

# Determinants of retirement of formal and informal sector workers in Mexico: the role of health and economic security

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## Abstract

**Objective.** We examine the socioeconomic and health drivers of retirement decisions and compare these determinants between formal and informal sector workers in Mexico. **Materials and methods.** Using data from the Mexican Health and Aging Study 2012 and 2015, we estimate conditional probit models of retirement using sociodemographic, health, health care utilization, health insurance, private pensions, and social security systems covariates. The Institutional Review Board at the University of Southern California reviewed and approved the research (IRB # UP-15-00023). **Results.** We find that the social security systems are an important determinant for retirement age for formal sector workers. The informal sector workers, who lack access to retirement benefits of the social security system, make retirement decisions mainly based on health and access to health insurance through social security. **Conclusion.** Despite the lack of access to social security benefits, informal sector workers do not respond strongly to socioeconomic factors in determining the timing of retirement. Strengthening access to better health care services could improve health, extend working lives, and promote healthy aging for workers in the informal sector.

Keywords: retirement; aging; informal sector; economics; Mexicans; MHAS; Mexico

## Resumen

**Objetivo.** Examinar los factores socioeconómicos y de salud en las decisiones de retiro y comparar estos determinantes entre los trabajadores del sector formal e informal en México. **Material y métodos.** Se utilizaron datos de la Encuesta Nacional sobre Salud y Envejecimiento en México 2012 y 2015. Se estimaron modelos condicionales probit de retiro utilizando variables sociodemográficas, de salud, utilización de servicios de salud, seguros de salud, pensiones privadas y sistemas de seguridad social. **Resultados.** Se encontró que los sistemas de seguridad social son un factor importante para determinar la edad de retiro de los trabajadores del sector formal. En cuanto a los trabajadores del sector informal, que carecen del acceso a pensiones del sistema de seguridad social; los principales factores que determinan su retiro son la salud y el tener acceso a los servicios de salud de la seguridad social. **Conclusión.** A pesar de la falta de acceso a pensiones del sistema de seguridad social, los trabajadores del sector informal no consideran factores socioeconómicos en su decisión de retiro. Fortalecer el acceso a mejores servicios de atención médica podría mejorar la salud, extender la vida laboral y promover un envejecimiento saludable para los trabajadores del sector informal.

Palabras clave: retiro; envejecimiento; sector informal; economía; mexicanos; Enasem; México

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Mexico's labor force is rapidly aging. The population aged 65 and above is predicted to triple between 2015 and 2050, increasing to 20.2% of the population.<sup>1</sup> Empirical evidence indicates many older Mexicans may not be sufficiently prepared for retirement. Mexico's poverty rates for the population aged 65 and above is 19.8%, much higher than the Organization for Economic Cooperation and Development (OECD) median poverty rate of 12.8%.<sup>2</sup>

Financial insecurity among aging workers can be exacerbated by Mexico's large informal sector, which comprises about 42.0% of its labor force. The informal sector includes self-employed individuals who choose to remain voluntarily in this sector, as well as salaried workers who are often unable to enter or stay in the formal sector due to their lack of skills and low levels of education. Informal sector workers' financial insecurity, experienced throughout the duration of working lives, tend to extend into the post-retirement years as they cannot claim retirement benefits from the social security system. Their absence from the social security system makes it financially difficult for the Mexican government to provide them with non-contributory pensions or social pensions.<sup>3</sup> In contrast, formal sector workers who are guaranteed retirement benefits through social security often find themselves at a financial advantage. The varying prospects of retirement financial insecurity of the informal sector workers and the formal sector workers can lead to divergent retirement decisions.

Indeed, social security wealth influence the timing of retirement. For instance, the initial claiming of social security benefits (i.e., start of the receipt of the monthly benefits) encourages retirement by introducing a steady source of income independent of work.<sup>4,5</sup> Similarly, the receipt of private pension benefits tends to align with the timing of retirement. Nevertheless, individuals tend to want to delay claiming –and delay retiring– under the defined-contribution schemes (e.g., 401k, individual retirement account) because the monthly pension benefit depends on the lifetime contribution and additional years of contribution can increase the benefit amounts.<sup>6</sup>

In addition to the retirement finances dictated in part by social security or employer provided pensions, retirement timing is determined by several other factors including salary income, household wealth, health, and access to health insurance. Increases in household wealth consistently have led to earlier retirement,<sup>7,8</sup> while salary income generating both the income- and the substitution- effects hold mixed effects.<sup>9-11</sup> As for health, poor physical and mental health are shown to expedite the timing of retirement –as such conditions add challenges and lower productivity at work.<sup>12,13</sup> Lastly, access to higher quality public health insurance

such as Medicare in the United States tends to encourage retirement by reducing the burden of healthcare costs independent of work. In contrast, any health insurance provided through employers –conditional on keeping the job– tends to deter retirement by creating a 'job-lock'.<sup>12,14</sup>

While the majority of studies on the determinants of retirement come from the Western advanced economies, several important works contribute empirical evidence from developing countries. Contrasting the ample evidence of retirement behaviors in the developed countries, less is known about them in emerging economies.<sup>15</sup> Still, a small but steady stream of literature has explored the role of public pensions (e.g., social security) on labor supply in various geographical contexts, including South Africa,<sup>16</sup> Brazil,<sup>17-19</sup> Vietnam,<sup>20</sup> Chile,<sup>21</sup> and Mexico.<sup>9,22</sup> Consistent with the literature from developed countries, these studies consistently found that the public pension benefits hold a retirement-encouraging effect by providing another source of post-retirement income independent of work, and that the pension eligibility coincided with a peak in retirement likelihood. A few studies addressed the impact of specific designs of the public pension system. James and Cox-Edwards<sup>21</sup> found evidence that the privatization of the pension system in Chile in 1982, which entailed the country's introducing restrictions on early retirement and stronger links to actuarially fair benefit and longer working lives, led to a postponement of retirement timing. Aguila<sup>22</sup> simulated the effect of the *Instituto Mexicano del Seguro Social* (IMSS) reform from a pay-as-you-go (PAYG) to the personal retirement accounts (PRA) system in Mexico and found that both systems encouraged early retirement. Quieroz<sup>15</sup> found that the rural workers in Brazil were more likely to retire earlier than urban workers, due to the fact that only urban workers' social security benefits increased based on the duration of work and thereby giving no financial incentives for rural workers to stay past the eligibility age.

We add to the growing literature from the developing countries by exploring the role of social security wealth and other determinants of retirement decisions in Mexico. In doing so, we contribute to the literature in several ways. First, we compare the formal (and the informal) sector workers' retirement decisions. Not enough is known about this vulnerable group of workers. Informality has been studied in the context of Africa and India, where the informal sector is substantial. A qualitative study found that most informal sector workers in Kenya were highly focused on their immediate lives and did not think about the future beyond the next few years,<sup>23</sup> and a meta-analysis concluded that informal sector workers in developing countries were often un-

able or unwilling to contribute to the social insurance system.<sup>24,25</sup> While the findings suggest that informal sector workers could suffer from a lack of retirement financial preparedness, it is uncertain whether this applies to the Latin American labor market. The literature on Latin American informality is limited despite its sizeable informal sector. One study, conducted by Legrand<sup>18</sup> went beyond demonstrating a link between the social security eligibility and retirement timing, and revealed that informal sector workers and self-employed workers had lower retirement likelihood than the formal sector workers did, given the same social security eligibility. Our study sheds lights on how informal and formal sector workers fare in the labor market and make retirement decisions in Mexico.

Second, we depart from the literature –largely focused on the advanced economies– by evaluating a unique set of factors as potential determinants of retirement. Specifically, we include intrafamily financial transfers as covariates affecting the financial preparedness of aging workers as well as their retirement decisions. We have added this variable based on the descriptive findings that family transfers was one of the major post-retirement income sources in Mexico.<sup>26</sup> Our paper is related to a study by Tran and Jung,<sup>20</sup> who found the strong retirement-inducing effect of intrahousehold financial transfers as well as of the receipt of public pension in Vietnam, another developing nation. In another study by Aguila and Zissimopoulos<sup>27</sup> where having more children increased the probability of retiring for non-migrant female workers in Mexico, the authors interpreted that the working mothers' retirement decisions might have been significantly affected by the financial transfers from children. In that family transfers are not widely discussed as a major determinant of retirement in the context of advanced economies, the authors' findings suggest that retirement decisions may be dictated by a unique set of factors, different from those of developed economies.

Third, we examine the effects of non-contributory pension in the informal sector. Non-contributory pension programs or social pensions have been introduced in more than 40 countries around the world.<sup>28</sup> Such programs are designed to reduce poverty of those without access to social security benefits or any other source of income during retirement by providing a flat-rate amount and only imposing an eligibility requirement to receive the benefit.<sup>29,30</sup> Previous studies have documented that non-contributory pension programs reduced labor supply of older beneficiaries in Mexico<sup>31-33</sup> as well as in other developing countries.<sup>34-36</sup> Specifically in Mexico, non-contributory pension program reduced labor supply of recipients for adults aged 70+ living in

various localities –in relatively smaller localities with less than 2 500 inhabitants<sup>31</sup> and larger localities with less than 30 000 inhabitants.<sup>32</sup> Similarly, Aguila and colleagues<sup>33</sup> found that a universal non-contributory pension program for adults 70 or older in Yucatán, Mexico, reduced the extent to which respondents worked for pay by 4.5 percentage points while the treatment group had a baseline work for pay rate of 16.5 percent. Across the studies, evidence suggests a reduction in labor supply of older workers after receiving a non-contributory pension by 4-20 percentage points. Yet, none of the previous studies examined the effects non-contributory pension specifically for the informal sector workers.

Lastly, we contribute to the retirement literature by providing evidence from Mexico, an understudied geographical context. While the region suffers from sparse literature, a study by Rocha-Salazar<sup>37</sup> serves as a rare exception –which found that macroeconomic factors such as unemployment rates and stock market fluctuations, as well as individual factors such as bad health and unfavorable work environments, pushed individuals toward retiring in Mexico. In the meantime, their effects varied for men with different levels of educational attainment. In this paper, we deviate from Rocha-Salazar's<sup>37</sup> study by focusing on microeconomic, individual factors of retirement decisions and conducting a longitudinal analysis using a rich, more recent data from Mexico –the Mexican Health and Aging Study (MHAS) linked to social security administrative records.

Based on the insights from the existing literature, we provide the following hypotheses:

*Hypothesis 1:* Unlike informal sector workers, only formal sector workers in Mexico respond to retirement incentives that are similar to those documented in high-income countries –especially socioeconomic determinants such as formal sources of income and wealth.

*Hypothesis 2:* For informal sector workers, not only the formal sources of income (e.g., salary income) but also other sources affect their retirement decisions. For instance, existing studies find that the role of remittances and family transfers are important sources of retirement income for older individuals in Mexico.<sup>3,26</sup> Informal sector workers may need to rely on multiple sources of retirement income because they tend to suffer from income insecurity in old age, lacking access to social security benefits.

*Hypothesis 3:* Health would be a ubiquitously determinant for work and retirement decisions across sector. Yet, as individuals' abilities to pay for healthcare costs vary, whether individuals have access to health insur-

ance coverage will also play an important role. Access to health insurance will be more important for informal sector workers' retirement decisions than those of formal sector workers because the informal sector workers tend to lack access to high-quality employer provided health insurance over their working life, unlike their formal sector counterparts.

## Materials and methods

### Background

Among the known determinants of retirement decisions, we paid special attention to the role of social security benefits. In Mexico, social security benefits (i.e., old age public pension) are not provided unilaterally and are only available to formal sector workers.<sup>3</sup> In the formal sector, the IMSS covers most private sector employees, while the *Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado* (ISSSTE) covers the public sector. IMSS and ISSSTE provide healthcare benefits for workers and retirees, as well as social security benefits for retirees. The Mexican Oil Enterprise (Pemex), the Army, the Marines, or private firms with their own pension and health care systems provide coverage for the remaining formal sector workers.<sup>3</sup> In 2017, IMSS, ISSSTE, and other private or public institutions covered 36.3, 5.6, and 18.8% of the Mexican population.<sup>38</sup> Our sample's formal sector workers are strictly from the private sector, thus covered by the IMSS. IMSS's social security system was reformed in 1997 from a PAYG system to a fully funded system of PRA managed by Pension Fund Managers (*Administradoras de Fondos para el Retiro*, Afores).

While the informal sector workers *do not* enjoy social security benefits such as IMSS or ISSSTE, they are eligible to receive a non-contributory pension or social pension at age 65.<sup>9</sup> The non-contributory pension program is equivalent to the U.S. Supplemental Security Income (SSI) program established in 2007. The program initially targeted adults 70 years old or above living in rural areas with less than 2 500 inhabitants and a monthly pension of 500 Mexican pesos (82.20 U.S. dollars purchasing power parity [USD PPP]). In 2008, the program expanded to localities with less than 20 000 inhabitants and in 2009 the program included localities with less than 30 000 inhabitants. In 2012, the program became universal. In 2013, the program reduced age eligibility to 65 years old. In 2014, the non-contributory pension increased to 580 Mexican pesos (73.3 USD PPP). In 2019, the age threshold remained 65 for indigenous population and increased for other Mexicans to age 68.<sup>39</sup>

In 2017, *Seguro Popular* covered 39.3% of the Mexican population regardless of sector.<sup>38</sup> During our period

of analysis, specifically, *Seguro Popular* provided health-care services for the uninsured in the informal sector.<sup>40</sup> Informal sector workers could also access higher quality social security health insurance coverage as a spouse or parent of a formal sector worker.<sup>3</sup>

### Data

Data was drawn from the 2012 and 2015 waves of the MHAS. The Internal Review Board at the University of Texas Medical Branch approved MHAS protocols (IRB # UP-15-00023). MHAS is a nationally representative survey of population 50 years old and older collected in 2001, 2003, 2012, 2015, 2018, and 2021, containing information on respondents' income, wealth, health, and health insurance.<sup>41</sup> It is a nationally representative sample refreshed in 2012 and 2018 to represent once again the population 50 years old or older in those years. We linked the MHAS data with IMSS's administrative records provided by the *Comisión Nacional del Sistema de Ahorro para el Retiro* (Consar). IMSS's administrative records provided information on formal sector respondents' demographics, earnings history, and contributions to the social security system.

We restricted our sample to Mexicans aged 50-80 who worked in 2012 either in (1) the formal (private) sector with IMSS administrative records or (2) the informal sector without contributions to any social security system. We obtained a sample of 1 738 formal sector workers and 1 737 informal sector workers in MHAS after excluding individuals who were return-migrants from the United States, had no follow-up in 2015, fell outside the 50-80 age range, did not work in 2012, and had missing covariates. The supplementary material provides detailed information on sample selection and processes used to link IMSS administrative records to MHAS respondents.<sup>42</sup>

Our outcome is a dynamic indicator defined for each individual  $i$  as follows:

$$R_i = \begin{cases} 0 & \text{if working in 2012 and 2015} \\ 1 & \text{if working in 2012 and fully retired in 2015} \end{cases} \quad (1)$$

The outcome variable allowed us to identify those who transitioned from being in the labor force in one wave to retiring in the subsequent wave, from those who continued working across the two waves.

### Social security metrics

We devised a metric for social security wealth to account for retirement incentives generated by social security benefits (IMSS) for formal sector workers. IMSS covered most workers in our sample, providing benefits to

72.9% of eligible retirees in 2017. ISSSTE covered 19.7%, and other social security institutes covered 7.4%.<sup>38</sup> We included only IMSS's covered workers because the data at our disposal allowed only the linkages between MHAS and IMSS's administrative records. The administrative data for ISSSTE or other social security institutes was not available, so we dropped them from our sample.

Of note, workers who started contributing to IMSS after 1997 reform are considered the *new generation*, and workers who started contributing to IMSS before 1997 are the *transition generation*. New generation workers can only retire according to the new PRA system rules, whereas transition generation workers can choose between PAYG or PRA rules at retirement.<sup>22</sup> According to previous estimates,<sup>43</sup> the transition generation workers receive higher benefits with PAYG than PRA, so most choose to retire under PAYG. The transition generation workers can only choose PRA social security benefits when contributing for at least 22 years. Our sample included workers born between 1932 and 1962 with less than 22 years of contributions to the PRA system. Thus, we focused on social security benefits rules for the PAYG system, for which 65 was the normal retirement age. By the rule of early retirement, benefits could be claimed as early as 54, with a reduction of 5% per year below normal retirement age.<sup>22</sup>

First, we computed Mexican IMSS monthly PAYG benefits ( $ssb_s$ )—the amount a respondent is to receive monthly from the age of retirement ( $s$ ) to age at death—using the following formula:

$$ssb_s = (1 - \delta_s) * \theta(\bar{Y}) * \bar{Y} + \varphi * (\omega - 10) * \theta(\bar{Y}) * \bar{Y} \quad (2),$$

where  $\delta_s$  is the penalty for early retirement,  $\bar{Y}$  is the average wage for the five years prior to retirement, and  $\theta(\bar{Y})$  is the average wage replacement rate, a decreasing function of  $\bar{Y}$ . Wage is top-coded to a max of 25 times the minimum wage, representing the maximum number of years a worker can contribute to the system. In the second term,  $\varphi$  is a binary variable indicating if the individual has contributed more than 10 years,  $\omega$  is the years of contribution to IMSS,  $\theta(\bar{Y})$  and is the average wage replacement rate for every year of contribution beyond ten, an increasing function of  $\bar{Y}$ . The last term reflects Mexican social security system incentives to remain in the labor force (and contribute) for more than 10 years.

Next, we calculated respondents' lifetime social security wealth ( $SSW_t$ ) at year  $t$  as the sum of the expected net present value of all monthly social security benefits ( $ssb_s$ ) to be received from the age of retirement ( $s$ ) until age at death ( $S$ ):

$$SSW_t = \sum \frac{S [pr_{s/t} * ssb_s]}{(1+d)^{(s-t)}} \quad (3),$$

where  $pr_{s/t}$  is the probability the individual is alive at age  $s$  conditional on being alive at  $t$ .  $ssb_s$  is the social security benefit to be collected monthly if the individual chooses to retire at age  $s$ . Following Coile and Gruber,<sup>4</sup> we set  $d$ , the real discount rate, to be 3 percent and  $S$ , the maximum possible age reachable by an individual, equal to age 120 according to Mexican life-expectancy tables.<sup>44</sup> We computed survival probabilities as  $pr_{s/t} = \prod_{i=t}^{s-1} (1 - \lambda_i)$ , whereby  $\lambda_i$  is a hazard function where  $\lambda_i = D_i/L_i$ . Here,  $D_i$  is the number of people dying in period  $t$ , and  $L_i$  is the survivors at time  $t$ . Information on survival and mortality prospects for the computation of  $pr_{s/t}$  was obtained from the National Population Council in Mexico. Here, we used gender-specific survival probabilities. We computed the social security wealth to be nonzero starting at age 60 (the allowed early retirement age). To estimate future earnings projected to age 120, we set participants' earnings to increase by 1 percent every year, starting in 2016, following the literature.<sup>4</sup>

Financial retirement incentives generated by lifetime social security wealth can be modeled as a peak value (PV).<sup>4</sup> PV is a forward-looking retirement incentive, measuring the difference in expected social security wealth if an individual retires at a future *optimal age* (giving the maximum expected value of SSW) rather than retiring immediately at age  $t$ —appropriately discounted. We calculated PV by taking the arithmetic difference between (a) the maximum expected social security wealth one would have by delaying retirement to the optimal year and (b) the social security wealth one would have if retiring immediately: the bigger the PV, the greater was the incentive to delay retirement.

## Other covariates

We included the following sociodemographic variables in our analysis: age, gender (1=male, 0=female), years of education, marital status (1=married/partnered, 0=no), number of household members, monthly total income, and household net wealth. Monthly total income referred to the respondent and spouse income and includes salary income, social security benefits, public support (non-contributory pensions and any other federal or state subsidy program), family transfers, business income and debts, property income and debts, and capital gains (earnings from savings accounts, fixed investments, stocks, company shares, or bonds). Net wealth was defined as the amount of money in checking and savings accounts, bonds, stocks, deposits, mutual funds, primary and secondary estates, and other savings, minus debts. We converted income and wealth variables in MHAS to 2012 USD PPP.<sup>45</sup>

We accounted for intra-family transfers in the previous two years by creating binary indicators for receiving financial support from children, and providing financial support to children. We also included a binary variable for business ownership. Lastly, we identified respondents' job types and categorized them into white-collar workers, upper blue-collar workers, lower blue-collar workers, and agricultural/forestry/fishing workers. White-collar included jobs as executives, supervisors, and administrative support personnel; upper blue-collar included jobs in maintenance; lower blue-collar included jobs in activities such as repair and factory work.

Next, we accounted for physical health using a binary indicator for diagnoses of chronic health conditions (high blood pressure or hypertension; diabetes or high blood sugar; cancer or a malignant tumor; chronic lung disease; heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems; stroke). We also included self-reported number of difficulties with activities of daily living on a 0-5 scale (walking, dressing, bathing, eating, getting in and out of bed). We identified respondents with health insurance coverage from a Mexican social security system, including IMSS and ISSSTE (1 = yes, 0 = no), and access to *Seguro Popular* public healthcare services (1 = yes, 0 = no). Lastly, we included a binary indicator of receipt of non-contributory pension for those 70 years old or older according to the 2012 eligibility criteria.

### Estimation methods

To assess relative contributions of different covariates to retirement decisions between 2012 and 2015, for workers in the formal and the informal sectors, we estimated this probit model:

$$\Pr(R_i = 1) = f(\alpha + \delta SSW_i + \gamma PV_i + \chi_i \beta + \varepsilon_i) \quad (4),$$

where  $R_i$  indicates labor status transitions of respondents ( $i$ ), taking the value 1 when a respondent transitioned from working in 2012 into full retirement in the subsequent wave (2015), and the value 0 when the respondent continued working in both waves-as specified earlier in equation (1). All covariates were measured in time 2012. In the covariate specification I, we included social security wealth ( $SSW_i$ ) and the peak value retirement incentive metric ( $PV_i$ ), to be estimated only for the formal sector workers.

We estimated two additional covariate specifications. In specification II, we added in the covariates vector  $\chi_i$  the sociodemographic traits (i.e., age, gender, years of education, marital status, household size, salary income, net wealth, family transfers) and labor market characteristics (business ownership, job

type). In specification III, we further included health variables (chronic conditions, difficulties with ADL), access to health insurance (coverage through social security institutes and through *Seguro Popular*), and non-contributory pension receipts. Standard errors were clustered at the household level.

## Results

Table I summarizes the characteristics of formal and the informal sector workers in Mexico. In our sample, the informal sector workforce was older, slightly more male, single, less educated, and had larger households than the formal sector workers.

In terms of financial conditions, informal sector workers were more financially vulnerable, indicated by substantially less total income and net wealth. A higher proportion of informal sector workers received support from children, rather than providing support to children. Income, wealth, and financial transfers indicated that informal sector workers had greater financial insecurity. Informal sector workers were almost twice as likely as formal sector workers to own businesses, suggesting more self-employment than salaried employment. Informal sector workers operated mostly as lower blue-collar workers or in agriculture, forestry, or fishing. Most formal sector workers held white-collar or lower blue-collar jobs.

Though informal sector workers exhibited more difficulties with activities of daily living, a lower proportion reported having at least one chronic condition. Unlike formal sector workers, who could obtain healthcare through social security institutes, most informal sector workers accessed healthcare services through *Seguro Popular*. Yet, we observed about one fifth of the informal sector workers having health insurance coverage through social security as a spouse or parent of a formal sector worker. Lastly, more informal workers received a non-contributory pension than formal sector workers.

Figure 1 compares sources of income for formal and informal sector workers in our sample. Among formal sectors workers aged 50-59, salary constituted the primary source of income, followed by family transfers. For older formal sector workers (60+), social security benefits, public support, and family transfers increased their shares, suggesting their growing reliance on social security retirement benefits.

Primary income sources differed for informal sector workers. Among informal sector workers aged 50-59, family transfers and salary earnings constituted the primary sources of income, followed by business income. For older workers (60+), public support, family transfers, and social security benefits increased their

**Table I**  
**DESCRIPTIVE CHARACTERISTICS FOR FORMAL AND INFORMAL SECTORS. MEXICO, 2012**

	Formal sector	Informal sector	Diffe- rence	P
	% or mean (SD)	% or mean (SD)		
Retire in t	18.18	15.95	0.02	0.080
Covariates				
Age	59.31	60.71	-1.40	0.000
Male	65.71	66.61	-0.01	0.575
Years of education	8.24 (5.12)	5.36 (4.60)	2.88	0.000
Couple (1 = yes, 0 = no)	76.01	74.78	0.01	0.403
No. of household members	2.84 (1.90)	3.07 (2.24)	-0.23	0.001
Real monthly total income (USD PPP)	99.23 (408.54)	71.10 (290.68)	28.13	0.019
Real net wealth (USD PPP)	158 210.47 (226 760.35)	141 292.92 (231 720.34)	0.17	0.030
Receive money from child (1 = yes, 0 = no)	21.63	28.32	-0.07	0.000
Give money to child (1 = yes, 0 = no)	35.50	25.22	0.10	0.000
Business owner (1 = yes, 0 = no)	7.25	14.74	-0.07	0.000
Job types				
White collar (1 = yes, 0 = no)	28.08	10.54	0.18	0.000
Upper blue collar (1 = yes, 0 = no)	19.33	18.13	0.01	0.366
Lower blue collar (1 = yes, 0 = no)	44.82	41.62	0.03	0.057
Agricultural, forestry, fishing (1 = yes, 0 = no)	7.71	29.65	-0.22	0.000
Chronic conditions (1=one or more, 0=none)	47.64	40.82	0.07	0.000
Difficulties with ADL (0-5)	0.09 (0.41)	0.12 (0.47)	-0.02	0.152
Social security health insuran- ce (1 = yes, 0 = no)	80.15	21.70	0.58	0.000
Received Seguro Popular (1 = yes, 0 = no)	12.89	52.79	-0.40	0.000
Received non-contributory pension (1 = yes, 0 = no)	6.85	11.63	-0.05	0.000
No. observations	1 738	1 737		

USD PPP: dollars purchasing power parity  
ADL: activities of daily living

shares. Informal sector workers with social security benefits would probably have retired from the formal sector and continued working in the informal sector. In the estimations, we accounted for these income sources as covariates.

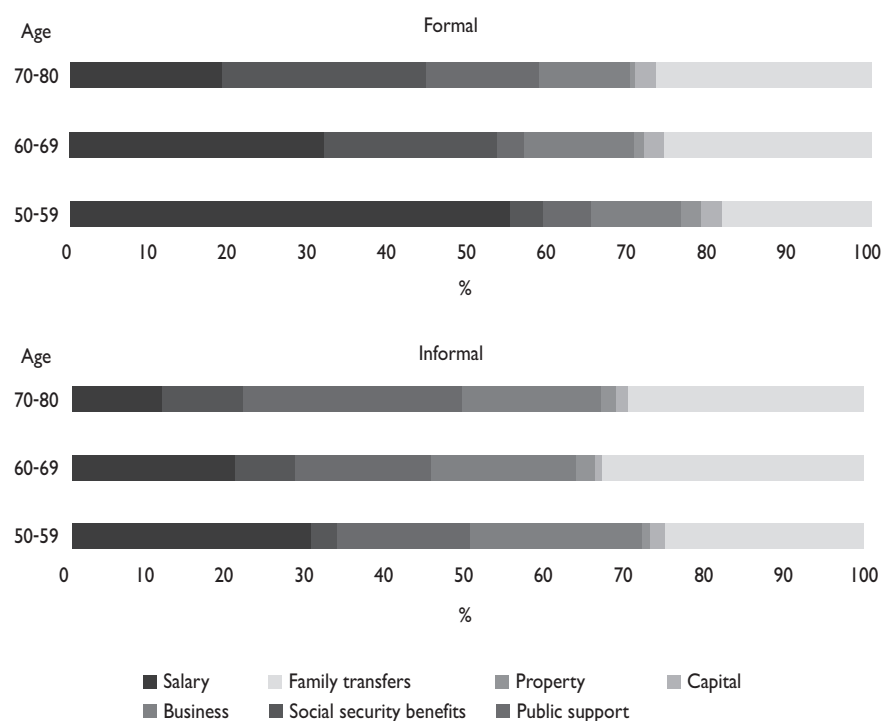
For formal sector workers, we estimated social security wealth and the peak value retirement incentive measure (table II). Consistently across the 10th, 50th, and 90th percentiles, social security wealth peaked around age 66 and decreased afterwards, consistent with previous research.<sup>4</sup> Social security wealth was relatively comparable between the 10th and 50th percentiles. In contrast, we observed a large gap between the 50th and 90th percentiles, primarily driven by sharp income inequalities and a concentration of wealth at the top in Mexico.

PV continuously decreased from age 60 for the 10th, 50th, and 90th percentiles. For the 10th percentile, PV was negative across all ages, suggesting there was no incentive to delay retirement from age 60+. PV turned negative at age 65 for the 50th and 90th percentiles, suggesting no financial incentives to work past this age—consistent with previous research.<sup>22</sup>

Table III displays the probit regression results, using the three covariate specifications. Regressions were run separately for formal sector workers and informal sector workers. Marginal effects of the probit regressions from Equation (4) are displayed. For all models, the outcome variable measures retirement likelihood across 2012 and 2015.

Across three covariate specifications in table III, the social security system was an important determinant for the timing of retirement for formal sector workers in Mexico. In our fullest model (specification III), a \$10 000 increase in social security wealth increased retirement likelihood by 0.9 percentage points, while a \$10 000 increase in the peak value deterred retirement by 2.5 percentage points. Regarding the direction of the estimated coefficients, greater social security wealth encouraging retirement and greater PV deterring retirement aligned with extant theory and empirical findings.<sup>5</sup> Greater retirement security, implied by higher social security wealth, seemed to have induced retirement. In specification I, greater PV significantly deterred retirement. As a larger PV indicated that the gap between the lifetime social security wealth at a later optimal retirement age and the social security wealth to be collected by retiring immediately was greater, the measure held a retirement-delaying effect on respondents.<sup>4</sup> Yet, PV lost statistical significance in specifications II-III.

Formal sector workers responded to most socio-economic drivers—consistently across specifications II and III. One exception lay in wealth: In specification II,



**FIGURE I. SOURCES OF INCOME FOR FORMAL AND INFORMAL WORKERS, BY GROUPS OF AGE. MEXICO, 2012**

**Table II**  
**SOCIAL SECURITY WEALTH AND PEAK VALUE (USD PPP) FOR FORMAL SECTOR WORKERS.**  
**MEXICO 2012**

	SSW 10th	SSW 50th	SSW 90th	PV 10th	PV 50th	PV 90th
60	53 153.56	60 182.16	246 311.10	-2 085.95	9 300.40	60 825.60
61	51 806.41	63 480.81	264 810.90	-2 126.38	7 437.81	47 126.92
62	50 458.06	67 050.62	282 499.80	-2 166.86	5 215.07	34 132.72
63	49 109.92	70 232.81	300 261.80	-2 207.26	3 198.79	21 930.95
64	47 763.50	73 393.12	316 688.50	-2 247.67	1 478.53	10 287.25
65	46 420.30	76 433.69	332 019.60	-7 410.68	-2 566.41	-1 879.25
66	45 081.84	75 270.89	333 224.30	-8 229.48	-2 717.28	-2 020.07
67	43 749.74	73 989.11	330 645.80	-9 084.21	-2 886.69	-2 136.42
68	42 425.58	72 606.59	327 595.90	-10 137.87	-3 048.94	-2 230.55
69	41 111.04	71 288.05	324 112.20	-11 241.44	-3 208.51	-2 320.98
70	39 807.84	70 431.67	320 857.40	-12 353.54	-3 347.96	-2 398.88

USD PPP: dollars purchasing power parity  
SSW: social security wealth; PV: peak value



**Table III**  
**MARGINAL EFFECTS OF THE PROBABILITY OF RETIREMENT IN FORMAL AND INFORMAL SECTORS. MEXICO, 2012**

	Formal sector			Informal sector		
	Coef.	SE	P	Coef.	SE	P
Specification I: No controls						
Social security wealth (10 000)	0.015*	[0.003]	0.000	-	-	-
Peak value (10 000)	-0.050‡	[0.026]	0.050	-	-	-
Specification II: Sociodemographic						
Social security wealth (10 000)	0.010*	[0.003]	0.004	-	-	-
Peak value (10 000)	-0.024	[0.025]	0.335	-	-	-
Age	0.029*	[0.006]	0.000	0.028*	[0.006]	0.000
Male	-0.202§	[0.086]	0.018	-0.468*	[0.089]	0.000
Years of education	-0.021§	[0.010]	0.028	-0.012	[0.011]	0.262
Couple	0.095	[0.091]	0.296	0.084	[0.093]	0.366
Household members	0.059*	[0.018]	0.001	0.013	[0.017]	0.450
Real monthly total income	0.000§	[0.000]	0.020	0.000	[0.000]	0.983
Real net wealth	0.028‡	[0.017]	0.090	-0.007	[0.015]	0.666
Receive money from child	-0.081	[0.090]	0.366	0.053	[0.084]	0.533
Give money to child	-0.105	[0.080]	0.189	-0.115	[0.090]	0.198
Business owner	-0.497*	[0.169]	0.003	-0.257§	[0.127]	0.043
Job type (reference= white collar)						
Upper blue collar	-0.209‡	[0.119]	0.080	-0.186	[0.150]	0.216
Lower blue collar	-0.148	[0.110]	0.180	-0.292‡	[0.150]	0.051
Agricultural, forestry, fishing	-0.297‡	[0.177]	0.094	-0.358§	[0.169]	0.034
No. observations	1 738			1 737		
Specification III: Sociodemographic and health						
Social security wealth (10 000)	0.009*	[0.003]	0.006	-	-	-
Peak value (10 000)	-0.025	[0.025]	0.327	-	-	-
Age	0.023*	[0.008]	0.004	0.029*	[0.008]	0.000
Male	-0.168‡	[0.087]	0.053	-0.415*	[0.091]	0.000
Years of education	-0.021§	[0.010]	0.037	-0.015	[0.011]	0.184
Couple	0.092	[0.092]	0.315	0.055	[0.094]	0.559
Household members	0.060*	[0.018]	0.001	0.015	[0.017]	0.388
Real monthly total income	0.001§	[0.000]	0.025	0.000	[0.000]	0.776
Real net wealth	0.027	[0.017]	0.107	-0.003	[0.016]	0.824
Receive money from child	-0.093	[0.091]	0.306	0.027	[0.084]	0.751
Give money to child	-0.110	[0.080]	0.172	-0.135	[0.090]	0.135
Business owner	-0.495*	[0.168]	0.003	-0.249‡	[0.130]	0.054
Job type (reference= white collar)						
Upper blue collar	-0.225‡	[0.121]	0.062	-0.153	[0.152]	0.314
Lower blue collar	-0.151	[0.111]	0.173	-0.236	[0.152]	0.121
Agricultural, forestry, fishing	-0.299‡	[0.176]	0.090	-0.281	[0.174]	0.107
Chronic conditions	0.264*	[0.074]	0.000	0.183§	[0.077]	0.017
Difficulties with ADL	0.166§	[0.079]	0.035	0.200*	[0.070]	0.004
Social security health insurance	0.038	[0.151]	0.800	0.307*	[0.114]	0.007
Received Seguro Popular	0.020	[0.176]	0.907	0.103	[0.096]	0.283
Received non-contributory pension	0.122	[0.166]	0.464	-0.090	[0.150]	0.548
No. observations	1 738			1 737		

ADL: activities of daily living. White collar is the reference category.

\*  $p < 0.01$

‡  $p < 0.1$

§  $p < 0.05$

a dollar-increase in real net wealth increased retirement likelihood by 3.2 percentage points –yet the variable lost statistical significance in the fullest specification. In specification III, a dollar-increase in real monthly total income encouraged retirement likelihood by 0.1 percentage points, whereas owning businesses delayed retirement by 49.5 percentage points –consistent to the specification II. Having a white-collar occupation tended to increase retirement likelihood, compared to upper blue-collar and agricultural, forestry, and fishing jobs.

As we added health and health insurance metrics to specification III, we observed their significant effects as drivers. Worse health –in terms of chronic illnesses and difficulties with activities of daily living– increased retirement likelihood. Meanwhile, formal sector workers' retirement decisions were not significantly influenced by family transfers from and to children or access to health insurance through the social security system or *Seguro Popular*.

In contrast to formal sector workers, informal sector workers' retirement decisions were *not* driven by educational attainment, household size, or total income –consistently in specifications II and III. Instead, their retirement decisions were primarily shaped by health and access to health insurance. Nevertheless, there lay notable differences across the effects of health and health insurance coverage on formal- and informal- sector workers' labor supply. Health was a significant predictor of retirement decisions regardless of the sectors. Using specification III, informal sector workers with one or more chronic conditions or reporting difficulties with activities of daily living were more likely to retire by 18.3 percentage points and 20.0 percentage points, respectively, compared to their healthier counterparts. Similarly, formal sector workers with chronic conditions or difficulties with activities of daily living were more prone to retiring by 26.4 percentage points and 16.6 percentage points. Yet, in terms of insurance, only the informal sector workers respond to the health insurance coverage through social security –with the workers with coverage being more likely to retire by 30.7 percentage points.

There were some similarities in formal and informal sector workers' retirement decisions. Older respondents without business ownership were more likely to retire across both sectors. Moreover, formal and informal sector workers' retirement timing was not significantly affected by family transfers to and from children and receipt of a non-contributory pension.

## Discussion

Our results indicated that social security incentives significantly influenced the timing of retirement of Mexican

formal sector workers in MHAS, consistent with research from the United States and other European countries.<sup>5</sup> Regarding the measures that captured the incentives of the social security system, social security wealth was a stronger predictor of retirement than PV. The latter deterred retirement, but its statistical significance was weak –possibly indicating that participants in the formal sector in Mexico tended to optimize instantly rather than intertemporally. Moreover, years of education, household size, monthly total income, and business ownership were found to be strong predictors of retirement likelihood for the formal sector workers. In contrast, while the lack of coverage of social security system weakened the retirement financial preparedness of informal sector workers, these workers did not respond strongly to wealth, income, family transfers, and other socioeconomic factors when making retirement decisions. From this, we find support for hypothesis 1, that only formal sector workers in Mexico responded to socioeconomic incentives known as important determinants in the retirement literature from the developed countries. At the same time, our hypothesis 2 is unsupported by our findings, in that the informal sector workers' retirement decisions were not significantly driven by the other sources of income such as family transfers. The general unresponsiveness of informal sector workers to income (both formal and other sources) and wealth indicators may imply that informal sector workers' lack of financial security is so dire that they cannot afford to let current socioeconomic conditions sway their retirement decisions. Informal sector workers may have almost an absolute preference and need for continued work, and this tendency may explain the little impact the family transfers had on their retirement decisions. In a similar vein, it could be that the family transfers may not be sufficient to gauge –either induce or discourage– their retirement likelihood.

As we conjectured in hypothesis 3, health was an important determinant of retirement decisions for both formal and informal sector workers. Worse health deterred longer working lives by inducing retirement for all workers in the Mexican labor force. The existence of stark differences in the effects of other covariates on formal and informal sector workers make the consistent retirement-inducing effect of worse health all the more important, as a determinant of retirement decisions. Given the strong impact of health, it is not surprising that workers' varying abilities to pay for healthcare costs –dictated in part by health insurance coverages– also affected their retirement decisions. Our findings indicated that only informal sector workers' retirement decisions were shaped by their social security health insurance coverage, further lending support for hypothesis 3.

The results indicate that, for the informal sector workers most of whom did not have access to high-quality employer sponsored insurance over their working life, the new access to high-quality insurance through social security reduced financial burden of paying for healthcare -thereby relieving them from continuing work for pay. Unlike formal sector workers who have access to comprehensive health insurance during their working years through employers, informal sector workers rely on more basic universal health coverage (i.e., *Seguro Popular*, which offers more basic coverage for several chronic illnesses than the more comprehensive social security system) while working.<sup>40</sup> Informal sector workers that gain access to quality health insurance through social security -for being spouses or parents of formal sector workers- may face sudden incentives to retire, as the insurance effectively reduces the burden of healthcare expenditures. In other words, in our results, social security health insurance coverage could have encouraged retirement by increasing the financial capability of informal sector workers to pay for healthcare expenditures without relying heavily on salary earnings. They drew a stark contract to the rest of the informal sector workers without insurance plans or more limited access through *Seguro Popular*. For formal sector workers most of whom had access to employer-sponsored health insurance through social security, the continuation of health insurance through social security did not have a significant effect.

Our work has several limitations. First, our sample portrayed a partial picture of the Mexican formal labor market because we only included private sector employees covered by IMSS. This was due to the limited data at our disposal, which precluded us from computing the public sector employees' social security wealth. Next, in assuming that all workers in the informal sector in 2012 (baseline wave) were not eligible for social security benefits, we fell short of capturing the full effects of the transitions between formal and informal sectors. Our strategy may not have reflected the reality, where some of these workers could have transitioned back to the formal sector long enough to meet the eligibility criteria to claim social security benefits. Modeling labor force transitions between formal and informal sectors could generate more nuanced results. Moreover, we excluded return-migrants who worked in the United States and returned to work in Mexico from our sample, because their socioeconomic statuses or retirement decisions could be influenced by both Mexican and U.S. institutions.<sup>9</sup> The truncated labor histories of return-migrants could have generated widely different labor supply behaviors compared to non-migrant Mexican workers.<sup>9</sup>

Future changes in the Mexican social security system -benefits calculation, eligibility rules- are expected to have strong effects on labor force participation and retirement decisions of formal sector workers in Mexico, given the significant effects social security benefits have on the labor supply decision of beneficiaries. Moreover, the significant effect of workers' health in gauging the timing of retirement in both sectors suggests that efforts are needed to improve health in order to promote aging workers' prolonged engagements in the labor force. Lastly, strengthening public health infrastructure and access to better healthcare could increase aging workers' agency and control over their timing of retirement, better aligning the timing to their preferences.

### Ethics review

The Institutional Review Board at the University of Southern California reviewed and approved the research (IRB # UP-15-00023).

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