(b) 15 years of contributions

(c) 10 years of contributions

Figure 5: Distributions of Age at First Contribution, by Years of Contributions

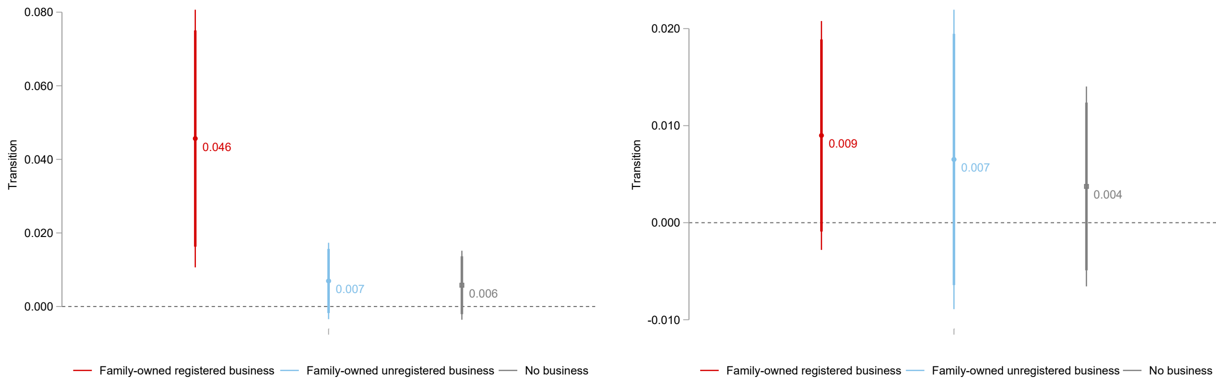
Notes: This figure plots the distributions of ages (in years) at which an individual made their first contribution to the social security system. Each panel corresponds to a different subsample. Panel (a) is for people who retired with exactly 30 years of contributions, panel (b) is for people who retired with exactly 15 years of contribution, and panel (c) is for people who retired with exactly 10 years of contributions.



(a) Transitions upon turning 30 years old (b) Transitions upon turning 50 years old (c) Transitions upon turning 60 years old

Figure 6: Effects of Reaching Earlier Critical Ages on Transitions to Formal Employment

Notes: This figure depicts the mean probability of transitioning to formal employment by distance (in years) to the earlier critical age cutoffs. Panel (a) depicts transitions to formal employment around age 30, panel (b) depicts transitions around age 50, and panel (c) depicts transitions around age 60. The solid lines represent quadratic fits of the outcome as a function of the distance to the cutoff.



(a) Effects of transitioning to formal employment from informal employment at a registered firm

(b) Effects of transitioning to formal employment from informal employment at an unregistered firm

Figure 7: Heterogeneous Effects of Reaching Age 50 on Transitions to Formal Employment by Family Business Ownership

Notes: This figure depicts RD estimates from estimating equation (6) for different groups of people. In panel (a), the outcome is the probability of transitioning from informal work at a formal firm to formal work. In panel (b), the outcome is the probability of transitioning from informal work at an informal firm to formal work. Within each panel, we plot RD estimates for three different groups: (i) individuals who live in the same household as an owner of a formal business registered with the tax authorities, (ii) individuals who live in the same household as an owner of an informal business not registered with the tax authorities, and (iii) individuals who do not live in the same household as a business owner. The vertical lines display confidence intervals at the 90% level (the thicker lines) and the 95% level (the narrower lines), based on robust standard errors.

Table 1: Effects of Reaching Pension Eligibility Ages on Retirement by Age of Entrance to the Formal Workforce

	(1) Began formal work between 20 and 30	(2) Began formal work between 35 and 50	(3) Began formal work between 55 and 60
Panel a. Age 60 cutoff			
Above cutoff	0.113***	0.012	0.001
	(0.006)	(0.009)	(0.018)
Obs.	308,544	143,230	29,958
Mean below cutoff	0.303	0.551	0.271
Effect size (%)	37.30	2.14	0.29
Panel b. Age 65 cutoff			
Above cutoff	0.129***	0.141***	0.025*
	(0.006)	(0.012)	(0.015)
Obs.	229,876	72,010	40,717
Mean below cutoff	0.562	0.502	0.472
Effect size (%)	22.93	28.12	5.21
Panel c. Age 70 cutoff			
Above cutoff	0.036***	0.091***	0.204***
	(0.005)	(0.012)	(0.019)
Obs.	155,763	47,138	27,799
Mean below cutoff	0.821	0.711	0.449
Effect size (%)	4.33	12.86	45.39

Notes: This table reports RD estimates for the effects of reaching pension eligibility ages on retirement. The point estimates come from estimating equation (4). Each panel corresponds to a different cutoff, and each column corresponds to a different group who entered the formal labor force at different ages. Robust standard errors are reported in parentheses.
* $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Table 2: Effects of Reaching Earlier Critical Ages on Transitions to Formal Employment

	(1) Age 30 cutoff	(2) Age 50 cutoff	(3) Age 60 cutoff
Above cutoff	-0.001	0.018**	-0.005
	(0.009)	(0.008)	(0.013)
Obs.	107,663	84,841	63,527
Mean below cutoff	0.111	0.083	0.112
Effect size (%)	-1.01	21.33	-4.83

Notes: This table reports RD estimates for the effect of reaching earlier critical ages on transitioning to formal employment. The estimates come from estimating equation (6). Each column corresponds to a different critical age cutoff. Robust standard errors are reprated in parantheses.
* p<0.1, ** p<0.05, *** p<0.01.

Table 3: Unpacking the Transitions to Formal Employment at Age 50

	(1) Transition from Informal Employment	(2) Transition from Non-employment
Above cutoff	0.014**	0.003
	(0.006)	(0.006)
Obs.	84,841	84,841
Mean below cutoff	0.044	0.039
Effect size (%)	32.82	8.40

Notes: This table reports RD estimates for the effect of reaching critical age 50 on additional outcomes. The point estimates come from estimating equation (6). Each column corresponds to a different outcome. Column (1) is for transitioning to formal employment from informal employment. Column (2) is for transitioning to formal employment from non-employment. Column (3) is for occupation-specific tenure. Robust standard errors are reported in parentheses.

* p<0.1, ** p<0.05, *** p<0.01.

Table 4: Mechanisms: Effects of Reaching Age 50 on Different Types of Transitions from Informal to Formal Work

	(1) Occupational Tenure	(2) Transition as an Employee	(3) Transition as Self-employed	(4) Transition from an Unregistered Firm	(5) Transition from a Registered Firm
Above cutoff	0.454	0.009*	0.005	0.004	0.010***
	(0.364)	(0.005)	(0.003)	(0.004)	(0.004)
Obs.	68,165	84,841	84,841	84,841	84,841
Mean below cutoff	13.923	0.030	0.015	0.018	0.018
Effect size (%)	3.26	31.07	30.24	24.29	57.29

Notes: This table reports RD estimates for the effects of reaching at 50 on additional outcomes that capture informal-to-formal employment transitions. The point estimates come from estimating equation (6). Each column corresponds to a different outcome variable. Column (1) is for transitions to formal employment as a salaried, dependent worker. Column (2) is for transitions to formal employment as a self-employed, independent worker. Column (3) is cor transitions to formal employment from firms that are not registered with the tax authorities. Column (4) is for transitions to formal employment from firms that are registered with the tax authorities. Robust standard errors are reported in parentheses * p<0.1, ** p<0.05, *** p<0.01.

Appendix: Additional Figures and Tables

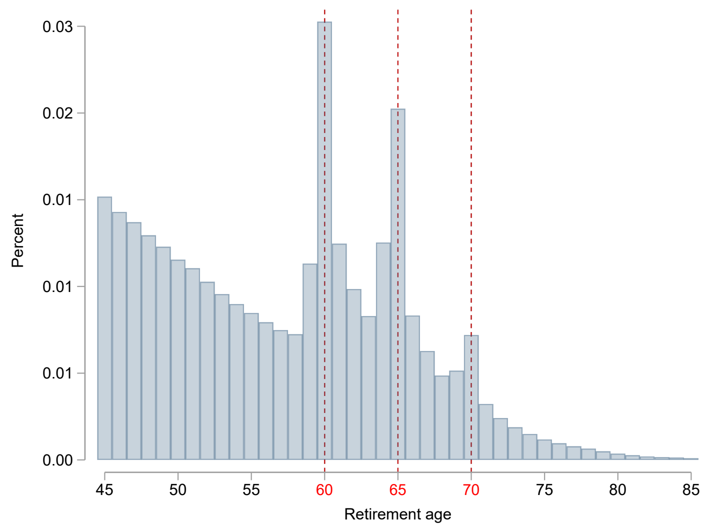
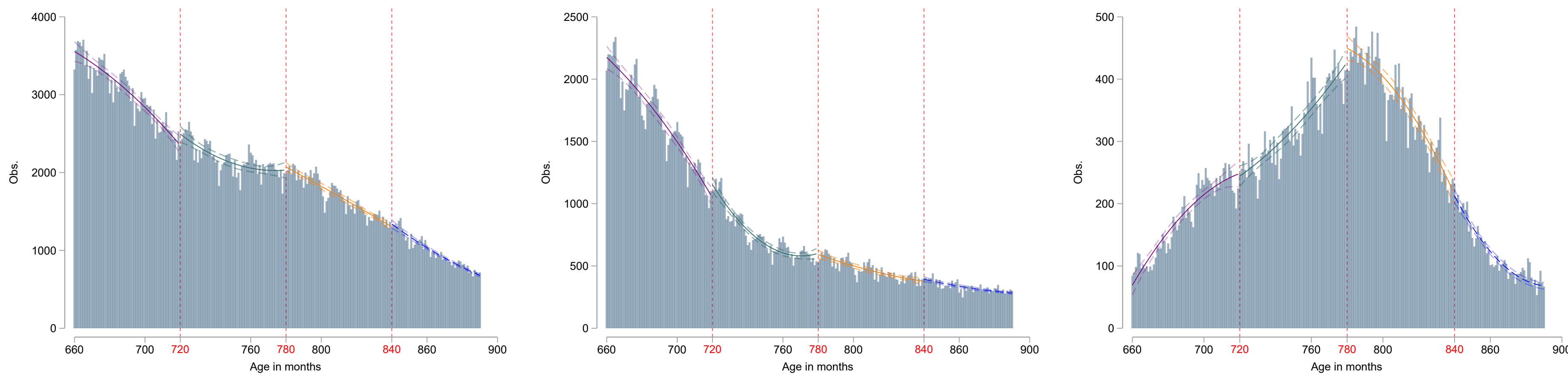


Figure A1: Distribution of Retirement Ages for Individuals who Did Not Contribute for at Least 2 Years Since December 2020

Notes: This figure plots the distribution of retirement ages for individuals who did not contribute to the social security system in 2021 and 2022. Unlike the corresponding figure in our main analysis, this figure is not limited to people who are at least 55 years-old in December 2022.



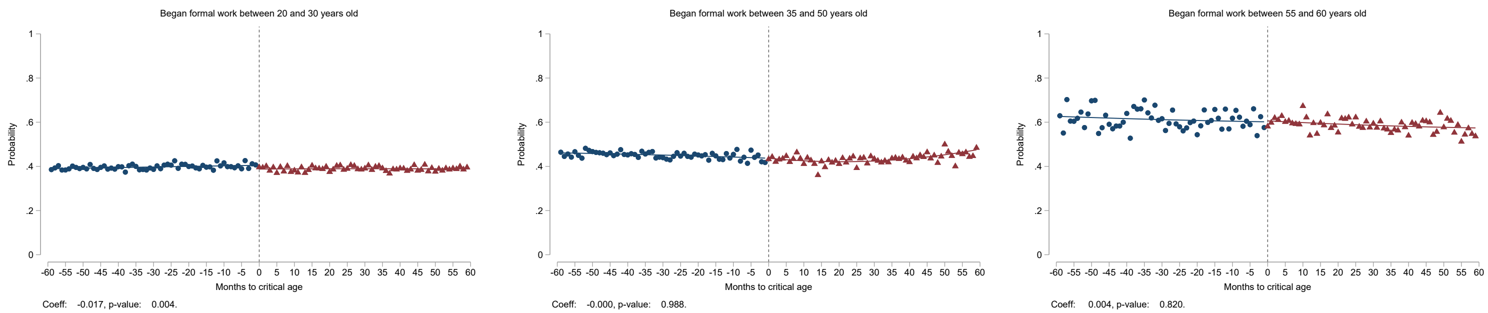
(a) 20 to 30 years old

(b) 35 to 50 years old

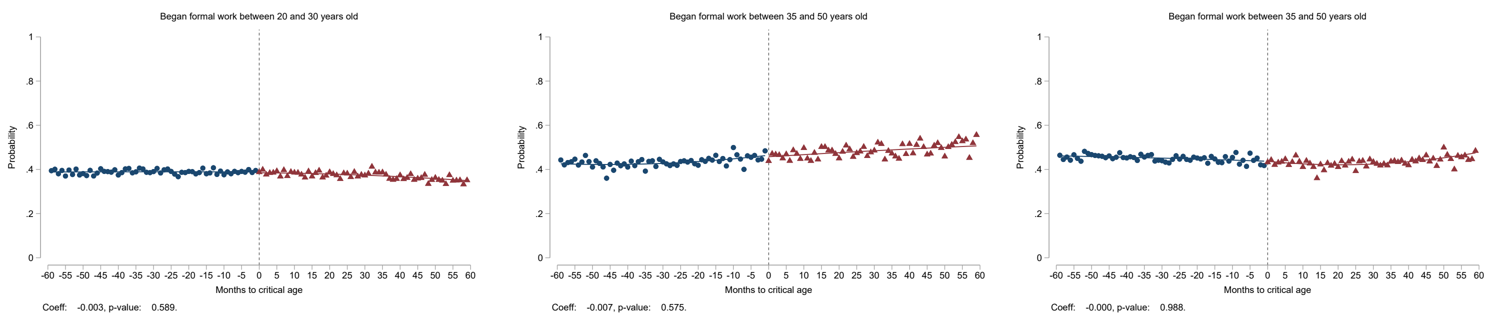
(c) 55 to 60 years old

Figure A2: Density Test for the Effects of Pension Eligibility Ages on Retirement

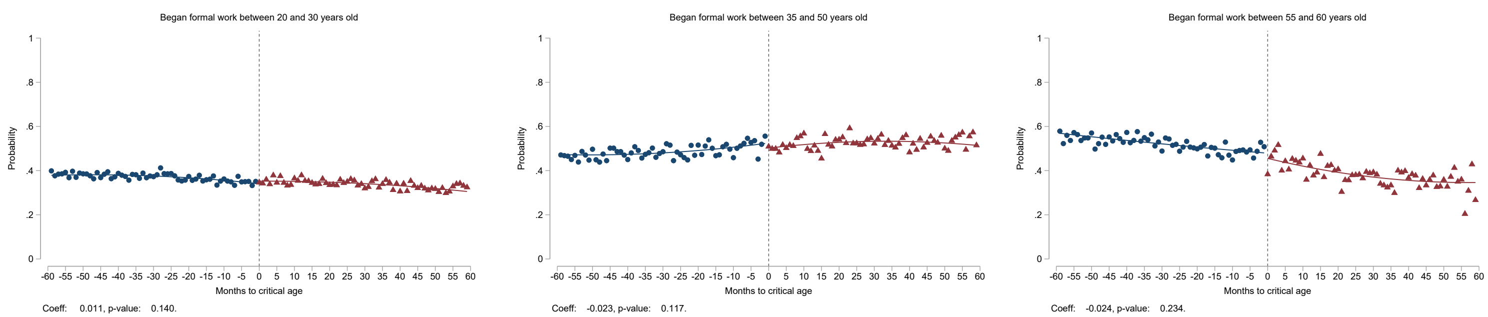
Note: This figure depicts the distribution of current ages (in months) by age of entry to formal employment (panels) using our administrative data. The solid lines represent a quadratic fit of the outcome (number of observations per current-age bin as a function of current age (in months). The dotted lines represent confidence intervals at the 95% confidence levels, based on robust standard errors. In each panel, we use a 60-month bandwidth to estimate the polynomials to the right and left of the first and last cutoffs, respectively. We use all the observations in between cutoffs to estimate the remaining two polynomials.



(a) Prob. of being female around age 60



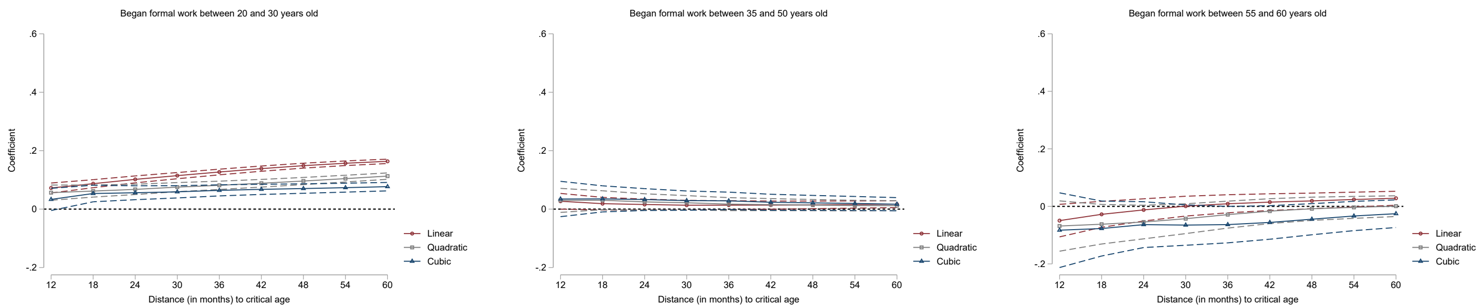
(b) Prob. of being female around age 65



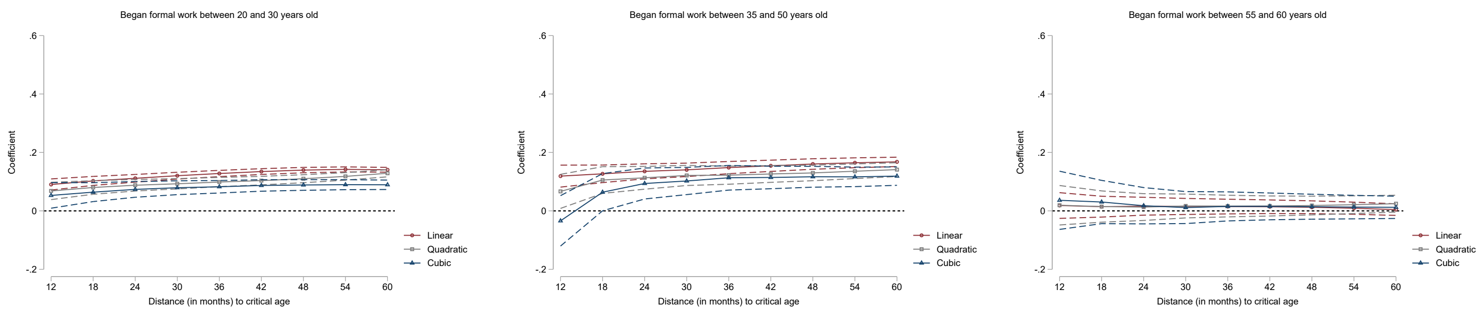
(c) Prob. of being female around age 70

Figure A3: Effects of Reaching Pension Eligibility Ages on Gender, by Age of Initial Contribution

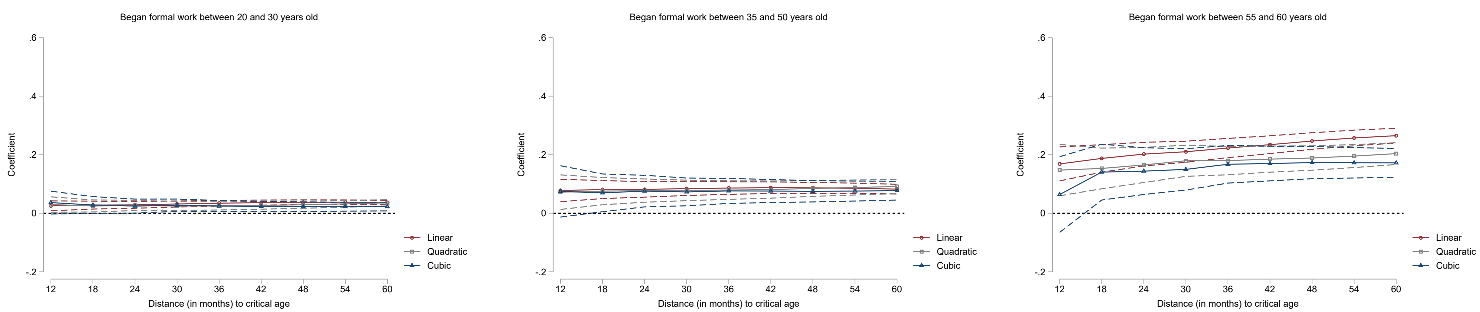
Note: This figure reports the means of the probability of being a woman by distance (in months) to each retirement eligibility cutoff (Panels), differentiating by age of entry into the formal labor force (Columns). The solid lines represent a quadratic fit of the outcome as a function of distance to the threshold on either side of each cutoff.



(a) RD estimates for age 60



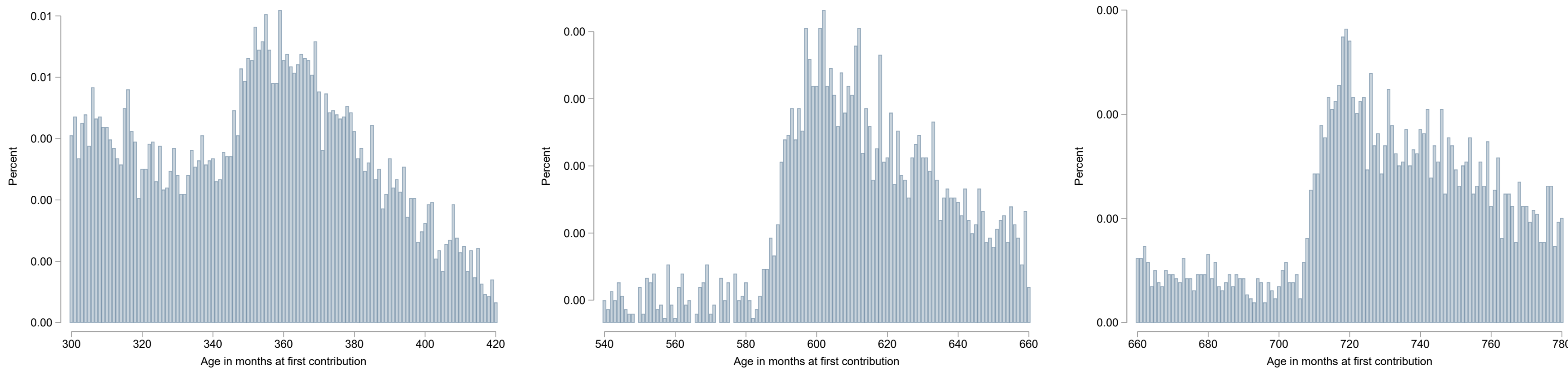
(b) RD estimates for age 65



(c) RD estimates for age 70

Figure A4: Robustness of Retirement Estimates to Alternative Polynomials and Bandwidths

Notes: This figure plots RD coefficients estimated based on variations to Equation (4) for each retirement age cutoff (Panels) and age of entry into the formal labor force (Columns), as a function of the estimation bandwidth, using linear, quadratic and cubic polynomials. Dashed lines depict 95% confidence intervals.



(a) 30 years of contributions (b) 15 years of contributions (c) 10 years of contributions

Figure A5: Distributions of Age at First Contribution, by Years of Contributions

Notes: This figure plots the distribution of the age (in months) at which an individual made their first contribution to the IESS, for three subsamples: individuals who retired with exactly 30 years of contributions (Panel a), individuals who retired with exactly 15 years of contributions (Panel b), and individuals who retired with exactly 10 years of contributions (Panel c).

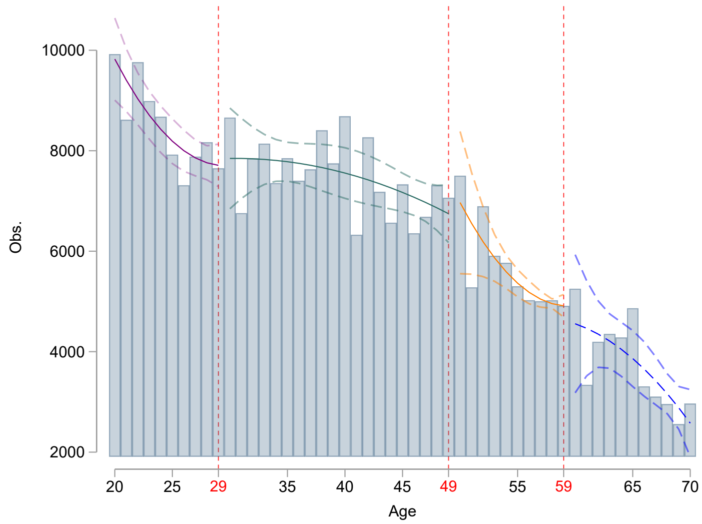
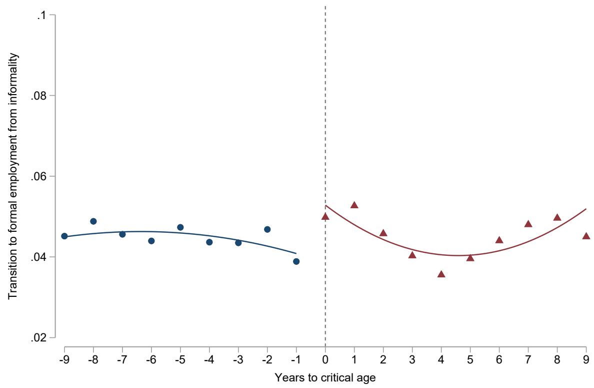
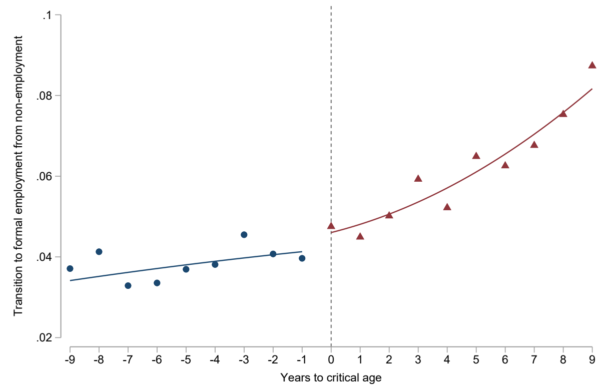


Figure A6: Density Test for the Effects of Earlier Critical Ages on Formal Employment

Notes: This figure depicts the distribution of current ages (in years) using survey data. The solid lines represent a quadratic fit of the outcome (number of observations per age bin as a function of age (in years). The dotted lines represent confidence intervals at the 95% confidence levels, based on robust standard errors. In each panel, we use a 10 year bandwidth to estimate the polynomials to the right and left of the first and last cutoffs, respectively. We use all the observations in between cutoffs to estimate the remaining two polynomials.



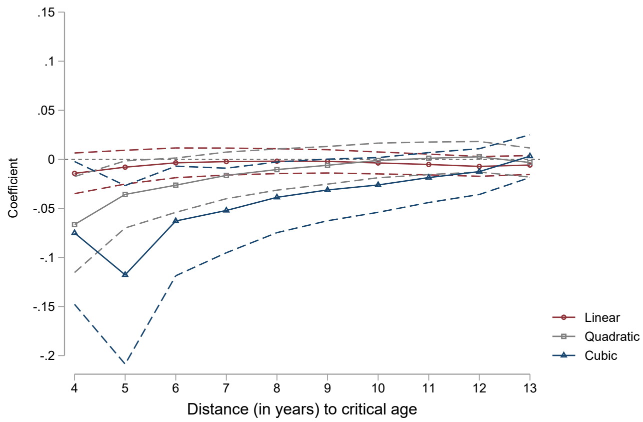
(a) Transitions from informal employment



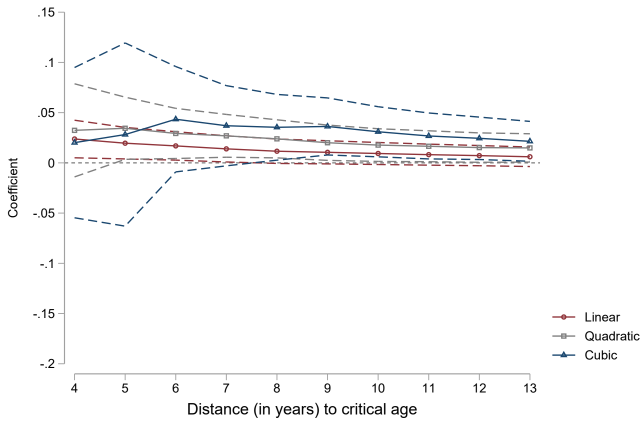
(b) Transitions from non-employment

Figure A7: Effects of Reaching Earlier Critical Ages on Transitions from Informal Work and Non-Employment to Formal Employment

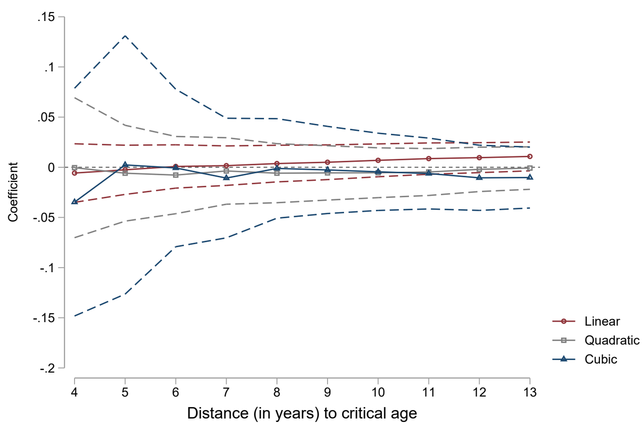
Notes: This figure depicts means of the probability of transitioning to formal employment from informal employment (Panel a) and non-employment (Panel b), around the 50 years old cutoff. Solid lines represent fitted quadratic polynomials on either side of the cutoff.



(a) RD estimates for age 30



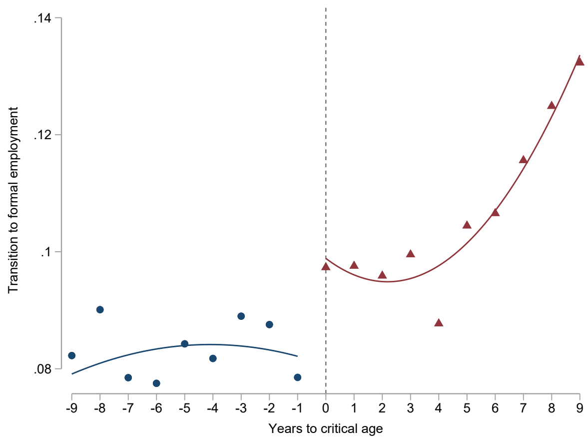
(b) RD estimates for age 50



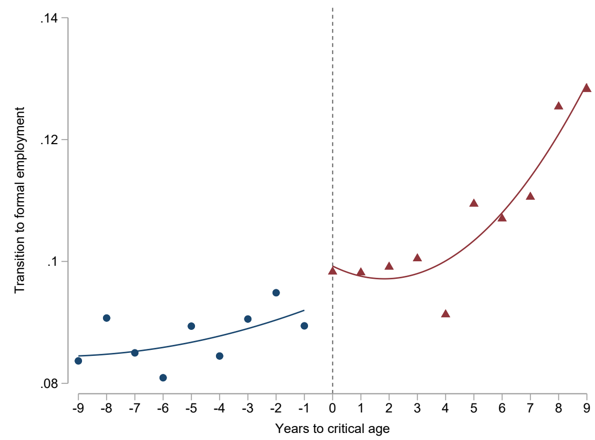
(c) RD estimates for age 60

Figure A8: Robustness of Estimates for Transitions to Formal Employment to Alternative Polynomials and Bandwidths

Notes: This figure plots RD coefficients estimated based on variations to Equation (6) for each earlier critical age cutoff (Panels) as a function of the estimation bandwidth, using linear, quadratic and cubic polynomials. Dashed lines depict 95% confidence intervals.



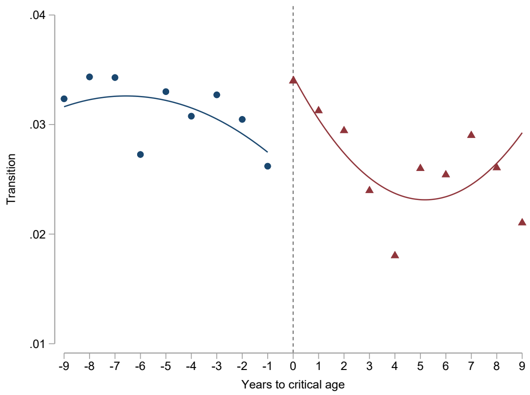
(a) With survey weights



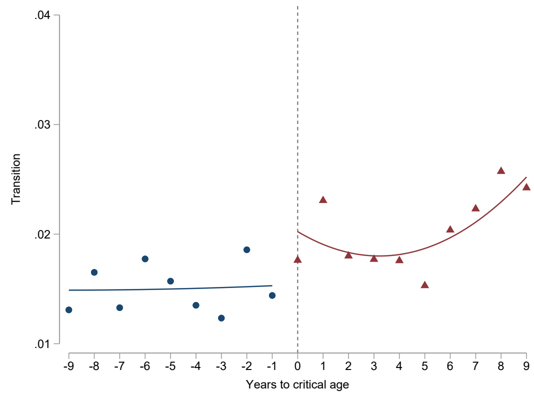
(b) Without survey weights

Figure A9: Effects of Reaching Age 50 on Transitions to Formal Employment: RD Graphs with and without Survey Weights

Notes: This figure depicts means of the probability of transitioning to formal employment around the 50 years old cutoff using sampling weights (Panel a) and without sampling weights (Panel b). Solid lines represent fitted quadratic polynomials on either side of the cutoff.



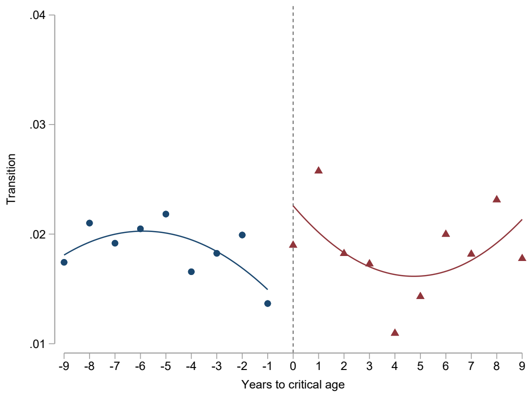
(a) Transitions to formal employment as a salaried worker



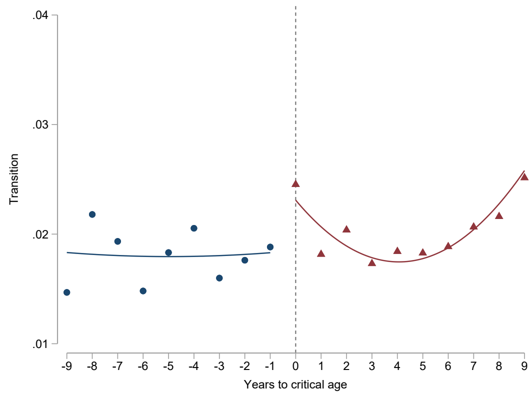
(b) Transitions to formal employment as a self-employed worker

Figure A10: Effects of Reaching Age 50 on Transitions to Formal Employment as a Salaried, Dependent Worker and as a Self-Employed Worker

Notes: This figure depicts means of the probability of transitioning to formal employment affiliated to the dependent social security system (Panel a) and affiliated to the independent social security system (Panel b), around the 50 years old cutoff. Solid lines represent fitted quadratic polynomials on either side of the cutoff.



(a) Transitions to formal employment from registered firms

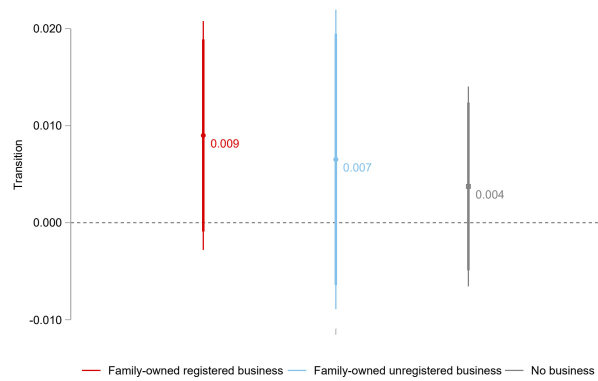


(b) Transitions to formal employment from unregistered firms

Figure A11: Effects of Reaching Age 50 on Transitions to Formal Employment from Registered Firms and from Unregistered Firms

Notes: This figure depicts means of the probability of transitioning to formal employment from informal employment in a registered firm (Panel a) and from informal employment in an unregistered firm (Panel b), around the 50 years old cutoff. Solid lines represent fitted quadratic polynomials on either side of the cutoff.

(a) With weights: effects of transitioning to formal employment from informal employment at a registered firm



(b) With weights: effects of transitioning to formal employment from informal employment at an unregistered firm

(c) Without weights: effects of transitioning to formal employment from informal employment at a registered firm

(d) Without weights: effects of transitioning to formal employment from informal employment at an unregistered firm

Figure A12: Heterogeneous Effects of Reaching Age 50 on Transitions to Formal Employment by Family Business Ownership With and Without Using Survey Weights

Notes: This figure depicts RD estimates from estimating Equation (6) with and without using survey weights, where the outcome is the probability of transitioning from informal work at a formal firm to formal work (Panels a and c), and from informal work at an informal firm to formal work (Panels b and d). Each point estimate corresponds to a different subsample: (i) individuals who live in the same household as an owner of a formal business registered with the tax authorities, (ii) individuals who live in the same household as an owner of an informal business not registered with the tax authorities, or (iii) individuals who do not live in the same household as a business owner. All regressions are estimated within a 10-year bandwidth around each cutoff and include survey-wave fixed effects, quadratic polynomials on both sides of the cutoff, and triangular kernels. Vertical lines represent confidence intervals at the 90% (thicker lines) and 95% (narrower lines) confidence levels, based on robust standard errors.

Table A1: Summary Statistics

	Mean	Std. Dev.
Panel a. Administrative data on workers		
Prob. of being a woman	0.41	0.49
Age when joined IESS	25.53	9.03
Dependent worker (%)	0.89	0.32
Elegible for retirement (%)	0.07	0.00
Obs.	6,323,252	

	Mean	Std. Dev.
Panel b. Administrative data on beneficiaries		
Pension eligibility age	63.61	5.84
Pension claiming age	65.74	5.58
Number of contributions	332.06	119.31
Obs.	460,041	

	Mean	Std. Dev.
Panel c. Survey data on working-age adults		
Prob. of being a woman	0.52	0.50
Age	39.44	18.55
Completed elementary school	0.10	0.31
Completed middle school	0.28	0.45
Completed high school	0.37	0.48
Completed university education	0.19	0.39
Affiliated to IESS	0.30	0.46
Affiliated to IESS as an employee	0.23	0.42
Affiliated to IESS as self-employed	0.07	0.26
Prob. of being employed	0.61	0.49
Prob. of being an employee	0.32	0.47
Prob. of being self-employed	0.19	0.39
Prob. of working and affiliated to IESS	0.25	0.43
Prob. of working and not affiliated to IESS	0.36	0.48
Prob. of working for a registered firm	0.18	0.38
Prob. of working for an unregistered firm	0.25	0.43
Obs.	967,451	

Notes: This table reports sample means and standard deviations based on administrative records on contributors to IESS (Panel a), administrative records on current pensioners (Panel b), and survey data corresponding to the 2008-2016 period (Panel c).

Table A2: Robustness of Retirement Estimates to Alternative Regression Specifications

	Began formal work between 20 and 30			Began formal work between 35 and 50			Began formal work between 55 and 60		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel a. Age 60 cutoff									
Above cutoff	0.117***	0.140***	0.066***	0.008	0.019**	0.022	0.009	0.009	-0.059**
	(0.006)	(0.005)	(0.009)	(0.009)	(0.008)	(0.014)	(0.018)	(0.017)	(0.029)
Obs.	308,544	313,843	96,722	143,230	145,823	50,526	29,958	30,457	11,319
Specificiation	Controls	w/o Kernel	MSE-Optimal BW	Controls	w/o Kernel	MSE-Optimal BW	Controls	w/o Kernel	MSE-Optimal BW
Bandwidth	60	60	19	60	60	22	60	60	22
Panel b. Age 65 cutoff									
Above cutoff	0.133***	0.161***	0.090***	0.138***	0.156***	0.126***	0.021	0.045***	0.020
	(0.006)	(0.006)	(0.010)	(0.012)	(0.011)	(0.017)	(0.015)	(0.014)	(0.020)
Obs.	229,876	233,507	90,078	72,010	73,511	31,124	40,717	41,197	23,336
Specificiation	Controls	w/o Kernel	MSE-Optimal BW	Controls	w/o Kernel	MSE-Optimal BW	Controls	w/o Kernel	MSE-Optimal BW
Bandwidth	60	60	22	60	60	27	60	60	29
Panel c. Age 70 cutoff									
Above cutoff	0.037***	0.047***	0.025***	0.085***	0.101***	0.073***	0.208***	0.228***	0.189***
	(0.006)	(0.005)	(0.008)	(0.013)	(0.012)	(0.019)	(0.019)	(0.017)	(0.026)
Obs.	155,763	158,282	63,886	47,138	47,945	17,872	27,799	28,273	12,998
Specificiation	Controls	w/o Kernel	MSE-Optimal BW	Controls	w/o Kernel	MSE-Optimal BW	Controls	w/o Kernel	MSE-Optimal BW
Bandwidth	60	60	24	60	60	23	60	60	29

Note: This table reports RD coefficients estimated using Equation (4) for each cutoff (Panels), by age of entry into the formal labor force (Columns), using alternative specifications. Columns 1, 4, and 7 report coefficients from specifications that include sex and month-of-birth fixed effects as controls. Columns 2, 5, and 8 report coefficients estimated without using a triangular kernel. Finally, Columns 3, 6, and 9 report coefficients estimated over an MSE-optimal bandwidth. All regressions include quadratic polynomials on either side of each cutoff. Robust standard errors are reported in parentheses.
* p<0.1, ** p<0.05, *** p<0.01.

Table A3: Differences in Individual Characteristics for Individuals Around the Earlier Critical Age Cutoffs

	Below cutoff		Above cutoff				
	Obs.	Mean	Obs.	Mean	Mean diff.	Sd.	p-value
Panel a. Around age 30 cutoff							
Prob. of being a woman	54,223	0.52	53,440	0.54	0.00	0.01	0.791
Prob. of living in a urban area	54,223	0.81	53,440	0.79	0.00	0.01	0.912
Prob. of being married	54,223	0.48	53,440	0.69	-0.02	0.01	0.199
Numb. of household members	54,223	4.52	53,440	4.52	0.03	0.05	0.534
Completed elementary school	54,223	0.04	53,440	0.05	-0.01	0.01	0.086
Completed middle school	54,223	0.20	53,440	0.28	-0.00	0.01	0.756
Completed high school	54,223	0.40	53,440	0.37	-0.03	0.01	0.031
Completed non-university tertiary education	54,223	0.02	53,440	0.02	0.00	0.00	0.195
Completed university education	54,223	0.34	53,440	0.27	0.04	0.01	0.003
Numb. of survey waves	54,223	2.51	53,440	2.54	-0.00	0.02	0.961
Panel b. Around age 50 cutoff							
Prob. of being a woman	44,441	0.54	40,400	0.53	-0.01	0.02	0.721
Prob. of living in a urban area	44,441	0.79	40,400	0.80	-0.00	0.01	0.859
Prob. of being married	44,441	0.77	40,400	0.76	0.00	0.01	0.887
Numb. of household members	44,441	4.51	40,400	4.21	0.00	0.06	0.950
Completed elementary school	44,441	0.09	40,400	0.13	-0.00	0.01	0.634
Completed middle school	44,441	0.32	40,400	0.33	-0.00	0.01	0.936
Completed high school	44,441	0.33	40,400	0.27	0.01	0.01	0.334
Completed non-university tertiary education	44,441	0.01	40,400	0.01	-0.00	0.00	0.266
Completed university education	44,441	0.22	40,400	0.22	0.01	0.01	0.677
Numb. of survey waves	44,441	2.56	40,400	2.56	0.02	0.02	0.389
Panel c. Around age 60 cutoff							
Prob. of being a woman	35,670	0.52	27,857	0.51	-0.00	0.02	0.948
Prob. of living in a urban area	35,670	0.80	27,857	0.77	0.01	0.01	0.523
Prob. of being married	35,670	0.75	27,857	0.71	-0.01	0.02	0.660
Numb. of household members	35,670	4.03	27,857	3.68	-0.07	0.08	0.352
Completed elementary school	35,670	0.15	27,857	0.20	-0.01	0.01	0.579
Completed middle school	35,670	0.34	27,857	0.35	-0.01	0.02	0.461
Completed high school	35,670	0.23	27,857	0.19	0.01	0.02	0.406
Completed non-university tertiary education	35,670	0.01	27,857	0.01	0.00	0.00	0.362
Completed university education	35,670	0.21	27,857	0.15	-0.01	0.02	0.714
Numb. of survey waves	35,670	2.55	27,857	2.59	0.02	0.02	0.418

Note: This table reports sample means, mean differences, standard deviations, and p-values of the differences for sociodemographic characteristics of individuals around 30 years old (Panel a), 50 years old (Panel b), and 60 years old (Panel c). A 10-year bandwidth is used to compare individuals above and below each cutoff.

Table A4: Robustness of Estimates for Transitions to Formal Employment to Alternative Regression Specifications

	Transition to formality			
	(1)	(2)	(3)	(4)
Panel a. Around age 30 cutoff				
Above cutoff	-0.001	-0.002	0.006	-0.023*
	(0.009)	(0.009)	(0.009)	(0.014)
Obs.	107,663	107,663	107,663	59,914
Specificiation	Main	Controls	w/o kernel	MSE-Optimal BW
Bandwidth	10	10	10	5
Mean below cutoff	0.111	0.111	0.111	0.108
Effect size (%)	-1.01	-2.16	5.40	-21.34
Panel b. Around age 50 cutoff				
Above cutoff	0.018**	0.017**	0.015*	0.026**
	(0.008)	(0.008)	(0.008)	(0.011)
Obs.	84,841	84,841	84,841	58,559
Specificiation	Main	Controls	w/o kernel	MSE-Optimal BW
Bandwidth	10	10	10	6
Mean below cutoff	0.083	0.083	0.083	0.083
Effect size (%)	21.33	20.36	17.62	31.38
Panel c. Around age 60 cutoff				
Above cutoff	-0.005	-0.006	-0.004	-0.002
	(0.013)	(0.012)	(0.012)	(0.016)
Obs.	63,527	63,527	63,527	43,556
Specificiation	Main	Controls	w/o kernel	MSE-Optimal BW
Bandwidth	10	10	10	6
Mean below cutoff	0.112	0.112	0.112	0.115
Effect size (%)	-4.83	-5.15	-3.70	-1.77

Notes: This table reports estimates of the effect of reaching earlier critical ages on transitions to formal work, using variations of Equation (6). For each critical age cutoff (Panels), we report results from our main specification (Column 1) and using a vector of controls that includes gender, area of residence, marital status, number of household members, number of survey waves, and dummies for educational level (Column 2). Column 3 exclude triangular kernels and Column 4 reports results using an MSE-optimal bandwidth. All estimates include a quadratic polynomial on either side of the cutoff and time (survey wave) fixed effects. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Table A5: Robustness of Estimates for Transitions to Formal Employment to the Use of Survey Sampling Weights

	(1) Age 30 cutoff	(2) Age 50 cutoff	(3) Age 60 cutoff
Panel a. Sampling weights at baseline			
Above cutoff	-0.001	0.018**	-0.005
	(0.009)	(0.008)	(0.013)
Obs.	107,663	84,841	63,527
Mean below cutoff	0.113	0.087	0.106
Effect size (%)	-1.00	20.31	-5.14
Panel b. Sampling weights at endline			
Above cutoff	-0.003	0.012	-0.004
	(0.009)	(0.009)	(0.013)
Obs.	107,663	84,841	63,527
Mean below cutoff	0.113	0.087	0.106
Effect size (%)	-2.40	14.23	-3.66
Panel c. Average sampling weights			
Above cutoff	-0.004	0.015*	-0.008
	(0.009)	(0.009)	(0.013)
Obs.	107,663	84,841	63,527
Mean below cutoff	0.113	0.087	0.106
Effect size (%)	-3.56	17.37	-7.29
Panel d. Without sampling weights			
Above cutoff	0.006	0.005	-0.002
	(0.006)	(0.006)	(0.009)
Obs.	107,663	84,841	63,527
Mean below cutoff	0.113	0.087	0.106
Effect size (%)	5.21	6.04	-1.51

Notes: This table reports RD coefficients estimated using Equation (4) for each cutoff (Columns) using different sampling weights (Panels). All regressions employ triangular kernels and quadratic polynomials on both sides of each cutoff. The estimations are based on observations within a 60-month bandwidth around each cutoff. Robust standard errors are reported in parentheses.
* p<0.1, ** p<0.05, *** p<0.01.

Table A6: Descriptive Statistics Around Age 50

	(1) All	(2) Lives with reg. business owner	(3) Lives with unreg. business owner	(4) Does not live with business owner
Prob. of being a woman	0.53	0.67	0.58	0.49
Prob. of being married	0.73	0.83	0.77	0.70
Prob. of being married to business owner	0.28	0.77	0.70	-
High demand for care in the household	0.34	0.28	0.39	0.34
Prob. of having completed tertiary education	0.21	0.33	0.11	0.22
Household income	778.34	1360.24	643.18	737.60
Prob. of being employed	0.79	0.79	0.75	0.80
Prob. of being a formal worker	0.34	0.39	0.25	0.37
Prob. of being an informal worker	0.45	0.40	0.51	0.44
Obs.	137,328	13,987	30,972	92,369
Share (%)	100.00	10.19	22.55	67.26

Notes: The table reports summary statistics using data corresponding to individuals age 40 to 48 at baseline, that is 9 years below the age 50 cutoff. Column 1 reports statistics for all individuals. Columns 2 and 3 report statistics for individuals who live with owners of registered and unregistered businesses. Column 4 reports statistics corresponding to individuals who do not live with a business owner. High demand for care in the households is computed as an indicator taking the value of 1 if the individual lives with either a child age 5 or younger or a person with disabilities.