Raising Household Leverage: Evidence from Co-Financed Mortgages*

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Abstract

Easing borrowing constraints, a major barrier to home ownership, can have negative implications for default risk. This article provides evidence on this issue by studying the impact of increasing borrowers' credit capacity through a large co-financing scheme in Mexico. Co-financed mortgages combine a bank loan and another from a housing provident fund (HPF) that benefits from a secure repayment system. Relative to traditional bank mortgages, we find that the co-financed come with substantially lower down payments, by 7.6 percentage points, but with no differences in the average values of purchased properties. Despite their higher leverage, co-financed bank mortgages are not more likely to default given their lower liquidity requirements and the priority of both loans combined with secure payments on the HPF loan. From a distributional standpoint, they reduce down payments more at lower incomes, especially when banks are smaller. Larger banks, which capture a greater share of low-income borrowers, use co-financing to reduce the amount lent and, hence, their exposure to such riskier segments.

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1 Introduction

Housing is a primary need and, across numerous economies, also the single most important asset of households (Badarinza et al., 2016). Consequently, expanding access to home financing has become a salient public policy goal. To deal with demand-side frictions, a wide menu of policies aimed at increasing household debt capacity exists. Indeed, borrowing constraints are a major barrier to home ownership (see, e.g., Linneman and Wachter, 1989; Duca and Rosenthal, 1994; Gete and Reher, 2018; Blickle and Brown, 2019; Fuster and Zafar, 2016, 2021). However, a higher leverage can adversely impact individual default risk and, under certain conditions, ultimately jeopardize financial stability. It can also have unintended consequences for wealth accumulation, given that more constrained borrowers can only afford less costly houses (Gupta et al., 2021). This trade-offs pose a challenge for lenders, policymakers, and regulators alike. Their often conflicting goals have lead to the roll out of new products that expand access and affordability of credit, along with the imposition of leverage limits and higher regulatory costs for riskier loans.

Facing diverse regulatory landscapes, the efficacy of mortgage innovations in improving borrowing conditions, without deteriorating loan performance, is likely influenced by the institutional setting. Yet, little empirical work has focused on mortgage innovations from emerging markets, where private banks often co-exist with public ones as well as with institutions not integrated into the market-based financial system. Against this backdrop, we focus on a product that aims at increasing mortgage leverage by pooling resources from a private bank and a so-called housing provident fund (HPF). HPFs are self-financing entities that several governments created to deal with the scarcity of long-term funding. They act as compulsory saving schemes and play a prominent role in mortgage provision in countries such as Brazil, China, and Mexico. The co-financing scheme studied here is offered by a Mexican HPF, which is the largest mortgage lender in Latin America. In order to differentiate from existing bank products, such scheme offers an enhanced credit capacity, a reduced down payment, and a higher property value.

Our purpose is to study empirically how these co-financed mortgages compare to traditional ones in terms of borrowing conditions and default risk. Whether the two loans combined indeed provide more funding depends on their degree of substitution. Conditional on a higher total loan volume, it is unclear whether the down payment will decline and the property value will raise at the same time, signalling a latent demand for higher liquidity and better quality homes, respectively. These are conflicting goals because the down payment and the property value are positively correlated. Furthermore, a potentially higher leverage—the counterpart of a lower down payment—should increase default, all else equal. Ultimately, the equilibrium effects of co-financed mortgages are determined by how private lenders' supply and borrowers' demand respond to distinctive features of the program.

Leveraging a comprehensive loan-level dataset, we first confirm that co-financing comes with a larger combined loan volume than mortgages funded solely by banks. At the same time, we show that co-financing leads to a reduced down payment with no impact on the value of the purchased house, fulfilling only partially the advertised goals of the program. Second, despite the higher combined loan-to-value (LTV) ratio, we do not find evidence of meaningful differences in default risk. Finally, according to the evidence, co-financing is not distributionally neutral: The relief of borrowing constraints concentrates at the bottom end of the income distribution. These heterogeneous effects by income vary with the business model of the private lender.

HPFs differ along many dimensions, but a shared trait is being funded with mandatory contributions from employers and employees.[1] In exchange, HPFs offer a saving product and the option to take a mortgage. Given their complex design, most of these funds end up cross-subsidizing participants (Chiquier and Lea, 2009). By offering better borrowing conditions to low-income contributors, the Mexican HPFs comply with their social mission. However, lending to more profitable segments is necessary to improve returns on savers. This motivated the introduction of co-financing schemes with banks, which target higher-income borrowers, usually demanding larger loans than those fully funded by HPFs. Thus, co-financing helps Mexican HPFs to balance their saving and lending functions. It offers the possibility to leverage the existing savings in the HPF by mobilizing private funding, while reducing the HPF loan. Therefore, these schemes have been recommended for HPFs with poor lending performance and a regressive subsidy structure (Taffin et al., 2011).

Our analysis centers on a co-financing scheme by the *Instituto del Fondo Nacional de la Vivienda para los Trabajadores* (Infonavit), which serves all formal private sector workers in Mexico. The scheme, marketed as "Cofinavit", was launched in 2004 and now represents 61% of Infonavit's portfolio of co-financed mortgages (Infonavit, 2017b).[2] It involves a loan from a bank and a smaller one from Infonavit, contracted and administered separately. The borrower's savings held by Infonavit are used to cover up to the entire amount of the down payment. To secure debt collection, the Infonavit loan and, after its repayment, a portion of the bank loan are paid back with mandatory employer contributions and wage discounts.

The empirical analysis resorts to granular data from the Mexican banking supervisor on the universe of mortgages granted by commercial banks. The selected sample comprises Cofinavit and traditional mortgages that originated over the period 2016–2019, restricted to borrowers eligible for and targeted by Cofinavit. We start by studying the drivers of product choice and document that borrowing-constrained households (i.e.,

[1] In similar schemes from India, France, Germany, and Thailand, for example, contributions either are not compulsory or only come from employees (see Taffin et al. 2011).

[2] Henceforth, we refer to "Cofinavit" and "co-financing" and to "Infonavit" and "HPF" interchangeably.

younger and with lower income) are more likely to opt for co-financed rather than for traditional bank mortgages. In turn, we find that credit risk at origination—proxied in a subsample by the probability of default from the internal-ratings based approach—does not drive the product choice. This suggests a similar risk profile across the two borrower bases, conditional on a host of observable characteristics. Next, given that the two mortgage products are not randomly assigned to borrowers, we adopt the coarsened exact matching (CEM) approach from Iacus et al. (2012) for their comparison. This reduces a potential selection bias by matching on a myriad of observable traits from borrowers and banks and by restricting the comparison to the region of common support.[3] In the final sample, Cofinavit loans represent 45% from a total of 92,294 mortgages.

Our baseline estimates confirm that total (i.e., Infonavit plus bank) loan volume is larger, by 15% on average, when the mortgage is co-financed than when it is traditional. This implies that, as intended, Cofinavit does not lead to a full substitution of a portion of the bank loan for the Infonavit loan. Additionally, we find that only one of the other two Cofinavit goals is achieved in equilibrium: The property value is not higher on average in a co-financed mortgage, whereas the down payment (as a percentage of the purchase price) is 7.6 percentage points (pp) lower. This is a large decline of 32% relative to the average down payment of a traditional mortgage (24%). Moreover, since Cofinavit borrowers use all their mandatory savings to cover the upfront costs of buying a property, the down payment paid with their private liquid assets is actually 15.9 pp lower. Hence, not only Cofinavit relaxes leverage constraints substantially, but the implied decline in households' liquidity needs is even larger, representing a 66% change relative to a traditional mortgage. In turn, differences in the cost of credit across products are small: The combined Cofinavit rate is slightly higher (36 basis points [bp]) according to our estimates, and the premium is driven by the risk-insensitive Infonavit rate. Banks actually charge a rate 21 bp lower (a 2% decline relative to the average interest rate of traditional mortgages), which is in line with the lower *bank* LTV ratio of co-financed mortgages.

Given their higher *combined* LTV ratio, co-financed bank mortgages are riskier than traditional ones ex ante.[4] However, looking at the probability of becoming non-performing for up to four years after origination, we find no significant differences across products. Moreover, conditioning on the combined LTV ratio at origination, co-financed mortgages are less likely to default. Features specific to the co-financing scheme contribute to overturn the effect on credit risk of a higher leverage. These include a lower usage of household's liquidity to cover the down payment and loan payments and Infonavit's secure repayment system combined with cross-collateralization on two senior loans.

[3]Our main results could still be biased if borrowers sort into co-financed mortgages on the basis of unobservables. Reassuringly, we verify their robustness to directly controlling for the ex-ante risk proxy in a subsample.

[4]Supervisory data do not track the loan portion granted by the HPF over time, on which default typically occurs later than in the bank portion.

Having documented the average effects of co-financing on mortgage origination conditions and performance, we next examine if it has any distributional consequences. Our estimates show that differences in total loan volume with traditional mortgages are small across the income distribution. Even so, the co-financed reduce down payments more (but not liquidity needs at origination) and lead to purchase less expensive properties at lower than at higher incomes. Consistent with their relatively higher leverage, we estimate a greater probability of default for co-financed mortgages at lower incomes. These findings are in line with the expected demand-side effects of a higher loan volume: Low-income households, with lower savings, would use the additional resources to reduce the down payment since they are less able to afford larger loan payments of a more expensive house (i.e., their payment-to-income [PTI] constraint is more likely to bind). The supply side, however, is likely to play a role as well. The Infonavit loan has a greater share at lower incomes, where its credit limits are relatively higher, and is generally more expensive than the bank loan. Hence, the average rate turns out to be slightly higher for poorer borrowers in a co-financed than in a traditional mortgage. This would lead to higher payments, reducing further the ability of low-income borrowers to acquire a better home through co-financing.

All average and heterogeneous effects do not change significantly after the terms of the Infonavit loan (credit limits and interest rates) were adjusted in April 2017, with different intensities for low- relative to high-income borrowers. This could be attributed to the comparatively small share of the Infonavit loan; on average, banks provide most of the funds in a co-financed mortgage. Thus, we further investigate whether our results vary across different types of private lenders, in particular, larger versus smaller ones. The business model of larger banks relies on an extensive network of branches that allows reaching more low-income borrowers than what smaller banks can. Consistent with this, we find that lender size plays a bigger role in the results by income. In particular, the heterogeneous co-financing effect on down payment is more pronounced among smaller banks. This reflects the greater decline in total loan volume at lower incomes among larger banks, given their greater substitution for the Infonavit loan. Larger banks can reduce their exposure to low-income, riskier borrowers by downsizing their co-financed loans to those segments. In line with this strategy, they also grant more co-financed loans, which are smaller than traditional ones in the bank portion, to poorer borrowers.

This study contributes to the literature on financial innovations in mortgage markets. A substantive body of work considers interventions dealing with supply-side frictions, such as securitization that lower the funding costs of private lenders (see, e.g., Loutskina and Strahan, 2009; Mian and Sufi, 2009; Keys et al., 2010). More related is the literature on innovations making mortgage markets deeper and more inclusive by targeting demand-side frictions. In a general equilibrium framework, Chambers et al. (2009) show that a generalized reduction of leverage constraints reduces home ownership by in-

creasing mortgage rates (see, also, Ortalo-Magné and Rady, 2006; Halket and Vasudev, 2014). However, they also show that expanding the choice set by introducing a "combo" or "piggyback" loan with a reduced down payment requirement, along with a standard mortgage, does increase ownership by suppressing the general equilibrium effect.[5]

Our paper directly relates to the empirical body of work that evaluates government policies seeking to ease borrowing constraints and increase housing affordability. An example is the Help-to-Buy program in the UK, which reduces down payment by topping up bank loans with "equity loans" from the government.[6] Tracey and Van Horen (2021) study the effect of the program on house purchases and household consumption. Benetton et al. (2021) find that the program prompted the purchase of more expensive properties given that borrowers treat public and private loans as complements. Crucial for their finding is that equity loans do not increase households' leverage—they are essentially shared equity, not debt—and are interest-free over the first five years. In the Cofinavit scheme, the Infonavit loan does increase leverage and its interest rate is actually higher than the bank rate. For such a program, our work provides evidence on its effects on borrowing conditions in a shallower private mortgage market. We further estimate distributional effects by income that are in line (but of the opposite sign) with those from the literature on macroprudential policies that *reduce* mortgage leverage (see, e.g., Kinghan et al., 2019; Acharya et al., Forthcoming).

This paper also relates to the literature on mortgage market design and default, which received increasing attention after the 2008-2009 financial crisis (for an earlier contribution, see Vandell, 1978). A branch focuses on mechanisms aimed at mitigating credit risk ex ante, considering the interaction between contractual features and market conditions. Among many others, some recent contributions are Greenwald et al. (2021); Campbell et al. (2021); Guren et al. (2021). More directly related to ours are the empirical studies on second mortgages and default. Mian and Sufi (2011) show that home-equity based borrowing increased both leverage and default in the US. For piggyback second liens, Sherlund (2008) and Mayer et al. (2009) find a higher default risk as well conditioning on their combined LTV ratio, but more recent evidence finds the opposite (Eriksen et al., 2013; Agarwal et al., 2020). Another related branch studies empirically the role of liquidity on mortgage performance. Ganong and Noel (2020), for instance, show that reducing short-term payments by extending maturity is effective in reducing defaults (see also Elul et al., 2010; Fuster and Willen, 2017; Defusco et al., 2019). We contribute to the literature by studying a contract that, to curb default incentives, counterbalances

[5]Government-sponsored enterprises (GSEs) launched piggyback loans in the US in the 1990s and private lenders later adopted them. They involve two loans, where the second one covers part or all of the down payment with a higher interest rate than the main loan. This scheme allows households to avoid mortgage insurance.

[6]The Irish government will launch a similar "First Home" scheme in 2022. The US also has had several down-payment assistance programs, such as the American Dream Downpayment Initiative.

higher leverage at origination with a secure repayment system for the second loan, with the same priority as the first, and lower liquidity needs throughout the mortgage's life.

Finally, our work complements the findings from the growing literature on HPFs, which uses survey or aggregated data, or calibrated models to study their impact on home ownership and prices (see, e.g., Tang and Coulson 2017 and Zhou 2020 on China; Phang and Wong 1997 on Singapore). While they focus on mortgages funded solely through HPFs, we instead provide novel evidence on products co-financed with private intermediaries. To this end, we resort to a unique supervisory dataset from commercial banks in Mexico that offers one source to, at least partially, circumvent the lack of loan-level data on HPFs.

2 The Mexican co-financing program[7]

Following the 1994 peso crisis, private financial institutions withdrew from the Mexican mortgage market, retaining a small role since then. Such institutions comprise commercial banks (focused on middle- to high-income households) and non-bank intermediaries, known as Sofoles and Sofomes (focused on low- to middle-income households). By contrast, HPFs have a major market share. Created in 1972, the two main funds are Fovissste and Infonavit, for public and private sector workers, respectively, contributing to social security (Carballo-Huerta and González-Ibarra, 2009).

Infonavit is a tripartite body with representation from government, employers, and trade unions. It has a dual mandate, acting as direct lender and providing retirement benefits. Historically, Infonavit's priority has been to encourage borrowing over saving. It enjoys a funding advantage over other financing institutions because it obtains resources from mandatory employer contributions, representing 5% of the employee's base salary, with a cap at 25 times the minimum wage (MW). These mandatory savings, collected in individual home accounts, can only be used by the worker to top up the funds for a mortgage or can be withdrawn upon retirement. Other advantages include a captive customer base, a secure repayment system, and a less strict regulatory framework than banks or pension funds.

Traditional Infonavit mortgages finance social housing for low-income participants (Garcia Mora and Shabsigh, 2016). Banks typically lend to mid- and high-income segments, for which the traditional Infonavit loans offer too low credit limits and high interest rates to be attractive. However, Infonavit is also interested in extending mortgages to higher-income segments, which render a higher net return and, ultimately, allow paying

[7]Unless otherwise noted, this section and Appendix A are based on interviews with officers from Infonavit and private banks, information requested to Infonavit through the National Transparency Platform, the Infonavit Law (article 43 bis), and its implementation decrees (Official Journal of the Federation of February 22, 2008, and of April 5, 2017).

better rates of return on workers' savings.[8] Thus, it introduced co-financed products as a means to serve more profitable segments through cooperation with private lenders. Specifically, we study a product marketed as Cofinavit, which was launched in 2004 and is the main co-financing scheme in the country. By 2018, Infonavit loans granted through Cofinavit amount to MX$7,435 millions (USD378 millions), representing 61% of Infonavit's co-financed loan portfolio (Infonavit, 2017b).

Cofinavit can be used to buy a new or second-hand property. It is advertised as enabling to enhance borrowers' credit capacity, to reduce or eliminate the down payment, and to give access to a property of higher value relative to a traditional (Infonavit or bank) mortgage. The scheme combines a mortgage from Infonavit and another from a private bank, signed under two separate contracts, and uses the home account balance as partial payment for the property. Future employer contributions are redirected to mortgage repayment.

Figure 1 displays the standard funding structures of houses purchased through traditional bank mortgages and co-financed ones. In a traditional mortgage, the down payment has to be fully covered with borrowers' private savings. Moreover, banks usually do not grant mortgages for the entire amount of the property to be purchased, borrowers need savings for the down payment and other costs. In turn, Cofinavit leverages borrowers' mandatory savings to cover part or all of the down payment and even other origination costs (e.g., the notary and home appraisal fees).[9]

In addition to contributing to the Infonavit's savings function via higher returns, Cofinavit avoids the liquidity strains that larger loans impose—the bulk of the property is funded by the bank. For banks, Cofinavit enables lending to otherwise down-payment constrained workers, but with a continued employment history in the formal private sector. In addition, banks directly or indirectly benefit from Infonavit's secured servicing procedures. For both lenders there are risk-sharing benefits as well, since the same asset is pledged as collateral and either can seize it upon default of its loan. In practice, however, Infonavit benefits more given that banks start legal action first.

2.1 Origination, servicing, and termination of Cofinavit mortgages

Here we describe the main characteristics of the bank and Infonavit loans in a Cofinavit mortgage, highlighting any differences with traditional bank mortgages (see Table 1 for a summary).

Screening. Each institution screens its portion of the Cofinavit mortgage separately. Banks use the same risk-based screening technologies as for traditional loans. Infonavit

[8]For the (large) fraction of workers who never take a mortgage from Infonavit, the return on their home accounts has generally been low (OECD, 2015).

[9]During the period under analysis, Cofinavit allowed the sum of the Infonavit and bank loans and the mandatory savings to be larger than the lesser of the purchased price and appraised value.

has less strict approval standards. In line with its social mission, it is unlikely to reject an application that fulfills the eligibility requirements, which include being currently employed and contributing to Infonavit, not having had an Infonavit loan before, and having a certain minimum score (determined by a combination of age and salary, the amount of savings in the home account, and the number of years of continued contribution to Infonavit). On the basis of demographic characteristics, employer information, and, since October 2017, credit bureaus' reports, a credit assessment establishes the maximum fraction of her Infonavit credit limit that the borrower can get (Infonavit, 2016).

Loan repayment. The repayment of the two loans starts simultaneously and is monitored separately by each lender. The Infonavit loan is repaid with employer contributions (i.e., 5% of the employees' base salary) and salary discounts (between 1% to 7% of the salary). Low-income borrowers, given their higher job turnover and the ensuing credit risk, are subject to a higher discount rate than high-income borrowers to ensure a prompter loan repayment. By contrast, the amortization of the bank debt initially relies on borrowers' cash on hand or private savings, as in any traditional mortgage. Once the Infonavit loan is fully repaid, the employer contributions can be redirected to pay the outstanding principal of the bank loan, which as a result will be paid down faster. This implies that, until being fully repaid, the Infonavit loan de facto has higher priority on the borrowers' cash flows that secure payments.

Default. Even though the debt with Infonavit has the higher financial cost, default typically occurs first on the bank loan. This reflects that, while remaining employed in the formal sector, the borrower retains the option to stop paying the debt with the bank but not that with Infonavit. The employer is obliged to deduct the contributions and discounts from the worker's paycheck and transfer them to Infonavit as payment for the mortgage. Consequently, most defaults on Infonavit loans occur when workers lose their formal job (OECD, 2015). If workers become unemployed or move to the informal sector, they should pay to Infonavit directly, which increases credit risk.

Non-performing status. Infonavit and commercials banks also follow different procedures to classify mortgages as non-performing. In case of unemployment, the insurance required by some banks covers between three to nine monthly installments, whereas an insurance fund covers the first six monthly installments to Infonavit. Banks generally classify mortgages as non-performing after three months of delinquent payments. In turn, Infonavit takes about 15 months, since the borrower can defer payments for up to a year and then has three months to start paying the equivalent of the employer contributions plus wage discounts.

Post-default actions. When a Cofinavit mortgage becomes non-performing, either the bank or Infonavit can start legal actions since both institutions have a first lien on the property. In practice, given that the borrower usually defaults first on the bank loan and that the bank flags the loan as non-performing earlier, the bank is likely to initiate

legal proceedings first (after about four to six months in delinquency). In the event of foreclosure, the bank sells the house and pays to Infonavit its portion. Yet, since Mexican mortgages are recourse loans, they are unlikely to go into foreclosure; deeds-in-lieu of foreclosure are more common.

2.2 Loans' financial conditions

Whereas the financial conditions of the bank loan are similar in a Cofinavit and in a traditional mortgage, the Infonavit loan has its own special conditions that we summarize here. First, the bank loan typically has a maturity of 20 years. In turn, the Infonavit loan has a shorter maturity, being normally repaid in about five to eight years—the higher the discount rate, the shorter its maturity. Second, banks set their interest rate on the basis of loan and borrower characteristics, such as the LTV ratio, income, and having an account for wage payments or an insurance contracted with the lender (Banco de México, 2020). In particular, the bank rate is decreasing in income. The interest rate charged by Infonavit is higher than the bank rate (see Panel D in Appendix Figure A.3). Until March 2017, it was a function of borrower's income alone and entailed a cross-subsidy from high- to low-income borrowers (see Panel A of Appendix Figure A.1).

Third, the maximum loan amount granted by Infonavit is increasing in borrowers' income and decreasing in age (see Panel A of Appendix Figure A.1). Originally, these credit limits were relatively more generous with borrowers whose income was below MX$26,522 (in pesos of 2017). Indeed, they dropped discretely by at least 52% as income increased from MX$26,522 to MX$26,765. It should be noted that, along with a borrower's credit assessment, these limits determine the actual loan amount that the borrower must take from Infonavit. Otherwise, since the Infonavit interest rate is higher than the bank rate, borrowers may prefer to only take a loan from the bank if a larger one were approved. The bank then determines the maximum size of its Cofinavit loan as a residual, considering a combined PTI limit of around 30%. Hence, a larger Infonavit loan reduces the maximum size of the bank loan.

A new Infonavit credit plan was announced on 30th November 2016, becoming effective on 5th April 2017 (Infonavit, 2017a). In relation to Cofinavit, it implied a shift in Infonavit credit supply towards higher-income (as well as older and married) borrowers, with the purpose of increasing the returns on workers' savings (Infonavit, 2016).[10] In order to achieve that goal, it adjusted the interest rates and credit limits of the Infonavit loan. The effect of these changes on the demand of high- versus low-income borrowers are, however, ambiguous. On the one hand, the advertised interest rate became the same (12%) for all borrowers (Panel B of Appendix Figure A.1). In consequence, between

[10]The more controversial aspect of the new plan was the increase in the amount of traditional Infonavit loans. BBVA Research (2018) argues that this could displace not only traditional but also co-financed bank lending, given that middle-income borrowers can resort to a larger traditional Infonavit loan.

March and April 2017 the interest rate in pesos dropped by over 2 pp at higher incomes, whereas it declined less or even increased at lower incomes, as shown in Figure A.2. This change was clearly more beneficial for high-income borrowers.

On the other hand, the new credit limits reduced the gap between low- and high-income borrowers. Thus, they drop by only 37% on average, as income rises from MX$28,686 to MX$28,916 (Panel B of Appendix Figure A.1). Appendix Figure A.2 plots the changes in credit limits between plans, which entail substantial increases for high-income borrowers. For low-income borrowers, the limits increased more modestly and even declined at certain maturities. Higher Infonavit credit limits are actually unattractive for borrowers: They imply a higher share of the more expensive Infonavit loan and, hence, an increase in the average cost of co-financed mortgages. Thus, unlike the new Infonavit rate, the new credit limits were actually less beneficial for high-income borrowers.

Another modification affects joint schemes for married couples, where Infonavit grants one loan for the main borrower and another for the spouse (banks instead grant only one loan based on the total income). The spouse, who could only take an Infonavit loan for up to 75% of her credit limit under the old plan, can take the entire amount after April 2017. Appendix A describes more in detail these aspects of the new Cofinavit program, as well as other changes concerning loan indexation, salary discounts, and administrative fees.

3 Theoretical effects of co-financing on mortgage outcomes

To guide the empirical analysis, here we present our conjectures about how Cofinavit potentially affects mortgage characteristics at origination and, for the bank portion only, performance. This discussion focuses on aspects derived from the contractual features of Cofinavit, as compared to those of traditional bank mortgages. We abstract from borrower selection and omitted variable issues that will be addressed in the empirical section.

3.1 Mortgage characteristics at origination

Cofinavit promises to enhance borrowers' credit capacity, meaning that its combined loan volume should be larger than that of a traditional bank mortgage. It also promises to enable the purchase of a more expensive property with a reduced down payment. These goals are somewhat in conflict because a larger property value increases down payment, all else constant.

Figure 2 compares the funding structure of a traditional bank mortgage with three hypothetical co-financing outcomes that could be observed in equilibrium. In the first

co-financing case, there is a full substitution between the Infonavit loan and a portion of the bank loan within a Cofinavit bundle. That is, the bank loan shrinks by an amount equal to that of the Infonavit loan, and the total loan volume remains the same. As a result, the property value and the down payment are not affected either. In this scenario, the Cofinavit goals are not achieved. In the other two cases, there could be partial or no substitution between the two loans so that the total loan volume increases. The equilibrium outcome will range between a pure reduction in down payment (second case) and a pure increase in property value (third case). Ultimately, the position between these corner cases will depend on borrowers' demand for liquidity versus a better property. For both goals to be achieved simultaneously, the property value can increase, but less than the total loan volume, so that the down payment declines. Note that if there is no substitution between lenders (as illustrated in the third case), the total volume increases by an amount equivalent to that of the Infonavit loan. This, however, could lead to an excessive leverage and to a potential violation of the PTI limits. Thus, some partial substitution is expected (as in the second case). Finally, in all three co-financing cases, borrowers experience a reduction in liquidity needs, that is, in private savings needed at origination because a fraction of the down payment is covered with mandatory savings.

Since the PTI ratio is declining in borrowers' income, there is room for a greater increase in total loan volume at higher incomes. We also expect the demand for liquidity versus a better property to vary by income level, which serves as a proxy for (unobserved) savings. Considering that the saving rate increases with income (Dynan et al., 2004), low-income borrowers potentially have lower savings to cover the down payment and other origination costs that represent between 7% to 9% of the property value. Hence, they may use the additional funding to reduce their liquidity needs rather than to buy a better house. Higher-income borrowers, by contrast, should have more liquid savings to afford all the upfront costs. Moreover, thanks to a lower PTI ratio, they can increase even more their credit capacity through co-financing, being able to acquire a more expensive house with the same down payment as in a traditional mortgage.

In terms of mortgage pricing, ex ante it is uncertain how the volume-weighted average interest rate of a co-financed mortgage will compare to the rate of a traditional bank mortgage. On the one hand, the impact of the higher Infonavit rate in the overall cost of a co-financed mortgage will be mitigated by the small share of Infonavit in total loan volume, especially at higher incomes. On the other hand, given the same borrower characteristics, banks could charge a different rate in a co-financed than in a traditional mortgage if its conditions are different. In particular, the bank LTV ratio of Cofinavit is expected to be lower if there is some partial substitution with the Infonavit loan and/or if the property value is higher. This will lead to a lower bank rate than in a traditional mortgage.

3.2 Bank mortgage performance

We center the discussion here around the probability of default of a co-financed bank loan, that is, the probability that the bank portion is formally classified as non-performing. We identify different conflicting forces that potentially play a role at this margin. First, origination conditions can lead to a worse performance of co-financed products. It is well known that mortgages with a higher LTV ratio at origination have a higher probability of default (Mayer et al., 2009; Campbell and Cocco, 2015). If co-financed mortgages effectively lead to a lower down payment (as in the second case of Figure 2), their *combined* LTV ratio will be higher. The lower equity stake at origination could translate into a worse performance ex post. It needs to be stressed that what drives default on the bank loan is the burden that both loans combined, not only the bank portion, places on a borrower's finances (Elul et al., 2010; Demyanyk and Van Hemert, 2011). Naturally, this channel will be muted if co-financing does not lead to a reduced down payment (as in cases 1 and 3).

On the other hand, Cofinavit reduces the risk of liquidity-driven defaults on the bank portion relative to that of a traditional bank mortgage (see Elul et al. 2010; Fuster and Willen 2017; Ganong and Noel 2020). This feature applies to all the scenarios considered in the previous section. First, Cofinavit borrowers require less private savings at origination to cover the (potentially smaller) down payment and also, possibly, other origination costs—their mandatory savings are unlocked with that purpose. Second, for the same combined PTI ratio, a Cofinavit mortgage leaves more disposable income since its payments are partly covered by employer contributions. Payments of a traditional mortgage are entirely drawn from the borrower's cash on hand (or private savings), while the employer contributions are still deposited into Infonavit's home account. Finally, if becoming unemployed, the borrower has the option to defer the payments of the Infonavit loan for more than a year after the insurance coverage ends. The ensuing financial relief should have a positive impact on the ability to pay the bank mortgage.

Another feature that also reduces the credit risk of Cofinavit is Infonavit's secure repayment system combined with the use of the same collateral (i.e., cross-collateralization) for two first-lien loans. While employed in the formal sector, the borrower can default on the bank but not on Infonavit. As a result, upon defaulting on the bank, the borrower will not get back the full cash flow of payments, whereas the bank may initiate legal actions to recover the property. The risk of losing the house in foreclosure, while still paying to Infonavit, reduces the incentives to default on the bank portion. If the bank did not had a first lien, it would be less interested in the resolution of a distressed mortgage. By contrast, it is less crucial that Infonavit also has a first lien—the repayment system ensures that its default occurs later and, thus, it usually does not directly engage in recovery actions.

Note that once the Infonavit loan is fully repaid, the employer contributions and wage discounts are used to repay a portion of the bank loan. While this may slightly alter how some of the forces described above operate, they all should continue acting in the same direction. On the other hand, since our dataset does not follow the Infonavit loan over time, we cannot study its performance empirically. However, given the characteristics of Infonavit's repayment system, studying default of the Infonavit loan is only interesting for borrowers that lose their formal job. In such case, origination conditions should affect it in the same way as the bank loan, whereas the factors that reduce risk will be muted.

4 Data

4.1 Data sources and sample selection

We use mortgage-level data from the R04 H report, collected monthly by the banking regulator (*Comisión Nacional Bancaria y de Valores, CNBV*). This confidential dataset covers the entire life of each mortgage granted by commercial banks in Mexico, except for the application stage.[11] Among other mortgage characteristics, it contains data on the lending institution, the loan's origination and expiration dates, its volume and interest rate, and the value and municipality of the property used as collateral. We extract data on borrower characteristics at origination from the R04 H-0491 sub-report, which includes the employment sector, income, gender, age, marital status, and the municipality where she is employed. Loans' non-performing status is obtained from monthly follow-up of mortgages in the R04 H-0492 sub-report.

Whereas the dataset does not cover loans entirely funded by HPFs, it allows identifying Cofinavit bank mortgages through the names of the co-financing institution and of the mortgage product. For such loans, the dataset reports the amount granted at origination by both the bank and the co-lender as well as other characteristics corresponding to the bank portion only, such as maturity or delinquency status. The Infonavit rate applied to Cofinavit loans prior to April 2017 is extracted from the "Terms of Contract" (Official Journal of the Federation, 24 April 2008).

We select a sample that only includes traditional and Cofinavit bank mortgages, granted to borrowers that are potentially eligible for either product. We exclude any other bank mortgage granted through an arrangement with a HPF, development bank, or promotion agency. We restrict the dataset to mortgages taken by private sector workers eligible for a Cofinavit mortgage and with an income in pesos between 3 and 25 MWs (MW defined as of March 2017). Few bank customers have an income below 3 MWs and Infonavit does not target borrowers with an income above 25 MWs (even if some also take

[11] This is a supervisory report, not a credit registry. The latter is characterized as a network exchange of credit information that also records queries from loan applications.

Cofinavit mortgages). We select mortgages originated to purchase a new or a second-hand property, which are the only possible uses admitted for a Cofinavit loan.[12] The origination period spans three years going from June 2016—the first month in which the enhanced version of the R04 H report is available—until June 2019. Monetary variables are expressed in CPI-adjusted Mexican pesos (second fortnight of July 2018 = 100) and, along with the LTV ratios, are winsorized at the top and bottom 1.5% of the distribution. Appendix Table A.1 provides detailed variable definitions.

4.2 Data description

Table 2 reports the mean for several characteristics of traditional and Cofinavit mortgages. The mortgage is the unit of analysis and, generally, each borrower in the sample only takes one mortgage. The sample in the first two columns is obtained after applying the filters described in the previous section, whereas in the last two columns it is further restricted to the common support region, using a matching procedure described below. The sample in Panel A contains 116,845 mortgages, whose characteristics are measured at origination. These mortgages are extended by ten banks, each granting both product types. Appendix Figures A.3 and A.4 allow visualizing the empirical distribution of these characteristics, using box plots for several percentiles and the mean.

Co-financed mortgages represent 40.9% and 44.9% of the entire and common support samples, respectively. In both samples, Table 2 shows that, relative to traditional bank mortgages, the total (i.e., Infonavit plus bank) volume is slightly larger and the volume of the bank portion is slightly smaller on average for co-financed mortgages. Appendix Figure A.3 further shows in Panel A that, within Cofinavit bundles, the Infonavit loan is substantially smaller than the bank loan. Relative to traditional loans, the co-financed ones exhibit lower down payments and a similar mean property value. Differences between the (volume-weighted) average interest rate in a Cofinavit mortgage and that charged by the bank in a traditional mortgage are small. However, within Cofinavit loans, the Infonavit rate is substantially higher than the bank rate and exhibits very little dispersion (Panel D of Appendix Figure A.3). Columns 1 and 2 of Table 2 show that co-financed borrowers on average earn less and are younger than borrowers with traditional mortgages (also apparent in Panels A and C of Appendix Figure A.4). Finally, in Panel B of Table 2, we take the same mortgages as in Panel A and follow them over two, three, and four years after origination (observations are at the mortgage–month level). In all cases, the percentage of co-financed loans that are non-performing is only slightly lower than that of traditional loans.

[12] Other data cleaning steps include the removal of co-financed loans with a combined LTV ratio greater than 100% (possible reporting errors), mortgages originated by development banks, mortgages originated by HPFs and acquired by banks, banks with less than 200 loans in the sample, and loans with missing values in some key variables.

5 Mortgage choice

Before presenting the main analysis on co-financing outcomes, we provide evidence on the observed factors driving product choice. To this end, we estimate the probability of selecting a co-financed mortgage versus a traditional one as a function of loan-, borrower -, and bank-level covariates. First, we report marginal effects from probit models in columns 1 to 3 of Table 3. All specifications include time fixed effects and the standard errors are clustered at the income group level. In column 3, we control for a bank's internal measure of default risk. Thus, that sample is restricted to mortgages originated by the only bank that adopted an internal ratings-based based approach for credit risk, introduced by Basel II, during the sample period (specifically, after December 2018). Given the incidental parameter problem in the fixed effect probit estimator, we also estimate linear probability models adding fixed effects for banks (columns 4 and 5) and for municipality where the borrower works (column 5).

We find that taking a mortgage to buy a new versus a second-hand property is not a robust predictor of opting for a co-financing scheme. Other estimated coefficients suggest that co-financed mortgages are taken by borrowing and liquidity constrained households. In particular, having a co-borrower, low income, and being young increase such likelihood. Larger credit constraints among low-income and younger households are documented by Jappelli (1990); Ortalo-Magné and Rady (1999); Chiuri and Jappelli (2002). We also estimate a higher rate of co-financing among married borrowers. Similar to having a co-borrower, this could be attributed not only to borrowing constraints but also to the possibility of pooling the mandatory savings from both spouses for the down payment. Thus, these two traits are associated with a higher ratio of illiquid, mandatory savings to total savings that we do not observe. Our findings also reveal negative coefficients for regions where the borrower works relative to the center region, the omitted category. This is consistent with properties in Mexico City, part of the center region, being more expensive and requiring larger down payments.

In addition, the estimates show that co-financed mortgages are more demanded by men—even among single borrowers or those without co-borrower (not reported). We conjecture that this could reflect differences in financial literacy and sophistication across gender. Co-financing is less common among smaller banks, especially when borrowers' income is low as shown in column 3. In Section 7.4, we argue that this is a consequence of banks' business models. Importantly, the proxy for the probability of default at origination is insignificant, suggesting the absence of differences in the ex ante risk profile of borrowers opting for co-financed mortgages.

6 Empirical approach

Next we present our empirical strategy to evaluate the impact of co-financing on credit conditions at origination and ex post performance. The analysis focuses on the intensive margin of mortgage loans for households that apply for a Cofinavit or a traditional bank mortgage and get lenders' approval. Formal private sector workers that have not taken either of these products during the sample period are not part of our dataset. Thus, conditional on the borrowing choice, we first estimate OLS regressions that control for observable borrower characteristics and unobservable bank-level factors. We then use a matching procedure to better account for borrowers' self-selection into one of the two mortgage products.

6.1 OLS estimation

We begin with a descriptive analysis of how co-financing relates to mortgage outcomes by estimating OLS regressions of the form:

$$y_i = \alpha_0 + \alpha_1 \cdot \textit{Co-financed}_i + X_i'\lambda + \gamma_l + \gamma_t + \Gamma' + \epsilon_i, \tag{1}$$

where i and t denote the mortgage and the time period (i.e., the cohort of origination of the mortgage), respectively. We consider several mortgage-level outcomes as dependent variables, y_i, comprising terms at origination (volume, down payment, property value, and interest rate) and performance (default). The regressor of interest, $\textit{Co-financed}_i$, is equal to 1 for Cofinavit mortgages and to 0 for traditional bank mortgages.

We control for borrower characteristics at mortgage origination in the vector X_i, which comprises income (a restricted cubic spline transformation of its logarithm), age, gender, and marital status. In addition, we progressively augment equation (1) with a rich structure of fixed effects. Through γ_l, we control for borrower's income group (50 bins of MX\$0.04 logarithmic length) to compare mortgages within the same income segment. γ_t accounts for time (i.e., cohort of origination) fixed effects to absorb variation in macroeconomic conditions. The vector Γ includes fixed effects for banks and for municipalities of the purchased property and of the borrower's workplace, which capture unobservable time-invariant differences across private lenders and across local economic conditions affecting mortgage demand. Γ further includes bank-specific linear time trends. ϵ_i denotes the error term. Standard errors are clustered by income group, as Cofinavit provisions differ by income bracket.

Whereas equation (1) helps to uncover a set of stylized facts about co-financing, it is not informative in terms of causation. Endogeneity most prominently stems from potential omitted variables that could bias the estimates in either direction. For example, younger and low-income borrowers tend to apply more for Cofinavit, as described in the

previous section. If they are also more likely to buy a smaller property and to default, the OLS estimates would attribute the age and income effects to co-financing. This would lead to a downward and upward bias in the estimates for property value and default, respectively. Thus, we resort to a matching approach to move closer to a causal interpretation of co-financing effects.

6.2 Matching approach

Unconditional differences in mean outcomes between co-financed and traditional mortgages may not arise primarily from selection on unobservables, but from selection on observables and lack of common support. In that case, matching on a rich set of covariates and performing the analysis in a region of common support can substantially reduce bias. With that purpose, we employ a matching procedure to estimate the average treatment effect (ATE) of co-financing. In the absence of random assignment, we allow selection of the mortgage product to be driven by borrower and lender characteristics.

Specifically, we implement the CEM approach described in Iacus et al. (2012). This approach involves pre-processing the data to reduce the imbalance between co-financed (i.e., treated) and traditional (i.e., control) mortgages. One advantage of this method is that we can ex ante decide the level of imbalance by coarsening the predictors influencing the mortgage choice. To perform the matching, we select the following covariates and their corresponding coarsening levels:

1. Logarithm of borrower's income (20 bins defined using equally spaced cutpoints)
2. Borrower's gender (two bins)
3. Borrower's age (13 bins defined for five-year intervals)
4. Borrower's marital status (two bins)
5. Region where the borrower works (five bins for North, South, East, West, Center)
6. Bank granting the mortgage (ten bins for each bank in the sample)
7. Whether the mortgage is granted under the old or the new Infonavit credit plan (two bins defined before and after April 2017)

For some of the covariates (e.g., borrower's gender or marital status) we actually preserve the original classification, without further coarsening them. The first five (borrower) covariates are determined before the mortgage choice. The sixth variable captures the different propensity across banks to approve applications for co-financed versus traditional mortgages. The last variable is included because, under the new Infonavit plan of 2017, the distribution of borrower characteristics across co-financed and traditional mortgages may change.

The CEM algorithm defines strata for all combinations of the covariates' bins and sorts observations into those strata (some may be empty). Then, it assigns a weight of

1 to co-financed mortgages and the stratum weight to traditional bank mortgages—the stratum weight is increasing in the proportion of co-financed loans in that stratum. It assigns a weight of 0 to unmatched observations, that is, co-financed mortgages for which there is not at least one traditional mortgage in the same stratum, and vice versa. The algorithm matches 41,580 co-financed mortgages with 55,426 traditional bank mortgages, whereas 27,574 mortgages do not have a close match. A measure of global imbalance with respect to the full joint distribution of the covariates (including all interactions) is given by the statistic, $\mathcal{L}_1$, which varies between 0 (perfect balance) and 1 (largest imbalance, i.e., complete separation). We confirm an increase in balance resulting from the matching algorithm, since $\mathcal{L}_1$ declines from 0.77 in the unmatched data to 0.66 after matching (its absolute value is less important).

After implementing this algorithm, we estimate equation (1) using the weights generated by the CEM algorithm. This procedure compares co-financed and traditional mortgages granted to borrowers with similar characteristics by the same bank, under the same (old or new) Infonavit credit plan. The parameter α_1 provides an estimate of the ATE of co-financing in the population as long as two identifying assumptions are met.

One assumption is common support, which requires that there is sufficient overlap in the characteristics of co-financed and traditional mortgages to find adequate matches. To attain overlap, we use multiple filtering criteria that restrict the sample to borrowers and mortgage characteristics eligible for (and targeted by) Cofinavit (see Section 4.1). In this filtered sample, the CEM approach further reduces the data to common support by ensuring that only strata with both co-financed and traditional loans are used in the analysis. Columns 3 and 4 of Table 2 confirm that the mean differences in borrower characteristics disappear by construction. Appendix Figure A.4 also shows that the percentiles for borrower's income and age get closer across mortgage products in the balanced sample.

The second identifying assumption is ignorability of co-financing conditional on observable covariates. This means that, conditional on matched observables, the reason one borrower gets a co-financed and another a traditional loan is not due to an unobserved variable correlated with the outcomes. Since we cannot rule out that some unobserved variables potentially affect final outcomes, the matching estimates mitigate but might not fully eliminate the selection bias, as explained in the following section.

6.2.1 Omitted variables

To understand the main sources of selection bias, it is helpful to consider how borrower and lender actions affect the choice of mortgage products. Such choice is the result of a two-step selection process—application and approval—that characterizes most credit contracts.

In the first step, households self-select into Cofinavit or traditional mortgages taking into account their financial needs and eligibility conditions. From borrowers' side, two main unobservables from the application stage are the level and composition of savings, capturing borrowing and liquidity constraints, respectively. On the one hand, if co-financed borrowers have less overall (i.e., mandatory plus private) savings, as suggested by the findings in Table 3, they may opt for a less expensive house to reduce their disbursements at origination. Thus, borrowing constraints could bias downwards our estimates for the effects of co-financing on property value and down payment. On the other hand, for a given level of total savings, borrowers with a higher share of illiquid, mandatory savings may resort to Cofinavit to mobilize these funds, as also suggested in Table 3. For instance, conditional on income and socio-demographics, this may occur among borrowers that have been employed in the formal private sector for a longer period. These liquidity constraints could bias the results in the same direction as borrowing constraints.

Regarding the eligibility conditions, those set by banks are the same for traditional and Cofinavit mortgages and, therefore, should not be an important source of self-selection (see Appendix Figure A.5 for an application form model with the eligibility requirements). For a Cofinavit mortgage, Infonavit sets its own eligibility requirements described in Section 2. Some of them are also required by banks—being currently employed and contributing to Infonavit—and others that could affect selection into Cofinavit are unlikely to affect loan outcomes after conditioning on observables—not having a previous Infonavit loan and achieving the minimum Infonavit score.

In the second step, banks and, when applicable, Infonavit screen applications separately. The bank loan officer approves applications that are deemed creditworthy and meet the eligibility conditions for a specific mortgage product, using limited information from the application form and from the credit bureau on borrower's credit history. Conditional on that information, the final approval decision and the conditions of the loan granted are somewhat discretionary and independent of borrowers' actual risk profile and financing needs (i.e., borrowing and liquidity constraints). Thus, matching on such variables would increase the plausibility that our estimates indeed identify the co-financing impact. However, we do not observe some of the factors influencing the bank's approval decision (e.g., the program and collateral value originally chosen, length of employment, or borrower's credit history). In turn, the Infonavit loan officer plays a less crucial role in this approval stage. She generally does not reject Cofinavit applications that meet the eligibility requirements, and there is little room for discretion in determining eligibility.

Summarizing, the main unobservables that could bias downwards the results from the following section—after conditioning and matching on income and demographics—are borrowers' level and composition of savings. A limitation of our matching approach is that it does not account for all variables considered by bank officers to make the loan

approval decision, which could have fully eliminated potential biases. Thus, the following findings cannot be given a causal interpretation but should be interpreted as the expected bounds for the actual effects.

7 Results

7.1 Mortgage characteristics at origination

In this section, we examine how co-financing impacts on credit conditions at origination. We start by looking at loan volume in Table 4. Column 1 shows the OLS estimate of equation (1), controlling only for time and bank fixed effects. Column 2 further includes borrower socio-demographic controls and the full set of fixed effects. For total (i.e., Infonavit plus bank) loan volume as the dependent variable, the coefficient for the *Co-financed* indicator is statistically significant at the 1% level and goes from 0.09 in column 1 to 0.12 in column 2. We then re-estimate the two specifications using the weights generated by the CEM algorithm, which restricts the sample to the region of common support. These specifications render coefficients of 0.14, implying that the total volume of Cofinavit mortgages is on average 15% ($\exp[0.14]-1 = 0.15$) larger than that of traditional loans, which is a sizable effect. This result confirms that Cofinavit, on average, achieves its goal of enhancing borrowers' credit capacity. This also implies that there is not a full substitution between the Infonavit loan and a portion of the bank loan.

In columns 5 to 8 we specifically look at the volume of the bank loan that, for traditional loans, equals total volume. The estimated coefficients are negative and significant and decline only slightly with the addition of controls and fixed effects and with the use of the CEM approach. In particular, the estimates go from -0.20 in the simplest model to -0.15 in the fully saturated. From column 8, co-financed bank loans are on average 14% smaller than traditional loans. This is consistent with a partial substitution of bank for Infonavit lending within co-financed mortgages, which prevents an excessive increase in household leverage.

Table 5 shows the results for down payment and property value, the dimensions that ultimately determine whether a mortgage is attainable and attractive for borrowers. For the down payment, the point estimate of -8.3 pp in column 1 implies that it is substantially smaller for borrowers taking a co-financed loan. The coefficient is significant at the 1% level and remains similar in the remaining specifications, reaching -7.6 pp in the CEM estimates. This represents a large reduction of 32% relative to the average down payment of a traditional mortgage (24%). In columns 5 and 6, the dependent variable is the down payment that borrowers need to pay out of private savings, which represents their actual needs of liquidity to cover the upfront costs. That is, for co-financed mortgages this is the *portion* not covered by mandatory savings, and for the traditional this equals the *total*

down payment. The matching coefficient of -15.9 pp in column 6 represents a substantial decline of 66% relative to the average down payment of traditional mortgages. These results reveal that, to a large extent, borrowers use Cofinavit to reduce the required savings, especially the liquid ones, at origination.

Next, we investigate the impact of co-financing on property value. The OLS estimates provide mixed results (columns 7 and 8). The coefficient becomes positive and significant in the matching estimates (columns 9 and 10), suggesting that properties purchased with co-financed mortgages are only 2% more valuable.[13] Such increase is smaller than the 15% increase in total loan volume, enabling a reduction in the average down payment. This response reflects a low elasticity of the purchased property value to loan volume, which increases by 15%. Thus, the trade-off posed by the Cofinavit goals is resolved in favor of reducing down payment, at least on average.

In Table 6, we compare mortgages in terms of pricing at origination. From the estimates in columns 1 to 3, we observe that for Cofinavit bundles the volume-weighted average of the Infonavit and bank interest rates is between 34 and 36 bp higher than the bank rate of traditional mortgages. The benchmark specification points to a 3% increase relative to the sample mean of the dependent variable (10.5%). This premium results from the substantially higher Infonavit rate (see Panel D in Appendix Figure A.3). Looking at the bank rate alone in columns 4 to 6, the estimates become negative and significant. The differential, however, is economically modest (according to the matching result, only 21 bp or a 2% decline relative to the average rate of traditional mortgages). The lower bank rate of co-financed mortgages is consistent with their lower *bank* LTV ratio that, in turn, may result in lower loan loss provisions and capital requirements linked to these exposures. We conjecture that this finding is less likely to arise from borrower selection since there is no evidence that safer borrowers sort into Cofinavit (see Table 3) and remains robust to controlling for ex ante risk, as we show below.

Generally, across all models estimated in Tables 4 to 6, the inclusion of additional controls does not affect the OLS coefficients in a meaningful way. In turn, the more refined CEM approach does not substantially alter the results relative to the OLS ones either. The only exception are the results for property value that switch from negative to positive. The stability of the estimated coefficients in general gives us confidence that omitted variables are not playing an important role.

One crucial omitted factor is borrowers' ex ante risk. To address this concern, we re-estimate the previous models by controlling for the probability of default at origination computed under the internal ratings-based approach. Thus, the results in Appendix Table A.2 are obtained for the subsample of mortgages originated under that approach. Reassuringly, the coefficients on the probability of default are significant and have the

[13]Because excluding controls virtually does not alter the CEM estimates, in the remainder of the paper we report CEM results with the full set of controls only.

expected signs in the models for down payment and bank interest rate. We also find that the results for co-financing are not substantially altered when controlling for this risk measure, which suggests that it is not an important source of omitted variable bias. Moreover, the estimates are qualitatively similar to those from the main sample, except for the coefficient of co-financing on property value that is negative and insignificant.

Summing up, we confirm that Cofinavit leads to an increase in total loan volume. However, we also find a shrinkage in the size of the bank loan within Cofinavit bundles, which hints at some substitution between Infonavit and private lending. The higher funding is used to lower the upfront payment required to buy a house rather than to purchase a more expensive property. The slightly higher average interest rate reflects the differential in the rate charged by Infonavit, which varies only with income. The risk-sensitive bank rate is actually lower for a co-financed than for a traditional mortgage, in line with the lower bank LTV ratio.

7.2 Mortgage performance

We then examine differences in ex post performance across the two mortgage products. To this end, in Table 7 we estimate equation (1) for an indicator of whether a mortgage becomes non-performing in the first two years (columns 1 to 3), three years (columns 4 to 6), and four years (columns 7 to 9) after origination as the dependent variable (in percentage). Generally, the results show no significant differences between co-financed and traditional mortgages. Only for the three-year horizon we find a negative effect of co-financed loans, but small and only marginally significant (column 6). In the estimates for the four-year window, all coefficients become positive and insignificant. These findings indicate that the conflicting forces affecting the probability of default of co-financed mortgages tend to even out in equilibrium. Adding control variables to the OLS estimates generally leaves the coefficients of interest qualitatively unchanged. In addition, the benchmark CEM estimates are similar to the OLS ones, implying that the results are stable.

Next, we re-estimate the previous models controlling for the probability of default at origination computed under the internal model, for the same single-bank sample as in Appendix Table A.2. Because this should capture differences in loan and borrower risk at origination, any estimated differential in ex post risk is likely to reflect the impact of Cofinavit contractual features on borrowers' liquidity (assuming banks' monitoring is the same across products). In Appendix Table A.3, column 1 shows that, in this sample, co-financed mortgages are 0.26 pp more likely to default than the traditional ones over the first two years (longer horizons are not observed) when not controlling for ex ante risk. Interestingly, after accounting for the probability of default in column 2, they become less likely to default by 0.8 pp; this is a 10% change relative to the mean of the dependent

variable. In that specification, the estimated coefficient for the ex ante probability of default confirms its positive correlation with ex post default.

To provide further evidence on the effect of co-financing in reducing liquidity-driven defaults, we estimate the benchmark specifications adding fixed effects for the combined LTV ratio at origination, defined over 5% bins. We expect that, conditional on overall mortgage leverage, the co-financed ones are less likely to default. Columns 3 to 5 of Table A.3 confirm that, indeed, the coefficients on the co-financing indicator are negative and significant at the 1% level in the first two and three years and at the 10% level in the first four years.

All in all, we find no substantial differences in terms of default rates between co-financed and traditional mortgages in the main sample. We also find that, when conditioning on ex ante risk and on LTV at origination, co-financed mortgages perform better ex post. We interpret this as reflecting the impact of the lower liquidity requirements during the mortgage's life, which curbs the incentives to default arising from the riskier origination conditions of co-financed mortgages.

7.3 Heterogeneity by income

This section examines whether the baseline results vary with borrowers' income, considering that mortgage demand and supply differ along the income distribution. On the one hand, borrowers at the top of the distribution have more space to benefit from an increase in loan volume before the PTI ratio starts to bind. In addition, they have potentially more buffers to cover the down payment and other upfront costs, without fully depleting their liquid assets. On the other hand, some conditions of the Infonavit loan in a Cofinavit bundle, such as the credit limit and interest rate, also vary by income but not necessarily in the same magnitude or direction as in a traditional bank mortgage (see Section 2.2).

We start with a graphical representation of the distribution of mortgage characteristics by income in Figure 3. The left axes of all panels correspond to histograms for the density of new mortgages, where it becomes apparent that co-financing shifts originations towards lower income segments relative to traditional mortgages. The right axes correspond to scatterplots for the average mortgage conditions at origination. Panel A shows that total loan volume increases slightly more with income for a co-financed (red triangles) than for a traditional bank mortgage (black dots). This is consistent with the greater credit capacity of high-income borrowers. In turn, the bank volume (green crosses) exhibits a steeper increase than the total co-financed volume. This reflects a greater substitution within Cofinavit at lower incomes, where Infonavit has a comparatively larger share than the bank.

Table 8 provides regression-based estimates of these heterogeneous effects. Specifi-

cally, we estimate the benchmark specification of equation (1) interacting the *Co-financed* indicator with the logarithm of income. For total loan volume, column 1 shows that the interaction coefficient is positive and significant at the 1% level. It implies that for a 10% increase in income, total volume increases by 0.3% ($1.1^{.034} - 1 = 0.003$) more for a co-financed than for a traditional mortgage. For the bank loan volume, column 2 shows that it increases by 1.3% for the same increase in income. This confirms its larger downsize at the bottom of the income distribution than that of the total loan volume.

Next, we focus on down payment, which hardly varies with income for traditional mortgages (black dots in Panel B of Figure 3). By contrast, for co-financed mortgages (red triangles), it is increasing in borrowers' income. This is consistent with low-income borrowers having lower savings and, hence, using the larger loan from Cofinavit to reduce their liquidity needs more than high-income borrowers. In the regression estimates, column 3 of Table 8 shows that the interaction coefficient is positive and significant. Following a 10% increase in income, the down payment increases by .24 pp ($2.552 \times \log[1.1] = .243$) more for co-financed relative to traditional bank mortgages. By contrast, for the portion of down payment that is paid out of private savings alone, the interaction term in column 4 reveals no significant differences. This implies that the mandatory savings are larger for higher- than for lower-income borrowers and, therefore, finance their larger Cofinavit down payment. It also implies that, at origination, Cofinavit does not reduce the usage of liquid private savings more at lower incomes, only reduces that of total savings more.

In Panel C of the same figure, we look at the distribution of property values. For co-financed mortgages, they exhibit a steeper increase with income than for traditional ones. This confirms that higher-income segments, to a larger extent, use the co-financing scheme to buy a more expensive property. Column 5 in the table shows that, for a 10% increase in income, the property value increases by 0.7% more for a co-financed mortgage. Since this effect is larger than the 0.3% estimated for total loan volume, we can infer that the elasticity of property value to loan volume is also increasing in income. This explains why the down payment of co-financed mortgages increases more with income than that of traditional ones.

Finally, we look at interest rates in Panel D of Figure 3. The plot shows that the differential between the combined co-financed rate (red triangles) and the smaller traditional rate (black dots) seems to narrow down at higher incomes. In line with this, column 6 of Table 8 displays a negative but small (only -.4 bp) interaction coefficient for the volume-weighted average rate. Thus, co-financed mortgages turn out to be slightly more regressive in terms of pricing relative to traditional ones. Since the coefficient on the bank rate in column 7 is positive (but insignificant), one can infer that the regressive rate is a consequence of the Infonavit loan, which has a higher share at lower incomes and is more expensive than the bank loan.

After uncovering heterogeneous effects on origination conditions, leverage in particular, we also investigate if co-financing also has a differential impact on loan performance by income. In Table 9, the interaction coefficients show a decline in the probability of defaulting on co-financed relative to traditional mortgages at higher incomes. For a 10% increase in income, such probability declines by .03, .04, and .07 pp over the first 2, 3, and 4 years after origination, respectively. This result is consistent with the greater increase in the combined LTV ratio (equivalent to a greater decline in down payment) as income declines. Moreover, the previous findings for down payment paid out of private savings, indicate that lower income borrowers do not experience a greater decline in liquidity requirements at origination to offset their higher leverage.

The results presented so far may be sensitive to the introduction of a new Infonavit plan in April 2017. This credit plan altered some conditions of the Infonavit loan, with different implications across income groups. As explained in Section 2.2, Infonavit has changed its interest rates and credit limits with the goal of expanding its credit supply towards more profitable, higher-income segments. From the perspective of higher-income borrowers, however, only the interest rate changes have been relatively more beneficial, whereas those in credit limits have made their overall Cofinavit loan more expensive.

To examine the impact of these changes, in Appendix Tables A.4 and A.5 we re-estimate the benchmark models interacting all regressors and fixed effects with a dummy taking the value of 1 for mortgages originated under the new plan and of 0 otherwise. The results confirm that our main findings generally do not change significantly under the new plan. Differences are found on the portion of down payment paid out of private savings, which declines slightly more for co-financed mortgages under the new plan, and on the combined bank rate that became slightly smaller at the mean. The later effect is expected since the Infonavit rate has on average declined under the new plan. Importantly, no significant differences by income are estimated between the two credit plans. Thus, the main findings are robust to changes in the Infonavit conditions within a Cofinavit scheme, which is expected given the small share of Infonavit in total loan volume on average.

This section reveals that our results at the mean mask a series of distributional effects. First, low-income borrowers receive a relatively smaller loan volume through co-financed mortgages, with a higher share lent by Infonavit. Second, low-income households use co-financing to reduce the down payment more than high-income ones. In turn, high-income households use it more to increase the value of the purchased property but, thanks to their larger mandatory savings, they can avoid tapping into their private savings to cover the larger down payment. Third, co-financed mortgages turn out to be slightly more expensive for lower-income borrowers, given the higher share of the Infonavit loan. Finally, low-income borrowers are more likely to default than the high-income ones when taking a co-financed rather than a traditional loan. This is in line with their higher combined LTV ratio under Cofinavit, which is not counteracted by a relatively lower

requirement of liquid funds.

7.4 The role of banks

After documenting differences in borrowing conditions, on average and by income levels, we examine the role of private lenders. If the estimated responses are only shaped by Cofinavit's design, prudential lending standards set at the market level (LTV, PTI limits), and borrowers' demand, the results are expected to remain similar across different types of banks. Alternatively, the results could be dependent on banks' lending strategies. In particular, institutions with different business models could adjust their Cofinavit supply differently with respect to the benchmark of traditional mortgages.

To consider this possibility, in this section we examine whether the main findings vary by bank size. Some distinctive features of the business models of larger banks are relevant for this analysis. First, larger banks tend to have lower collateral requirements than smaller banks. Banco de México (2015) point this out for credit to small and medium enterprises, and we also observe it for mortgage products—for traditional mortgages, LTV ratios are 7 pp higher on average for larger than for smaller banks conditioning on income. Second, larger banks are in a better position to reach low-income borrowers and extend smaller loan volumes. Indeed, they have a wider brick-and-mortar branch network, which leads to economies of scale and scope, and also have a better screening technology (Banco de México, 2015, 2020).

To re-estimate equation (1) by bank size, we create an indicator that takes the value of 0 for the three largest banks in the sample—in terms of total assets as of June 2016—and of 1 for the rest. All regressors and fixed effects are interacted with this indicator for smaller banks. Table 10 reports the results, where some differences emerge at the mean (odd columns). In particular, for smaller relative to larger banks, bank loans decline by 7% less (column 3) and the down payments decline by almost 1 pp less (column 5) in a co-financed than in a traditional mortgage. These differentials, however, are moderate and the main findings still hold across both groups of banks.

We then look at the interplay between bank size and borrower income. Figure 4 shows the distribution of new mortgages and their characteristics by income, for larger and smaller banks (left and right graph, respectively). The histograms show that larger banks' portfolios have a greater share of low-income borrowers and, in those segments, they have a greater share of co-financed mortgages.

Moving to origination conditions, Panel A shows, for larger banks, that the co-financed total volume is larger than the traditional (red and black markers) at higher incomes. However, the differential disappears at lower incomes, where co-financed bank credit (green markers) experience a downsize, compensated by a greater Infonavit share, and traditional loans are enlarged. In turn, smaller banks exhibit a more constant differential

by income in total and bank volume across products. To formally assess these differentials, we estimate the baseline model adding the triple interaction between the smaller-bank indicator, the co-financing indicator, and borrower income. Consistent with the graphs, the coefficients in columns 2 and 4 of Table 10 are negative in the models for total and bank volume. They imply that, for a 10% increase in income, co-financed bank loans increase by 0.6% less and total loans by 1% less than the traditional when granted by smaller relative to larger banks.

As a result of the pattern for total loan volume, we find that low-incomes borrowers use co-financing to reduce down payment comparatively more when banks are smaller (column 6). For a 10% increase in income, down payment increases by .29 pp more for smaller versus larger banks when the mortgage is co-financed rather than traditional. Relative to the coefficients on the double interaction between the co-financed indicator and income, the triple interaction terms in columns 2, 4, and 6 are large. Finally, for the property value we find no differences by bank size and income (column 8 and Panel C). This confirms that the results for down payment are driven by differences in loan volume across bank types.

The previous findings suggest that banks' business models do not impact greatly on the average co-financing effects but do matter for the effects by income, especially those on loan volume and down payment. In addition, they shed light on banks' lending strategies when co-financing with a HPF. Larger banks, with an edge in lending to lower-income segments, extend more co-financed mortgages with a higher share of Infonavit financing to those segments. Hence, from their perspective, a co-financing scheme that is more generous with lower income borrowers is desirable because they can downsize their loans comparatively more. This allows serving riskier segments without increasing exposure excessively—that is, larger banks may trade-off a higher probability of default for a lower exposure at default. In turn, smaller banks' portfolios have a smaller share of co-financed mortgages at lower income segments. Conditional on co-financing, their share in total loan volume does not vary much along the income distribution. Given their lower exposure to low-income borrowers, risk-sharing strategies are less needed for smaller banks. Thus, our finding that Infonavit's share is larger at lower incomes is not a mere feature of Cofinavit's design, in particular, of the Infonavit credit limits. Partly, it seems to be also explained by larger banks' strategy to reduce more their exposure to lower-income segments. This is important to the extent that this strategy directly affects the overall cost of co-financed mortgages, by making the program less progressive.

8 Covinavit versus piggyback loan structures

Mortgage products can be positioned within a space that trades off access to housing (or, conditional on ownership, the quality of housing) and credit risk. Optimally designed

products are located on the "efficient" frontier, meaning that they offer the highest possible level of home access for a given level of risk. Our findings imply that co-financed mortgages increase access to home financing relative to traditional mortgages for the same level of risk and, therefore, are closer to the efficient frontier. In this section we revise the existing evidence for a similar product from the US, the so-called piggyback mortgages, to assess how it balances access versus risk. As other second mortgages, they have been suspected of contributing to the housing bubble that preceded the market collapse in 2008.

Piggyback mortgages proliferated in the US between 2004 and 2006. They are second-lien mortgages originated at the same time as the primary mortgage that enable households to reduce the down payment without having to take an insurance.[14,15] The first mortgage is 80% of the house price and the piggyback varies between 5% to 20%, so that the down payment can even be fully eliminated. Similar to the co-financed Infonavit loan, the piggyback loan is of smaller size and has higher interest rate than the primary bank loan. Thus, instead of an insurance premium, borrowers pay a higher rate on the mortgage with lower priority.[16]

It is apparent the potential of this product to expand access to home financing and home ownership. Lee et al. (2013) provide descriptive evidence that the combined LTV of piggyback mortgage structures is 95% or more for two thirds of the borrowers, much higher than for single-loan mortgages. In their model, Chambers et al. (2009) find that piggyback loans account for up to 70% of the increase in home ownership rates between 1994 and 2005. On the other hand, Lee et al. (2013) also argue that piggyback second liens potentially helped to fuel the housing bubble since they lead to more purchases of homes with prices exceeding their fundamental values. They interpret this as a consequence of subprime piggyback loans allowing prime borrowers to over leverage. However, Bhutta and Keys (2022) show that piggyback lending started to retrench in late 2006 since lenders and investors were not willing to bear the risk of high-LTV contracts, and they were replaced by private insured mortgages. Thus, they conclude that piggyback structures were not responsible for the subprime lending boom.

In terms of performance, the early evidence suggested that piggyback loans were riskier than other mortgages (Sherlund, 2008; Mayer et al., 2009; LaCour-Little et al., 2011). Using state-level data, LaCour-Little et al. (2011) find that the subprime, but not prime, second-lien piggyback mortgages are associated with higher default and foreclosure rates. However, their comparison group includes not only single-loan products but all first-lien

[14]Households can also use "home equity loans" to extract home equity after origination of the primary mortgage, but they are less comparable to Cofinavit.

[15]Such insurance contracts protect the lender from default risk when the LTV is above 80% and are needed for the mortgage to qualify for purchase by, for instance, GSEs.

[16]A reason why the same lender may issue two loans with different priority and pricing, rather than a larger single one, is the greater ease at which loans with LTVs below 80% can be securitized. In this way, the lender can obtain better terms thanks to the greater market liquidity (Kau et al., 2014).

loan originations. On the other hand, Eriksen et al. (2013) find that, when controlling for the current combined attributes of both loans, piggyback borrowers become less likely to default on their primary loan than single-loan borrowers. This reflects borrowers' decision to default on the second but not on the first loan, given that the junior lender does not have incentives to start a foreclosure. Similarly, matching on the combined LTV, Agarwal et al. (2020) find lower ex post default of piggyback loans than of single-lien insured mortgages. This results from bank' incentives to steer low-risk borrowers into piggyback mortgages to circumvent the role of mortgage insurance and make higher profits. While we also find a better performance of co-financed bank loans conditioning on the combined LTV, our evidence points to specific contractual features to curb borrowers' incentives to default. Unlike Eriksen et al. (2013), we cannot attribute such outcome to mortgage "performance mismatch" (Calem and Sarama Jr., 2017), given that Infonavit's loan and payments are secured. In addition, we do not find conditional differences in ex ante risk that could be driven by borrower selection, as found by Agarwal et al. (2020). In fact, larger banks exhibit a higher Cofinavit share at low-income, riskier segments, which could worsen its ex post performance (at least unconditionally).

Beyond the individual risk of high-LTV second-lien loans, intermediaries' misaligned incentives in their utilization also can have implications for the risk exposure of the system. Griffin and Maturana (2016) find that both originators and securities underwriters misreported second liens with the intention of securitizing the first loan. Thus, the actual combined LTV ratio was higher than the one reported, and misrepresentation was correlated with a worse loan performance. As a result, Piskorski et al. (2015) show that investors on mortgage-backed securities were taking more risk than that contractually agreed and suffered higher losses. In our setting, where securitization is virtually non-existent, banks' incentives to misreport the Infonavit loan with that purpose are absent.

The previous evidence suggests that the main risks arising from piggyback loan structures come from misaligned incentives on the supply-side in the presence of risk-shifting tools such as securitization. Issuing two loans with different priority also gives rise to holdup problems that prevent loan modification (Agarwal et al., 2019, 2020). However, beyond the possibility of performance mismatch, we do not detect any intrinsic feature of these products that increases borrower credit risk, conditional on combined leverage at origination. This implies that adding risk-reducing features, as in Cofinavit, should increase their efficiency relative to standard mortgages.

Admittedly, the costs, as well as the feasibility, of implementing the Cofinavit features deserve a separate analysis. The costs, difficult to quantify, are not born by taxpayers but by workers affiliated to the Institute. By handing the custody of a portion of their savings to Infonavit, eligible workers that have not borrowed from Infonavit yet lose the capacity to manage those assets and, hence, their returns. Once workers opt for taking a co-financed mortgage, such cost is reduced. However, the conditions of the Infonavit loan

may be worse than those offered by private lenders for some borrowers, and they lose the capacity to manage its payments. It is beyond the scope of this paper analysing the welfare implications of such mandatory saving scheme with a home financing option, in a setting where voluntary households' savings in the financial system are low. On the other hand, in the absence of an institution with special mandates, the features that seem more difficult to replicate are the collection of mandatory savings and the secure repayment system. Instead, generating the right incentives for lenders to issue two simultaneous first-lien loans is likely more feasible.

9 Conclusion

To provide evidence on the demand frictions prevailing in less developed mortgage markets, this paper studies bank mortgages co-financed with HPFs. Drawing on the experience of the main co-financing scheme in Mexico, we examine how such a program affects mortgage conditions and performance by enhancing borrowers' credit capacity.

Our estimates show an increase in the total volume of mortgages granted under the program relative to traditional ones. In addition, we find that borrowers use these additional funds to reduce down payment substantially. The usage of private savings required for down payment and other upfront costs declines even more—borrowers can at least partially cover them with their mandatory savings at the HPF. We do not find that co-financed borrowers buy a more expensive home on average, as many households may not be able to afford higher payments. Despite the higher combined LTV ratio of co-financed mortgages, our estimates do not reveal a larger probability of default. This is consistent with the fact that several program features mitigate credit risk.

Both demand and supply forces lead to heterogeneous results along the income distribution. At the bottom, where borrowing constraints are more prevalent, down payment declines more and, since the affordability constraint is more tight, the property value increases less. Higher income households, however, cover their larger down payments with their greater buffer of mandatory savings, implying no differences in the usage of liquid, private savings at origination. Consistent with their higher leverage, we also find a relatively higher default rate on co-financed mortgages at lower incomes. A somewhat regressive feature of Cofinavit's design is the higher combined interest rate at lower incomes, where the more expensive HPF loan takes a higher stake. This is a consequence of higher Infonavit credit limits as well as banks' lending strategies in those segments. In particular, we document a smaller decline in down payment at lower incomes among larger banks, where they downsize their loans comparatively more. Larger banks serve relatively more low-income borrowers through their extensive network of branches. Thus, to offset the exposure to such riskier groups, they arguably grant them more co-financed (and, hence, smaller) loans and reduce their volume even further than at higher incomes.

These findings imply that providing additional financing is an effective tool to expand households' access to bank mortgages by relaxing down payment constraints, especially among poorer borrowers. From the perspective of increasing access to better homes and, hence, contributing to wealth accumulation, its impact is more limited. One caveat is that an expansion in mortgage leverage may have more negative implications for credit risk in the absence of an institution with similar mandates as HPFs, which set constraints on how households' manage their savings and on the repayment mechanisms. By contrast, cross-collateralization of two senior loans is another feature of the program that curbs default and can be more easily extended to other settings. An interesting avenue for future research is to investigate the impact of co-financed mortgages on home ownership, which will depend on their degree of substitution with other home financing products in the market. Another open question is how the liquid funds released when taking a co-financed rather than a traditional mortgage affect consumption and investment decisions and, ultimately, retirement savings. For formal sector workers that take a traditional bank mortgage, the HPF continues managing their mandatory savings, present and future, until retirement.

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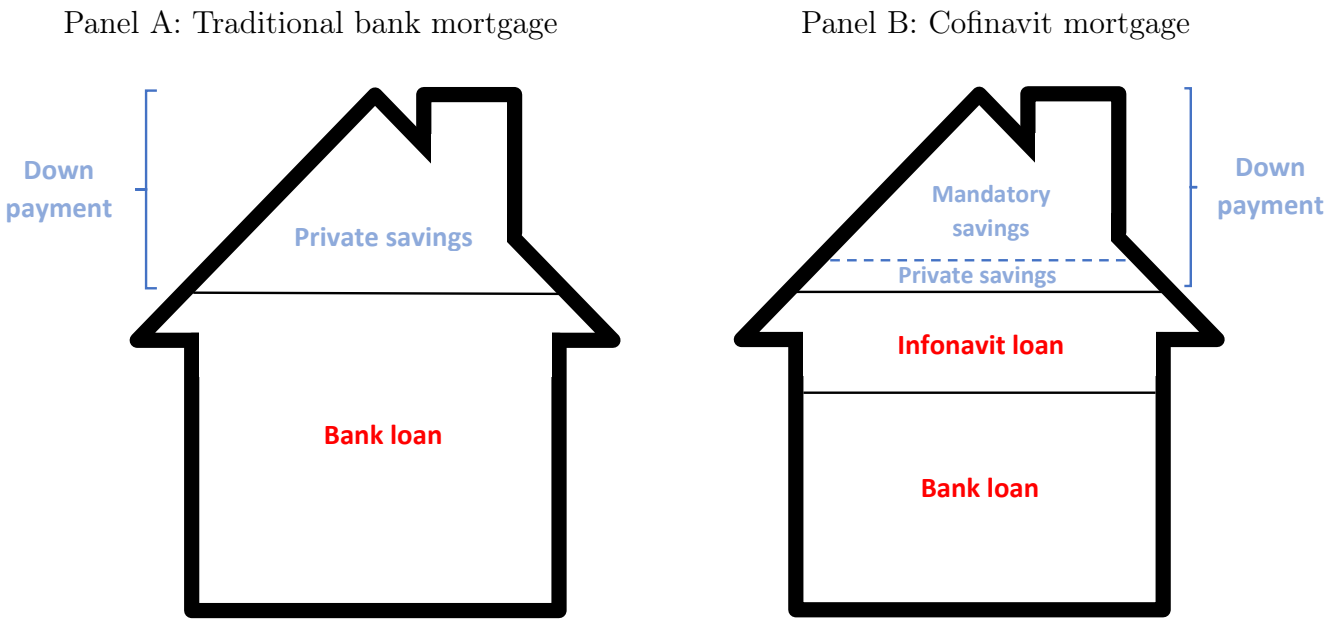
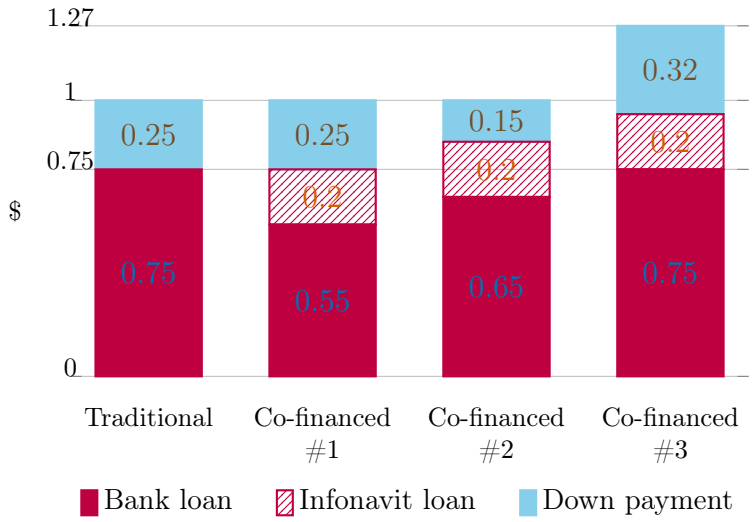
Figure 1: Funding structure in traditional and co-financed mortgages



NOTE. This figure shows how a borrower can buy a house using two different products. Under a traditional mortgage (Panel A), the borrower takes a bank loan and pays the entire down payment out of private savings. Under a co-financed mortgage (Panel B), the borrower takes a bank and an Infonavit loan, both collateralized with the property, and covers the down payment with her mandatory savings in the home account and, if insufficient, some private savings for the remaining portion.

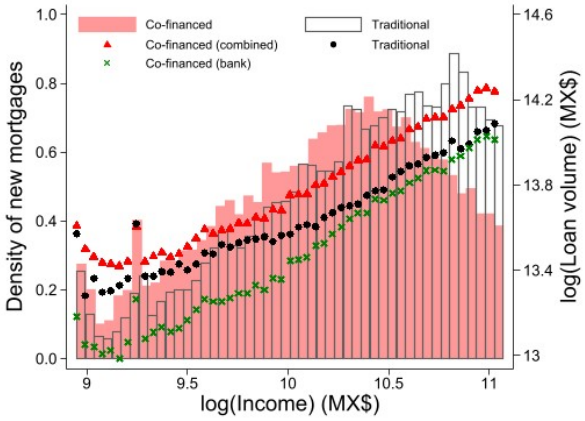
Figure 2: Theoretical effects on characteristics at origination



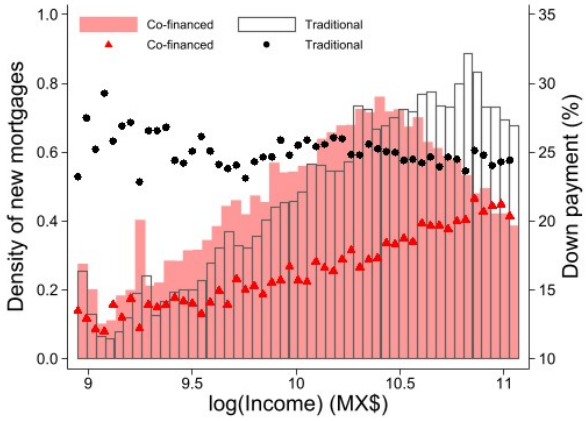
NOTE. This figure compares the funding structure of a traditional bank mortgage against three hypothetical examples of co-financed ones discussed in Section 3.1. In the first case, the co-financed mortgage exhibits no change in down payment or property value relative to the traditional one, in the second case it exhibits a pure down payment reduction, and in the third a pure increase in property value.

Figure 3: Origination conditions of mortgages by income

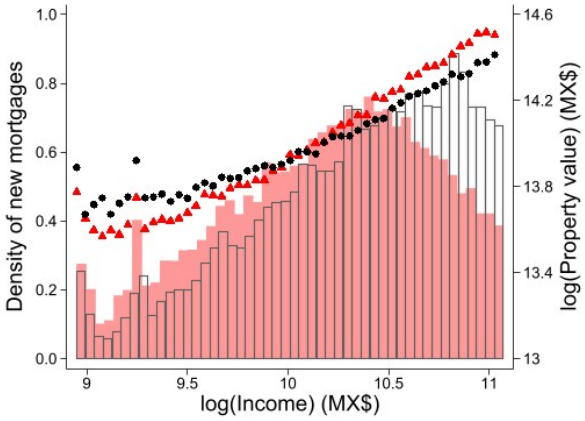
Panel A: Loan volume



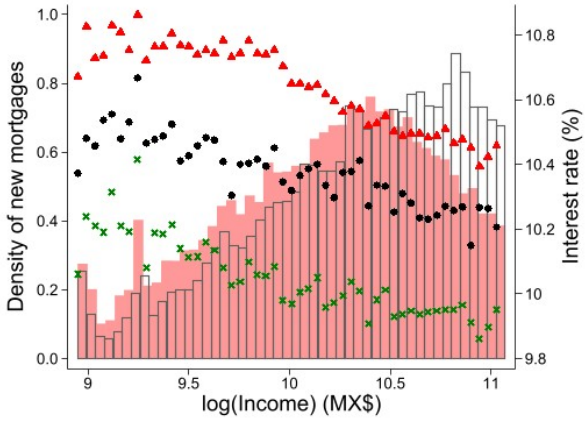
Panel B: Down payment



Panel C: Property value



Panel D: Interest rate

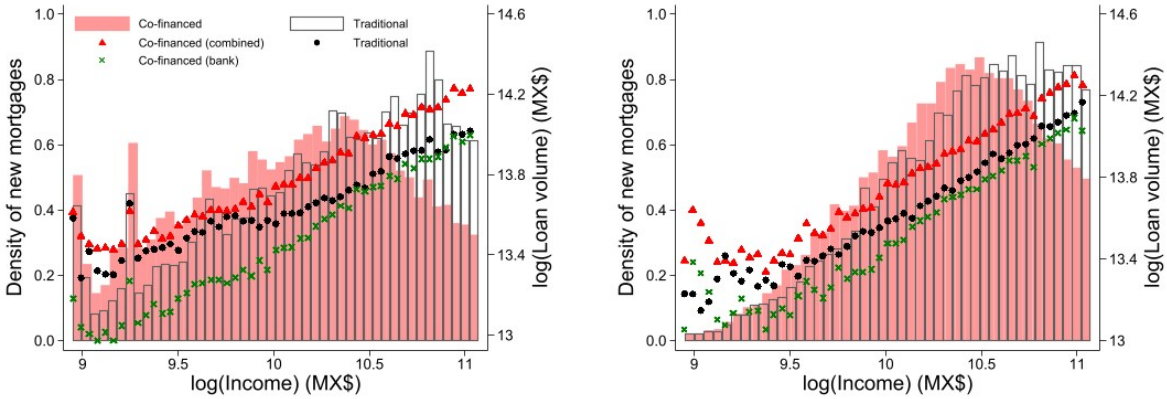


NOTE. This figure shows the density and characteristics of new mortgages by income. All the left-hand axes correspond to histograms for new co-financed and traditional bank mortgages (in red and transparent bars, respectively). For each mortgage product, the sum of the areas of the bars equals 1. In the right-hand axes, the figure shows scatterplots for the logarithm of loan volume (Panel A), down payment (Panel B), the logarithm of property value (Panel C), and interest rate (Panel D) whose averages are computed for logarithmic income bins of MX$0.04. For co-financed mortgages, the red triangles correspond to the total or average characteristic of the Infonavit and bank loans and the green crosses in Panels A and D to the loan granted by the bank only. The black dots correspond to characteristics of traditional mortgages. The horizontal axes represent the logarithm of income in Mexican pesos deflated by the CPI (July 2018 = 100). The sample includes all traditional and Cofinavit mortgages to private sector workers originated by all commercial banks between June 2016 and June 2019.

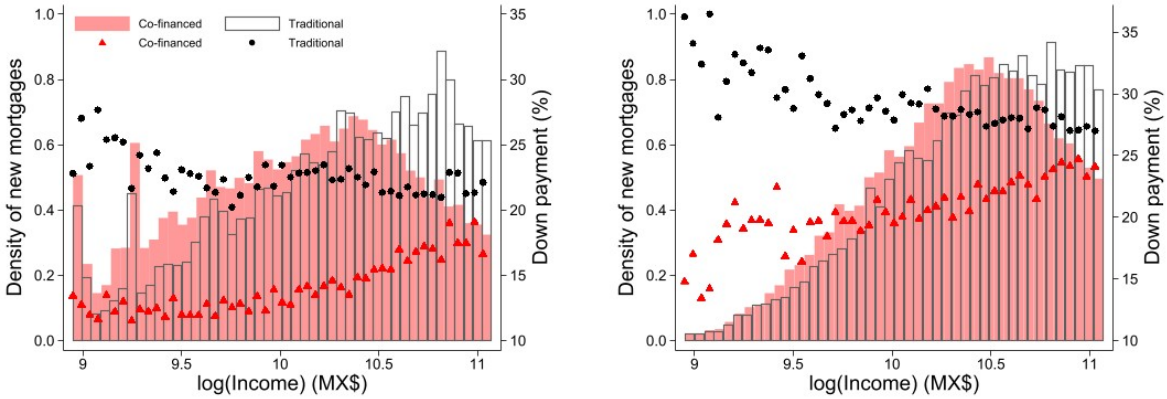
Figure 4: Origination conditions of mortgages by income: larger versus smaller banks

Larger banks Smaller banks

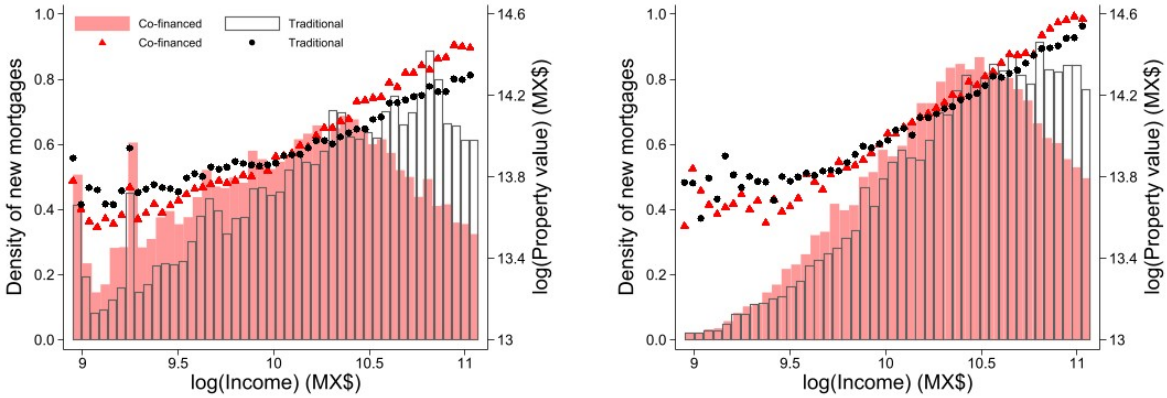
Panel A: Loan volume



Panel B: Down payment



Panel C: Property value



NOTE. This figure shows the same graphs as in Panels A, B, and C of Figure 3, computed separately for the top three banks (lefts Panels) and the remaining banks (right Panels), where bank size is determined by total assets as of June 2016. The sample includes all traditional and Cofinavit mortgages to private sector workers originated by all commercial banks between June 2016 and June 2019.

Table 1: Main features of traditional versus Cofinavit mortgages

	Traditional bank mortgage	Cofinavit mortgage	
		Bank	**Infonavit**
Screening	Risk-based standards for approval and to determine credit amount	As in a traditional mortgage	Eligibility criteria for loan approval (non risk-based minimum score). Simple assessment and credit limits to determine credit amount
Repayment	From cash on hand or private savings	As in a traditional mortgage. Once the Infonavit loan is repaid (around 5 to 8 years), partly repaid from employer contributions	From employer contributions and salary discounts
Default	No willingness or ability to pay	As in a traditional mortgage; usually earlier than on Infonavit loan	Option to default only if borrower loses formal job
Non-performing status	After three months delinquent	As in a traditional mortgage	After up to 15 months delinquent
Post-default actions	The bank can start legal actions	As in a traditional mortgage (first lien on the property)	Infonavit can start legal actions (first lien on the property), but usually the bank starts them first

NOTE. This table summarizes the key differences between traditional bank mortgages and Cofinavit mortgages in terms of origination, servicing, and (post-)default practices as well as contractual features. For Cofinavit mortgages, characteristics of the bank and Infonavit loans are presented separately.

Table 2: Summary statistics

	Full sample		Common support	
	Traditional	**Cofinanced**	**Traditional**	**Cofinanced**
Panel A: New mortgages (mortgage level)				
Mortgage and property characteristics				
log(Total loan volume) (MX$)	13.75	13.84	13.71	13.86
log(Bank loan volume) (MX$)	13.75	13.55	13.71	13.57
Down payment (% of collateral value)	24.82	17.01	24.02	16.37
Down payment minus home acc. (% of collateral value)	24.79	8.24	23.99	7.90
log(Property value) (MX$)	14.08	14.05	14.03	14.06
Average interest rate (%)	10.33	10.61	10.31	10.61
Bank interest rate (%)	10.33	10.01	10.31	10.03
Bank LTV ratio (%)	75.02	63.22	75.84	63.92
Borrower characteristics				
log(Income) (MX$)	10.32	10.18	10.20	10.20
Male (%)	52.45	56.35	56.47	56.47
Age (years)	41.12	34.97	34.81	34.74
Married (%)	44.75	44.28	43.37	43.37
N	***69,012***	***47,833***	***50,865***	***41,429***

Table 2: – *Continued*

	Full sample		Common support	
	Traditional	**Cofinanced**	**Traditional**	**Cofinanced**
Panel B: Mortgages followed after origination (mortgage-month level)				
Non-performing in the first two years (%)	0.76	0.59	0.70	0.56
N	***1,685,128***	***1,292,619***	***1,224,334***	***1,019,137***
Non-performing in the first three years (%)	1.09	0.91	1.03	0.83
N	***1,496,481***	***1,420,191***	***1,028,220***	***1,055,095***
Non-performing in the first four years (%)	1.28	1.22	1.22	1.05
N	***1,019,540***	***1,023,621***	***617,506***	***614,832***

NOTE. This table shows summary statistics (mean) for the final sample, where the unit of analysis is the mortgage. Statistics are presented separately for traditional and co-financed bank mortgages, both before (columns 1 and 2) and after (columns 3 and 4) the sample is restricted to the common support region. The sample includes traditional and Cofinavit mortgages for private sector workers originated by commercial banks between June 2016 and June 2019. In Panel A, characteristics are measured at origination. In Panel B, mortgages are followed monthly for two, three, and four years after origination, with the samples covering originations between June 2016 and June 2019, June 2018, and June 2017, respectively. Refer to Section 4.1 for data sources and sample selection and to Appendix Table A.1 for variable definitions.

Table 3: Determinants of mortgage choice

	Probit			Linear probab. model	
	(1)	(2)	(3)	(4)	(5)
New property	.024***	.024***	-.106***	-.001	-.002
	(.007)	(.007)	(.014)	(.006)	(.006)
Co-borrower	.168***	.173***		.149***	.137***
	(.007)	(.007)		(.007)	(.007)
log(Income)	-.086***	-.103***	-.087***	-.101***	-.108***
	(.007)	(.008)	(.012)	(.007)	(.007)
Male	.026***	.026***	.030***	.024***	.023***
	(.003)	(.003)	(.011)	(.003)	(.003)
Age	-.013***	-.013***	-.013***	-.013***	-.012***
	(.000)	(.000)	(.000)	(.000)	(.000)
Married	.018***	.018***	.020**	.022***	.022***
	(.003)	(.003)	(.009)	(.003)	(.003)
North	-.041***	-.041***	-.020*	-.032***	
	(.004)	(.004)	(.012)	(.005)	
South	-.083***	-.082***	-.005	-.070***	
	(.011)	(.011)	(.018)	(.009)	
East	-.104***	-.103***	-.139***	-.104***	
	(.007)	(.007)	(.022)	(.006)	
West	-.026***	-.026***	-.017	-.023***	
	(.007)	(.007)	(.021)	(.006)	
Smaller bank	-.035***	-.602***			
	(.005)	(.089)			
Smaller bank × log(Income)		.055***			
		(.009)			
Probability of default			.173		
			(.343)		
Time FE	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes
Workplace munic. FE	No	No	No	No	Yes
Mean dependent variable	.4	.4	.3	.4	.4
Observations	116,845	116,845	11,268	116,845	116,531

NOTE. This table reports estimates from probit (columns 1 to 3) and linear probability models (column 4 and 5), where the dependent variable is an indicator taking the value of 1 if the mortgage is co-financed and 0 if it is traditional. As indicated, specifications control for loan and borrower characteristics, a smaller bank indicator and fixed effects for time, bank and municipality where the borrower works. The coefficient for having a co-borrower is dropped from the specification in column 3, given that it shows almost no variation in the corresponding subsample. The sample includes traditional and Cofinavit mortgages to private sector workers originated by commercial banks between June 2016 and June 2019. Refer to Section 4.1 for data sources and sample selection and to Appendix Table A.1 for variable definitions. Standard errors clustered by income group are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table 4: Loan volume: co-financed versus traditional mortgages

Dependent variable:	log(Total volume)				log(Bank volume)			
	OLS		CEM		OLS		CEM	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Co-financed	.086***	.122***	.136***	.137***	-.202***	-.159***	-.150***	-.149***
	(.013)	(.005)	(.006)	(.006)	(.017)	(.009)	(.010)	(.010)
Borrower controls	No	Yes	No	Yes	No	Yes	No	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Workplace munic. FE	No	Yes	No	Yes	No	Yes	No	Yes
Property munic. FE	No	Yes	No	Yes	No	Yes	No	Yes
Income group FE	No	Yes	No	Yes	No	Yes	No	Yes
Bank time trends	No	Yes	No	Yes	No	Yes	No	Yes
Mean dep. var.	13.8	13.8	13.8	13.8	13.7	13.7	13.6	13.6
Observations	116,327	116,327	91,764	91,764	116,327	116,327	91,764	91,764

NOTE. This table reports OLS and CEM estimates from regressions of the log of total (columns 1 to 4) and bank (columns 5 to 6) mortgage volume on *Co-financed*, an indicator taking the value of 1 if the mortgage is co-financed and 0 if it is traditional. As indicated, specifications control for borrower characteristics at mortgage origination (a restricted cubic spline of the logarithm of income, age, and indicators for gender and marital status) and add fixed effects for time, borrower's income group (50 bins of MX$0.04 logarithmic length), municipalities where the borrower works and where the property is located, and lending bank, and bank-specific linear time trends. The CEM estimates are obtained using the weights generated by the CEM algorithm, restricting the sample to the common-support region. The sample includes traditional and Cofinavit mortgages to private sector workers originated by commercial banks between June 2016 and June 2019. Refer to Section 4.1 for data sources and sample selection and to Appendix Table A.1 for variable definitions. Standard errors clustered by income group are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table 5: Down payment and property value: co-financed versus traditional mortgages

Dependent variable:	Down payment									
	Total				Paid w/ private savings		log(Property value)			
	OLS		CEM		OLS	CEM	OLS		CEM	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Co-financed	-8.281***	-8.419***	-7.565***	-7.610***	-16.822***	-15.936***	-.045***	.006	.021***	.021***
	(.301)	(.292)	(.279)	(.274)	(.151)	(.170)	(.013)	(.006)	(.007)	(.007)
Borrower controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Workplace munic. FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Property munic. FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Income group FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Bank time trends	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Mean dep. var.	21.6	21.6	20.6	20.6	18.0	16.8	14.1	14.1	14.0	14.0
Observations	116,327	116,327	91,764	91,764	116,327	91,764	116,327	116,327	91,764	91,764

NOTE. This table reports OLS and CEM estimates from regressions of the total mortgage down payment (columns 1 to 4) and the portion paid out of private savings (columns 5 and 6), as a percentage of the collateral value, and the log of property value (columns 7 to 10) on *Co-financed*, an indicator taking the value of 1 if the mortgage is co-financed and 0 if it is traditional. All specifications are described in Table 4. The sample includes all traditional and Cofinavit mortgages to private sector workers originated by commercial banks between June 2016 and June 2019. Refer to Section 4.1 for data sources and sample selection and to Appendix Table A.1 for variable definitions. Standard errors clustered by income group are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table 6: Loan interest rate: co-financed versus traditional mortgages

Dependent variable:	Average rate			Bank rate		
	OLS		CEM	OLS		CEM
	(1)	(2)	(3)	(4)	(5)	(6)
Co-financed	.339***	.356***	.364***	-.246***	-.221***	-.213***
	(.010)	(.008)	(.009)	(.006)	(.005)	(.005)
Borrower controls	No	Yes	Yes	No	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Workplace municipality FE	No	Yes	Yes	No	Yes	Yes
Property municipality FE	No	Yes	Yes	No	Yes	Yes
Income group FE	No	Yes	Yes	No	Yes	Yes
Bank time trends	No	Yes	Yes	No	Yes	Yes
Mean dependent variable	10.4	10.4	10.5	10.2	10.2	10.2
Observations	116,327	116,327	91,764	116,327	116,327	91,764

NOTE. This table reports OLS and CEM estimates from regressions of the average (columns 1 to 3) and the bank (columns 4 to 6) mortgage rates (in percentage) on *Co-financed*, an indicator taking the value of 1 if the mortgage is co-financed and 0 if it is traditional. All specifications are described in Table 4. The sample includes all traditional and Cofinavit mortgages to private sector workers originated by commercial banks between June 2016 and June 2019. Refer to Section 4.1 for data sources and sample selection and to Appendix Table A.1 for variable definitions. Standard errors clustered by income group are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table 7: Default outcomes: co-financed versus traditional mortgages

	First 2 years after origination			First 3 years after origination			First 4 years after origination		
	OLS		CEM	OLS		CEM	OLS		CEM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Co-financed	-.070	-.004	-.044	-.120**	-.066	-.108*	.019	.026	.018
	(.044)	(.034)	(.040)	(.056)	(.049)	(.059)	(.074)	(.063)	(.088)
Borrower controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Workplace municipality FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Property municipality FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Income group FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Bank time trends	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Mean dependent variable	.7	.7	.6	1.0	1.0	.9	1.2	1.2	1.1
Observations	2,972,089	2,972,089	2,238,733	2,913,654	2,913,654	2,081,691	2,038,867	2,038,867	1,230,197

NOTE. This table reports OLS and CEM estimates from regressions of indicators taking the value of 100 if a mortgage becomes non-performing within the first two years (columns 1 to 3), three years (columns 4 to 6), and four years (columns 7 to 9) after origination, and of 0 otherwise on *Co-financed*, an indicator taking the value of 1 if the mortgage is co-financed and 0 if it is traditional. All specifications are described in Table 4. The sample includes all traditional and Cofinavit mortgages to private sector workers originated by commercial banks in the period from June 2016 to June 2019, June 2018, and June 2017, which are followed for two, three, and four years after origination, respectively. Observations are at the mortgage-month level. Refer to Section 4.1 for data sources and sample selection and to Appendix Table A.1 for variable definitions. Standard errors clustered by income group are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table 8: Conditions at origination by income level: co-financed versus traditional mortgages

Dependent variable:	log(Total volume)	log(Bank volume)	Down payment		log(Property value)	Average rate	Bank rate
			Total	Paid w/ priv. sav.			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Co-financed × log(Income)	.034***	.131***	2.552***	-.187	.074***	-.040**	.007
	(.012)	(.012)	(.366)	(.349)	(.009)	(.019)	(.010)
Co-financed	-.207*	-1.483***	-33.618***	-14.030***	-.732***	.774***	-.280***
	(.123)	(.124)	(3.762)	(3.600)	(.095)	(.194)	(.104)
log(Income)	-.009	-.039	-.497	-.206	.039	-.016	-.017
	(.170)	(.178)	(4.837)	(4.884)	(.172)	(.194)	(.187)
Borrower controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Workplace municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Property municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Income group FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank time trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dependent variable	13.8	13.6	20.6	16.8	14.0	10.5	10.2
Observations	91,764	91,764	91,764	91,764	91,764	91,764	91,764

NOTE. This table reports the benchmark CEM estimates from Tables 4 to 6, where the indicator for whether the mortgage is co-financed is interacted with the log of borrowers' income. Borrowers controls only include age and indicators for gender and marital status. Standard errors clustered by income group are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table 9: Default outcomes by income level: co-financed versus traditional mortgages

Dependent var.:	Default: years after origination		
	First 2	First 3	First 4
	(1)	(2)	(3)
Co-financed × log(Income)	-.365***	-.418***	-.724***
	(.060)	(.107)	(.166)
Co-financed	3.667***	4.135***	7.363***
	(.611)	(1.082)	(1.680)
log(Income)	.240	-.461	-.496
	(.870)	(1.111)	(1.627)
Borrower controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Workplace municipality FE	Yes	Yes	Yes
Property municipality FE	Yes	Yes	Yes
Income group FE	Yes	Yes	Yes
Bank time trends	Yes	Yes	Yes
Mean dependent variable	.6	.9	1.1
Observations	2,238,733	2,081,691	1,230,197

NOTE. This table reports the benchmark CEM estimates from Table 7, where the indicator for whether the mortgage is co-financed is interacted with the log of borrowers' income. Borrowers controls only include age and indicators for gender and marital status. Standard errors clustered by income group are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table 10: Conditions at origination by bank size: co-financed versus traditional mortgages

Dependent variable:	log(Total volume)		log(Bank volume)		Down payment		log(Property value)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Smaller bank×Co-financed	.002	.686***	.066***	1.221***	.940**	-31.303***	.009	.221
	(.010)	(.203)	(.015)	(.204)	(.458)	(6.796)	(.010)	(.194)
Smaller bank×Co-financed		-.068***		-.116***		3.064***		-.023
×log(Income)		(.020)		(.020)		(.657)		(.019)
Co-financed	.137***	-.392***	-.172***	-1.726***	-7.942***	-25.413***	.018**	-.809***
	(.008)	(.143)	(.013)	(.122)	(.242)	(4.160)	(.008)	(.115)
Co-financed ×log(Income)		.052***		.154***		1.732***		.082***
		(.014)		(.012)		(.408)		(.011)
Smaller bank×Borrower controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Smaller bank×Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Smaller bank×Workplace munic. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Smaller bank×Property munic. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Smaller bank×Income group FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank time trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dependent variable	13.8	13.8	13.6	13.6	20.6	20.6	14.0	14.0
Observations	91,410	91,410	91,410	91,410	91,410	91,410	91,410	91,410

NOTE. This table reports the benchmark CEM estimates from Tables 4, 5, and 8, where the indicator for whether the mortgage is co-financed (and its interaction with log income, as indicated) is interacted with *Smaller bank*, an indicator taking the value of 0 for the top three banks banks and of 1 for the remaining banks (bank size is determined by total assets as of June 2016). Specifications include the full set of double interaction and standalone terms that are not reported. All controls and fixed effects are interacted with the *Smaller bank* indicator. Standard errors clustered by smaller bank×income group are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Appendix for:

"Raising Household Leverage: Evidence from Co-Financed Mortgages"

Stefano Colonnello Mariela Dal Borgo

A Further details on the new Cofinavit scheme

Here we provide additional details on how the terms of the Infonavit loan in a Cofinavit scheme have changed under the new credit plan, comparing them to the terms of a bank loan.

Indexation. The Infonavit loan was originally indexed to the minimum wage, which tracks the rate of inflation. When a loan was originated, the amount in pesos was divided by the minimum wage and converted to "times the minimum wage". This implies that, following the annual increases in the minimum wage, the loan balance in pesos increased and this lengthened the repayment horizon. Since April 2017, the Infonavit loan is expressed in Mexican pesos, which prevents these changes in the loan balance. The loans already originated in minimum wages, will be indexed to a new CPI-linked index, the UMA (*Unidad de Medida y Actualización*).[17] In turn, bank loans are typically denominated in pesos during our sample period.

Interest rate. Before the reform, the advertised interest rate in minimum wages on the Infonavit loan entailed a cross-subsidy from high- to low-income borrowers: It varied from 4% to 9.5% for borrowers with income below 10 MWs (MX$24,332 in 2017) and equaled 10% for those with higher income (see Panel A of Figure A.1). Note that, because of the loan's indexation, the advertised interest rate was also indexed to the minimum wage. If the minimum wage increase tracks the inflation rate, the advertised rate resembles a real rate. The nominal interest rate (in pesos) approximately equals the advertised rate plus the minimum wage change. For instance, in 2016-2017 the minimum wage grew on

[17] In January 2016, the UMA replaced the minimum wage as the indexation unit for obligations required by federal, state, and local laws. Cofinavit shifted to the UMA in April 2017, one of the latest Infonavit products to adopt it.

average by 4%, and so the nominal interest rate in pesos varied between 8% and 14%.[18] The new credit plan set the interest rate at 12% across all income levels, eliminating the cross-subsidy (see Panel B of Figure A.1). As the reform removed the loan indexation to the minimum wage, the new advertised rate on the Infonavit loan is in pesos. In consequence, between March and April 2017 the interest rate in pesos dropped by over 2% at higher incomes, whereas it declined less or even increased at lower incomes, as shown in Figure A.2. On the other hand, the interest rate in pesos charged by the bank is typically smaller than that charged by Infonavit and is usually either fixed or increasing.

Credit limits.[19] Before the reform, the maximum loan amount granted by Infonavit, expressed in minimum wages, was a function of borrower's age and income, as shown in Panel A of Appendix Figure A.1. To target workers with income below 11 MWs, the credit limit dropped discretely by at least 52% as income increased from 10.9 to 11 MWs (from MX$26,522 to MX$26,765 in 2017). It then remained the same at incomes greater than or equal to 25 MWs (MX$60,830 in 2017), not targeted by Infonavit. In contrast, banks may offer differentiated conditions at all income levels, including at above 25 MW. After the 2017 reform, the maximum loan amount granted by Infonavit became a function of the loan's maturity, rather than of the borrower's age, and of her income, as shown in Panel B of Appendix Figure A.1. The new credit limits are expressed in UMAs and drop by 37% on average as income rises from 12.5 to 12.6 UMAs (from MX$28,686 to MX$28,916 in 2017). Appendix Figure A.2 shows the changes in credit limits under the new plan.

Salary discount rate. Under the old plan, the salary discounts were set at 7% for workers with a monthly wage of up to 10.9 MWs and at 1% for higher wage workers (Panel A of Figure A.1). After April 2017, the rate remained at 7% for borrowers with a wage of at most 12.5 UMAs and increased to 2.5% for those with higher wages (Panel B of Figure A.1). This implies that the salary discount rate has not changed for low-income borrowers but has increased from 1% to 2.5% for high-income borrowers (and from 1% to 7% for income segments near the thresholds of 11 MWs and 12.5 UMAs) (see Figure A.2). The increase in salary discounts at higher incomes is needed to avoid extending the time to repayment after the increase in credit limits—for a given salary discount rate, a larger loan will take longer to be repaid. By increasing the PTI ratio with Infonavit, a higher salary discount may lead to a reduction in the one with the bank, since the overall

[18]The formula for the interest rate in pesos is: $i = (1 + i_{\text{MW}}) \times (1 + \Delta\text{MW}) - 1$, where i_{MW} is the advertised rate in minimum wages, and ΔMW is the expected annual variation in the minimum wage.

[19]A credit assessment establishes whether a borrower gets up to 100%, 90%, or 80% of her Infonavit credit limit (Infonavit, 2016). Since October 2017, this assessment is enhanced with credit bureaus reports and borrowers that do not authorize disclosing such information can only receive up to a 75% of the maximum amount.

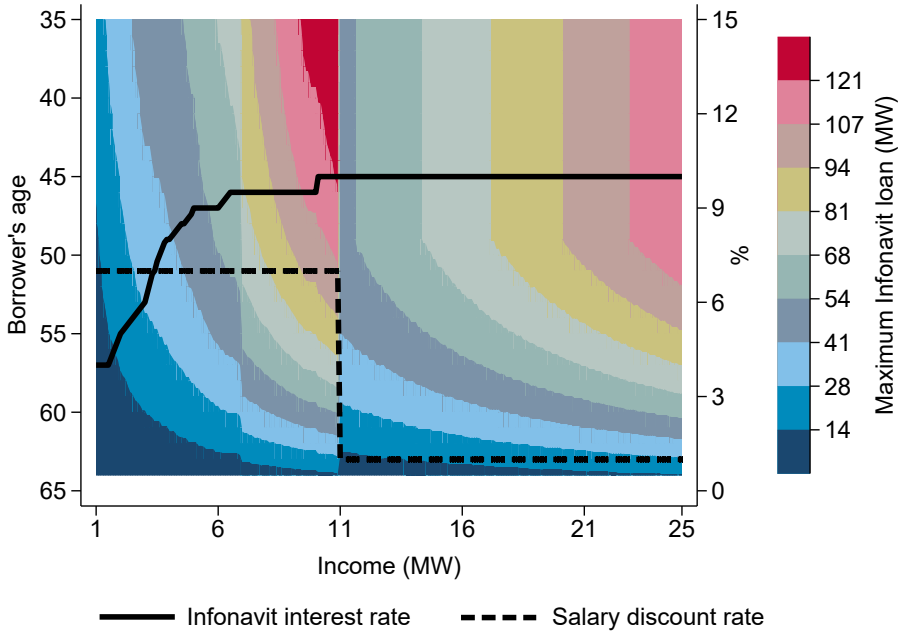
PTI ratio is set at about 30%. Ultimately, this could lead to a smaller bank loan, or to one with a lower interest rate or higher maturity.

Administration fees. The 2017 reform also introduced a monthly administration fee for the Infonavit loan (equivalent to an annual 1% of its outstanding amount).

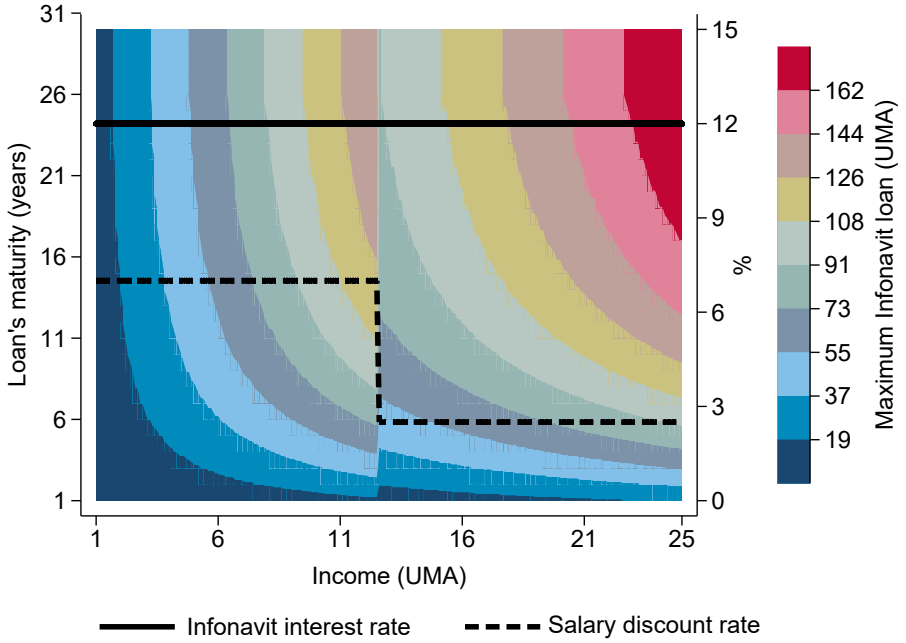
B Further results

Figure A.1: Terms of Infonavit loans

Panel A: Loans originated before April 2017

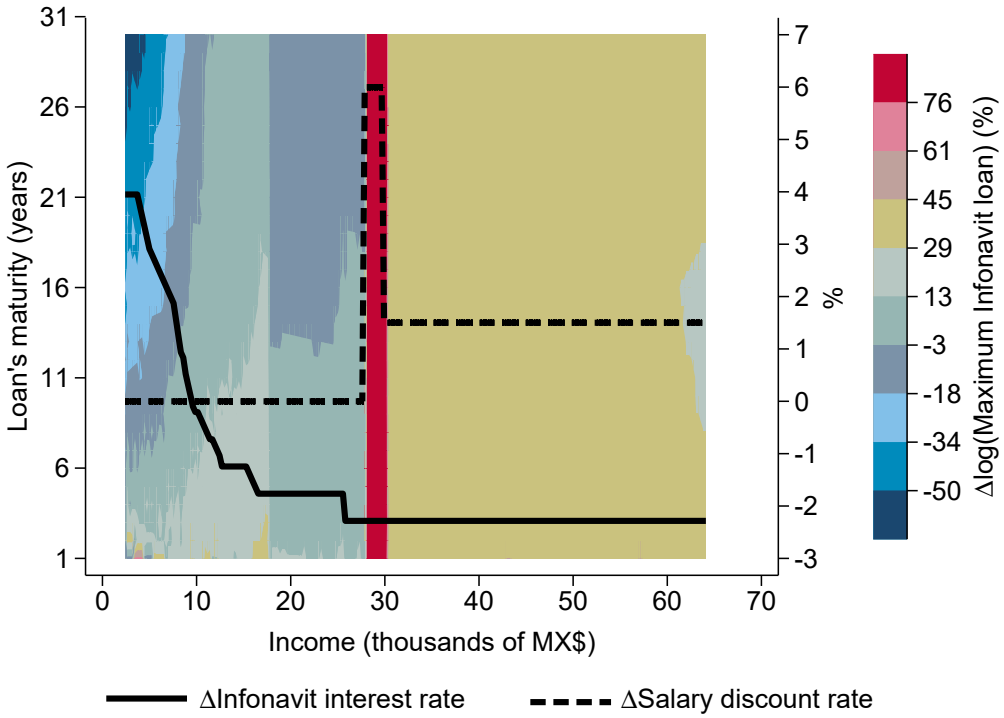


Panel B: Loans originated after April 2017



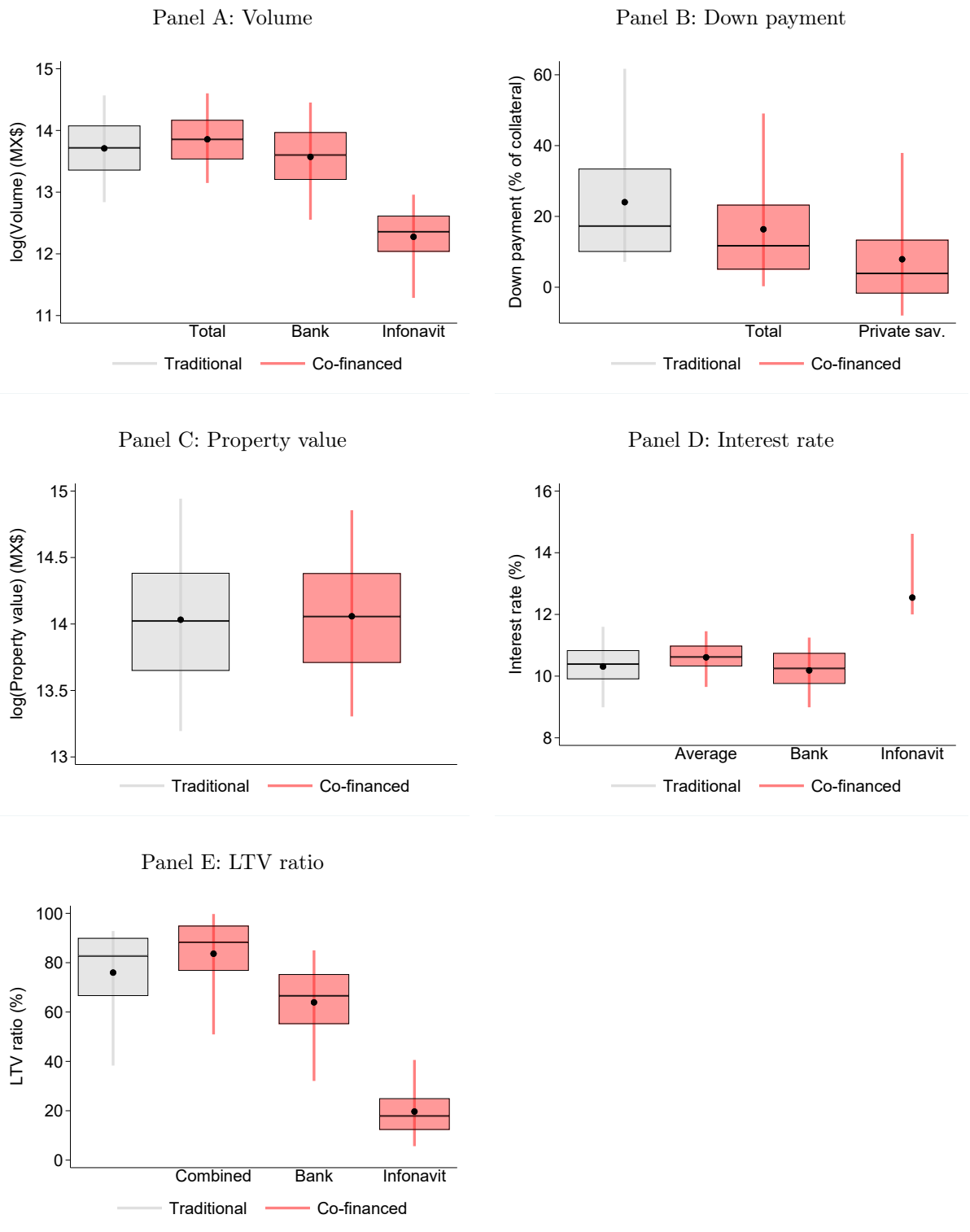
NOTE. This figure shows the credit limits, interest rates, and salary discount rates of Infonavit loans granted under the Cofinavit scheme, before (Panel A) and after (Panel B) April 2017. The credit limits are displayed as filled contours depending on borrower's age and income (Panel A) and loan's maturity and borrower's income (Panel B). Income and credit limits are expressed in minimum wages (Panel A) and UMAs (Panel B). The horizontal axes plot income for the bins defined by Infonavit. The left-hand side axis corresponds to borrower's age (Panel A) and loan's maturity (Panel B). The black solid line shows the nominal interest rates and the black dashed line shows the salary discount rates, as a function of borrower's income, using the scale on the right-hand side axes.

Figure A.2: Change in the terms of Infonavit loans under the new credit plan



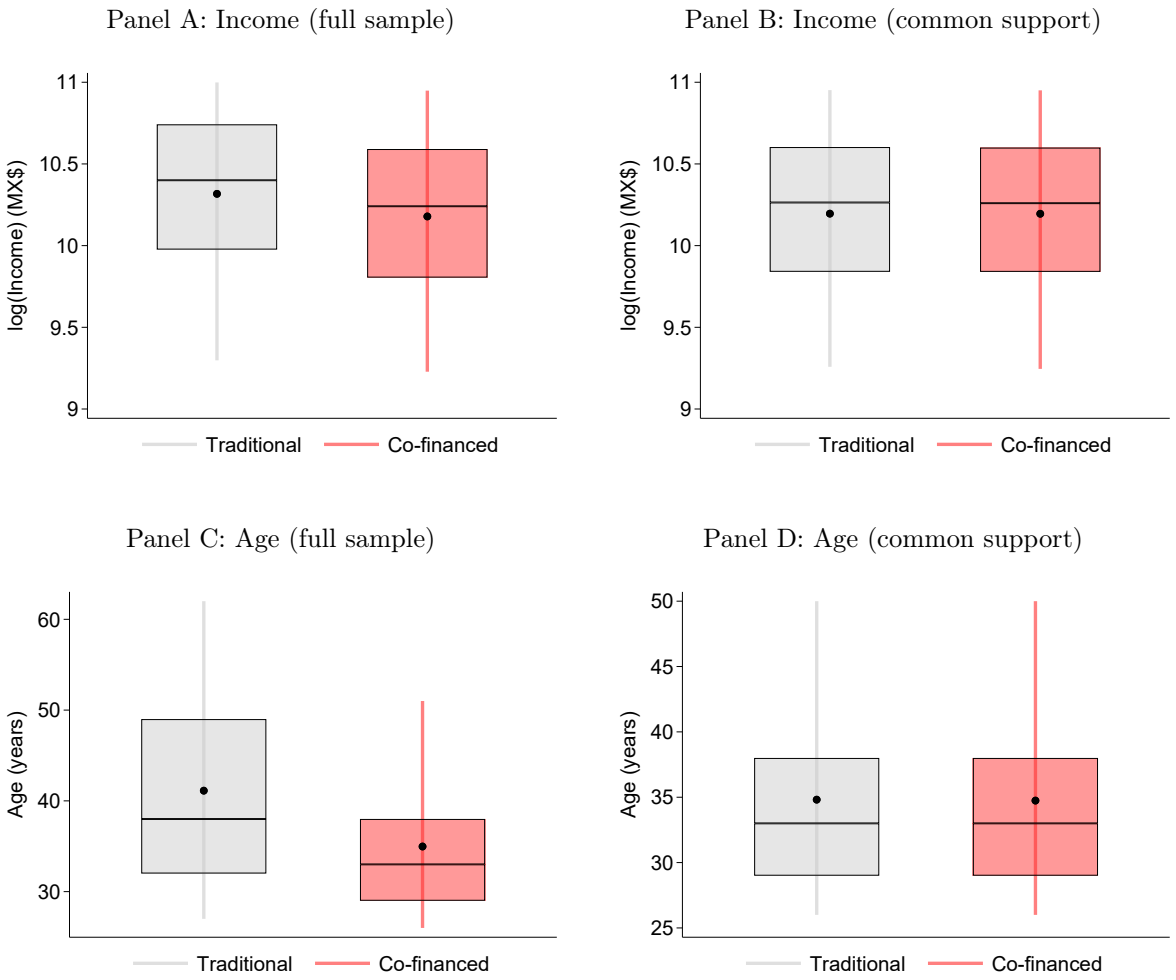
NOTE. This figure shows the first difference in the logarithm of the credit limits and in the interest rates and salary discount rates of Infonavit loans granted under the Cofinavit scheme. The differences are computed between April and March 2017. The change in maximum loan amounts are displayed as filled contours depending on loan's maturity and borrower's income. They are computed from credit limits in Mexican pesos, deflated by the CPI (July 2018=100). The horizontal axis plots income in thousands of constant pesos (July 2018=100) for bins of width equal to MX$257. The left-hand side axis corresponds to loan's maturity, defined as 65 minus the borrower's age before April 2017. The black solid line shows the difference in interest rates (in Mexican pesos) and the black dashed line shows the difference in salary discount rates by income level, using the scale in the right-hand side axis.

Figure A.3: Mortgage and property characteristics at origination



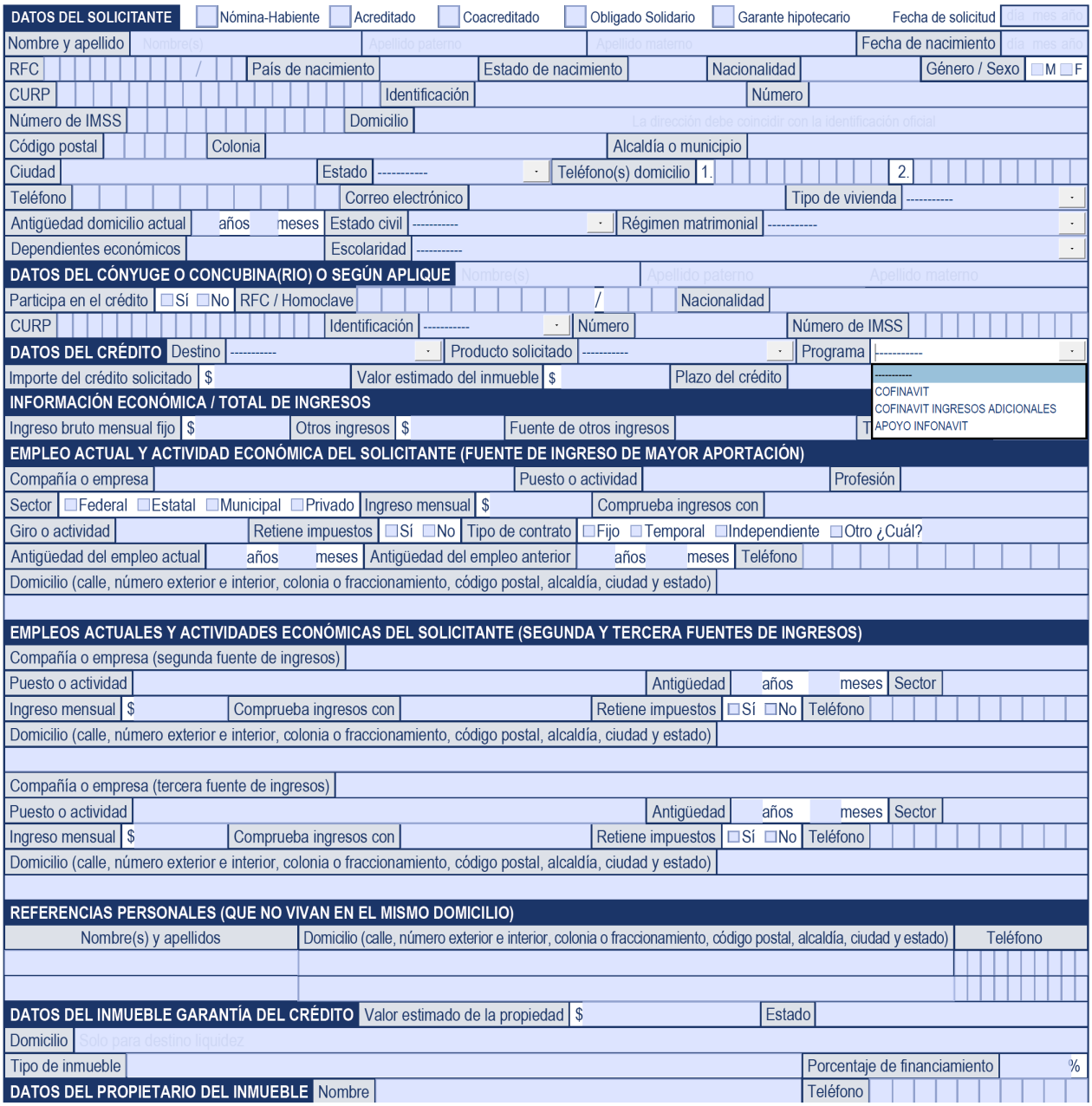
NOTE. This figure shows box plots for characteristics at origination of co-financed and traditional mortgages. The sample is restricted to the common support region. For characteristics in Panels A, D, and E, we report not only their combined value in a Cofinavit mortgage, but also discriminate between the values corresponding to the Infonavit and bank portions. The box plots report the 25th, 50th, and 75th percentiles of the distribution of each characteristic. The extremes of the whiskers indicate the 5th and 95th percentiles. The mean of each characteristic is marked by a black dot inside the boxes. Refer to Section 4.1 for data sources and sample selection and to Appendix Table A.1 for variable definitions.

Figure A.4: Borrower characteristics at origination



NOTE. This figure shows box plots for borrower's income and age corresponding to co-financed and traditional mortgages at origination. Statistics are presented both before (Panels A and C) and after (Panels B and D) the sample is restricted to the common support region. The box plots report the 25th, 50th, and 75th percentiles of the distribution of each characteristic. The extremes of the whiskers indicate the 5th and 95th percentiles. The mean of each characteristic is marked by a black dot inside the boxes. Refer to Section 4.1 for data sources and sample selection and to Appendix Table A.1 for variable definitions.

Figure A.5: Example of a mortgage application form



NOTE. This is an example of the actual form requested by a commercial bank to mortgage applicants. The entries displayed in the field "Programa" allow to select a specific co-financing program. Applicants not selecting Cofinavit or one of the other two programs are applying to a traditional bank loan. The form also specifies the following main requirements (not shown): 1. Be aged between 18 and 75 years old (depending on the product, the age plus the loan term cannot exceed 85 years old at origination). 2. Meet the insurance requirements set by the bank. 3. Have a lawful source of income. 4. Have a sound credit history and demonstrate sufficient economic solvency to repay the loan. 5. Verify minimum income and length of employment. The form further asks the authorization to request the applicant's credit history to the credit information societies for a period of three years.

Table A.1: Definition of variables

Variable	Definition
Mortgage and property characteristics	
Co-financed	Indicator equal to 1 for Cofinavit mortgages (i.e., co-financed between Infonavit and a commercial bank) and 0 for traditional bank mortgages.
log(Total loan volume) (MX$)	Logarithm of the total mortgage volume granted by the bank and, if co-financed, also by Infonavit.
log(Bank loan volume) (MX$)	Logarithm of the mortgage volume granted by the bank (for traditional bank mortgages, it is equal to the total loan volume).
Down payment (% of collateral value)	Collateral value (the lesser of the purchase price and the appraised value) minus total loan volume, as a percentage of the collateral value.
Down payment minus home account (% of collateral value)	Collateral value (the lesser of the purchase price and the appraised value) minus total loan volume, as a percentage of the collateral value, after subtracting the home account balance.
log(Property value) (MX$)	Logarithm of the property value, given by the purchase price of the house.
Average interest rate (%)	Volume-weighted average of the interest rates used by the bank and by Infonavit to compute the interest payments for the period. The Infonavit rate applied before April 2017 is extracted from the Terms of Contract in the Official Journal of the Federation, 24 April 2008, and converted to Mexican pesos using the formula in footnote 18. The rate applied after April 2017 is set equal to 12%.
Bank interest rate (%)	Interest rate used by the bank to compute the interest payments for the period (for traditional bank mortgages, it is equal to the average interest rate).
Bank LTV ratio (%)	Bank loan volume as a percentage of the collateral value (the lesser of the purchase price and the appraised value).
Non-performing in the first two, three, four years	Indicator equal to 100 if the bank loan is classified as non-performing (the payments of principal, interests, or both were not met as originally agreed or the borrower is in bankruptcy) within the first two, three, and four years after origination, and 0 if it remains performing.

(Continued)

Table A.1: – *Continued*

Borrower characteristics	
log(Income) (MX$)	Logarithm of the borrower's gross monthly income as reported at origination. It includes all sources of income considered for the loan decision (wages, business and professional activities, rents, interests, co-borrower's or other family members' income, etc.).
Male	Indicator equal to 1 if the borrower is male and 0 otherwise.
Age (years)	Borrower's age at the time of mortgage origination.
Married	Indicator equal to 1 if the borrower is married at the time of mortgage origination and 0 otherwise.

NOTE. All mortgage- and borrower-level variables are extracted from the regulatory report R04 H collected by the CNBV.

Table A.2: Characteristics at origination accounting for ex ante credit risk: co-financed versus traditional mortgages

Dependent variables:	log(Total volume)		log(Bank volume)		Down payment				log(Property value)		Bank rate	
					Total		Paid w/ priv. sav.					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Co-financed	.087***	.086***	-.270***	-.271***	-7.117***	-7.035***	-15.267***	-15.232***	-.011	-.010	-.285***	-.289***
	(.013)	(.013)	(.021)	(.021)	(.437)	(.432)	(.383)	(.384)	(.012)	(.012)	(.014)	(.013)
Probability of default		.006		.010		-.851***		-.370*		-.006		.034***
		(.006)		(.006)		(.179)		(.201)		(.006)		(.009)
Borrower controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Workplace munic. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Property munic. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Income group FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep. var.	13.8	13.8	13.6	13.6	16.9	16.9	13.6	13.6	14.0	14.0	10.2	10.2
Observations	7,813	7,813	7,813	7,813	7,813	7,813	7,813	7,813	7,813	7,813	7,813	7,813

NOTE. This table reports the benchmark CEM estimates from Tables 4, 5, and 6, before and after controlling for the probability of default at origination computed by a bank using an internal ratings-based model. The sample includes traditional and Cofinavit mortgages to private sector workers originated by the bank using the internal ratings-based model between December 2018 and June 2019. Standard errors clustered by income group are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table A.3: Default outcomes controlling for ex ante credit risk and LTV: co-financed versus traditional mortgages

Dependent variable:	Defaults: years after origination				
	First 2			First 3	First 4
	(1)	(2)	(3)	(4)	(5)
Co-financed	.255**	-.076**	-.124***	-.260***	-.158*
	(.107)	(.034)	(.038)	(.054)	(.080)
Probability of default		.865***			
		(.010)			
Borrower controls	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Workplace munic. FE	Yes	Yes	Yes	Yes	Yes
Property munic. FE	Yes	Yes	Yes	Yes	Yes
Income group FE	Yes	Yes	Yes	Yes	Yes
Combined LTV FE	No	No	Yes	Yes	Yes
Mean dependent variable	.8	.8	.6	.9	1.1
Observations	193,639	193,420	2,238,733	2,081,691	1,230,197

NOTE. This table reports the benchmark CEM estimates from Table 7, before and after controlling for the probability of default at origination computed by a bank using an internal ratings-based model (columns 1 and 2) and adding fixed effects for 5%-combined-LTV bins (columns 3 to 5). The sample in columns 1 and 2 includes traditional and Cofinavit mortgages to private sector workers originated by the bank using the internal ratings-based model between December 2018 and June 2019, which are followed for two years after origination. The sample in columns 3 to 5 is the same as in Table 7. Standard errors clustered by income group are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table A.4: Conditions at origination under different credit plans: co-financed versus traditional mortgages

Dependent variables:	log(Total volume)		Down payment				log(Property value)		Average rate	
			Total		Paid w/ priv. sav.					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Post × Co-financed	.008	-.134	.531	7.833	-1.448***	3.535	.014	.054	-.463***	-.851
	(.011)	(.238)	(.511)	(7.656)	(.394)	(8.072)	(.011)	(.205)	(0.021)	(.546)
Post × Co-financed		.014		-.688		-.488		-.003		.037
× log(Income)		(.023)		(.740)		(.775)		(.020)		(.052)
Co-financed	.124***	-.051	-7.873***	-42.149***	-14.665***	-18.082**	.006	-.763***	.704***	1.705***
	(.009)	(.206)	(.429)	(6.268)	(.357)	(6.968)	(.009)	(.183)	(0.020)	(.534)
Post×Borrower controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Post×Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Post×Workplace munic. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Post×Property munic. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Post×Income group FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dependent variable	13.8	13.8	20.6	20.6	16.7	16.7	14.0	14.0	10.5	10.5
Observations	91,382	91,382	91,382	91,382	91,382	91,382	91,382	91,382	91,382	91,382

NOTE. This table reports the benchmark CEM estimates from Tables 4, 5 6, and 8, where the indicator for whether the mortgage is co-financed (and its interaction with log income, as indicated) is interacted with *Post*, an indicator taking the value of 1 after April 2017 and of 0 otherwise. Specifications include the full set of double interaction and standalone terms that are not reported. All controls and fixed effects are interacted with the *Post* indicator. Standard errors clustered by post×income group are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table A.5: Default outcomes under different credit plans: co-financed versus traditional mortgages

Dependent variable:	Default: years after origination					
	First 2		First 3		First 4	
	(1)	(2)	(3)	(4)	(5)	(6)
Post × Co-financed	.111	.907	-.013	-.062	-.005	-2.223
	(.077)	(1.458)	(.101)	(2.039)	(.195)	(4.318)
Post × Co-financed		-.081		.001		.212
×log(Income)		(.142)		(.200)		(.421)
Co-financed	-.114*	3.097**	-.090	4.724***	.001	7.913***
	(.064)	(1.298)	(.076)	(1.541)	(.087)	(1.363)
Post×Borrower controls	Yes	Yes	Yes	Yes	Yes	Yes
Post×Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Post×Workplace munic. FE	Yes	Yes	Yes	Yes	Yes	Yes
Post×Property munic. FE	Yes	Yes	Yes	Yes	Yes	Yes
Post×Income group FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean dependent variable	.6	.6	.9	.9	1.1	1.1
Observations	2,238,731	2,238,731	2,081,689	2,081,689	1,230,195	1,230,195

NOTE. This table reports the benchmark CEM estimates from Tables 7 and 9, where the indicator for whether the mortgage is co-financed (and its interaction with log income, as indicated) is interacted with *Post*, an indicator taking the value of 1 after April 2017 and of 0 otherwise. Specifications include the full set of double interaction and standalone terms that are not reported. All controls and fixed effects are interacted with the *Post* indicator. Standard errors clustered by post×income group are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.