The potential impact of financial portability measures on mortgage refinancing: Evidence from Chile ☆

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ABSTRACT

This study estimates the potential impact of a recent Financial Portability Law in Chile on the households' mortgage refinancing probability. I show that mortgage refinancing is positively associated with financial education, liquidity needs, plus the value and timing for optimal refinancing. A counterfactual exercise shows the new legislation can substantially increase the refinancing probability and bring welfare gains, especially if it lowers the cognitive costs of the process. The refinancing probability may increase from 18% to 21.1% and create a welfare gain of 202 USD per borrower if only the pecuniary cost channel of the law is accounted for. However, the refinancing probability and welfare gains may increase to 29.2% and 902 USD, respectively, if the law can also significantly reduce the cognitive-education costs of refinancing. Welfare gains are larger for higher income households and owners of top valued homes. The refinancing gains could also boost the potential impact of monetary policy on consumption.

1. Introduction

Credit competition among lenders is a significant concern, since banks are multiproduct firms in a oligopoly market (Farrell and Klemperer, 2007,Degryse et al., 2019). In particular, mortgages are one of the financial institutions' most important products, since these represent large amounts in households and firms' budgets (Campbell, 2013). Also, mortgages are a long-term contract that often hinders borrowers that wish to switch to a new bank (Brunetti et al., 2016), even if it is to take advantage of other banking offers such as credit cards (Calem et al., 2006) or payments, insurance and savings products (Brunetti et al., 2016). The diversity of mortgage options, the size of its loans, the length of its contracts and the complexity to make an optimal decision (Deng et al., 2000) make mortgages a special product where additional clarity of choices and competition could bring significant welfare gains (Woodward and Hall, 2012,Campbell, 2013). Finally, there is extensive evidence of search frictions and switching costs for customers in both mortgages (Allen et al., 2019,Bhutta et al., 2020) and other credit products (Calem et al., 2006), which allows lenders to charge substantially higher rates and fees from individuals even after accounting for observable risk characteristics (Woodward and Hall, 2012,Allen et al., 2019, Bhutta et al., 2020), especially among less financially literate customers (Campbell, 2013,Bhutta et al., 2020).

For this reason, several countries implemented new legislation to compel financial institutions to allow banking accounts to be closed quickly and ease mortgage refinancing, so that clients may switch banks more easily and take advantage of competing offers. Such Financial Portability laws were implemented in New Zealand in 2007, Colombia in 2012, Mexico in 2014, Italy in 2015, France in 2017, Spain in 2019[1] and in Chile in 2020 (Chilean Congress, 2020). These legislations allow to subrogate a mortgage plus its collateral guarantees and all the customers' financial accounts with a single document[2], an expedite process (a maximum of 12 days in Italy, 13 days in Spain, 15 days in Mexico, 22 days in France, 30 days in Chile) and at a reduced cost (such as avoiding new notary fees and home appraisal)[3]. Furthermore, in 2014 the European Union, following a proposal of the European Central Bank, issued the Directive 2014/92/EU to encourage member countries to adopt financial portability laws and standardize access, switching, and fees related to payment accounts. The Chilean law was published on June 3 of 2020, although its implementation only started on September 8 of 2020 to give financial institutions the adequate time for adjusting.

This work analyzes the potential future impact of the Financial Portability law in Chile on household financial choices and welfare, in particular in terms of mortgage refinancing or renegotiation. Mortgage refinancing is an important financial decision since it involves large sums. Furthermore, there is strong empirical evidence that households do not take advantage of mortgage refinancing opportunities, losing substantial savings (Keys et al., 2016). Using data from the Chilean Household Finance Survey (in Spanish, *Encuesta Financiera de Hogares*, hence on, EFH), I show that few homeowners have ever completed a mortgage refinancing. Estimating a discrete choice model from the household survey data, I find that mortgage refinancing is more frequent among higher income and more financially literate households and for customers of mid-sized and small banks. Households also renegotiate due to higher liquidity needs or debt burden, confirming empirical evidence for the USA (Hurst and Stafford, 2004). Finally, households are more likely to renegotiate during a long period in which renegotiating has a positive net present value or in periods of higher credit demand, although refinancing is unrelated to higher bank supply slack, suggesting again a liquidity motive rather than banks' initiative. I then calibrate the impact of the Financial Portability law for the future mortgage refinancing probabilities and its welfare gains, taking into account two channels: one, the reduction in the pecuniary costs of the refinancing process; two, the reduction in the complexity and time costs of the documents required for the proceedings, which implies that households will find it easier to manage the refinancing process, even with lower financial literacy levels. Considering just the reduction in financial costs, the results show that the mortgage refinancing probability would increase from 18% to 21.1% of all mortgage borrowers, implying an average welfare increase of 4.8 Chilean UF (a sum around 202 USD) per borrower [4]. However, by considering both the reduction in pecuniary costs plus the lower time and cognitive requirements, then the legislation implies that mortgage refinancing probability could increase from 18% to 29.2%, with an average welfare increase of 21.4 UF (around 902 USD) per borrower. Accounting for both the pecuniary and cognitive channels, there is an increase in the refinancing probabilities across all income levels and home values, but with larger gains in absolute value for more expensive houses and for the second homes of high income households. Finally, using the model to evaluate the refinancing gains available to households under hypothetical scenarios in which the mortgage real interest rate falls, I find that the new legislation substantially increases the available savings of households as a percentage of GDP, which could then be used to boost household consumption during low periods of the business cycle (Amromin et al., 2020, Gomes et al., 2021, Wong, 2021).

This paper fits into a larger literature that uses microdata to study household finance issues (Bover et al., 2016, Madeira and Zafar, 2015, Madeira, 2018). This article is related to a growing literature using survey data to calibrate the impact of economic policies on heterogeneous households (Carpantier et al., 2018, Guerello, 2018, Casiraghi et al., 2018, (Madeira, 2019b)) and on the role of the housing market for economies with different financial development (Cesa-Bianchi et al., 2015). It is also related to the literature on mortgage refinancing and the substantial gains lost by customers (Green and Shoven, 1986, Agarwal et al., 2013). Furthermore, since mortgage refinancing is often a feasible alternative to loan default, this study is also related to how better loan contracts and option flexibility can reduce delinquency and improve financial stability (Das and Meadows, 2013, Agarwal and Zhang, 2018). The study is also related to how financial literacy impacts consumer decisions and their choice of complex products with risky characteristics (Campbell, 2013, Disney and Gathergood, 2013, Gathergood and Weber, 2017), which is especially detrimental for women's wealth (Goldsmith-Pinkham and Shue, 2020). Empirical evidence for the US shows that 20% of financially unconstrained households fail to refinance when it is optimal to do so and such a puzzle happens across all education levels, suggesting that psychological factors such as procrastination, trust, and the inability to understand complex decisions are significant barriers (Keys et al., 2016). Finally, this article

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[1] After Mexico's Financial Reform in 2014, the number of subrogated mortgages increased more than 17 times, from just 948 loans in 2013 to 7,205 loans in 2014, 8,975 loans in 2015 and 16916 loans in 2016 (Government of Mexico, 2016). However, in Spain the number of subrogated mortgages in the first quarter after the new law (April to June of 2019) was more than 25% lower relative to the previous year (INE, 2019).

[2] This single document obtained contract must detail all the fees and costs of closing the financial accounts in a simple and standardized statement, in order to facilitate borrowers' comprehension and ease their move.

[3] In particular, the Financial Portability laws differ from the "portable mortgage" schemes which are used in the USA, Canada and the Netherlands. The "portable mortgage" schemes allow the borrowers to move their mortgage loan with them when they buy a new house and keep the same interest rate and terms or get reduced costs of prepayment. However, in such schemes the borrower must still pay for notary fees to obtain a new loan and such schemes do not reduce the costs of refinancing the loan, switching to a new financial institution or closing other bank accounts. Also, the "portable mortgage" characteristic is optional among lenders in the USA, Canada and the Netherlands, therefore borrowers must choose such a contract and pay higher fees to obtain it.

[4] The UF is a real monetary unit that is updated for inflation in Chile and it is widely used for many long term contracts, such as rents, mortgages, consumer loans, and wages. Between 2010 and 2019, the average value of the UF was 42.13 USD and fluctuated between 38.25 and 46.43 USD.

is related to how regulation and technology impact financial markets structure to simplify choices and bring benefits to consumers (Bennett et al., 2001,Bhutta et al., 2020).

This paper is organized as follows. Section 2 summarizes the EFH survey data and the mortgage refinancing probabilities across different demographic groups. Section 3 describes the Financial Portability legislation and the empirical model of mortgage refinancing, based on the loan contract info, the household's tax rate and financial education, and the new mortgage loan rates observed on the market. Section 4 shows the results, while Section 5 exhibits a calibrated exercise for the welfare gains of the new law for borrowers, and Section 6 concludes with policy implications.

2. The Chilean Household Finance survey (EFH)

For this study I use the Chilean Household Finance Survey (in Spanish, *Encuesta Financiera de Hogares*, hence on EFH), which is a representative national survey with detailed information on assets, debts, income and financial behavior. The EFH is comparable to similar surveys in the United States and Europe, such as the Survey of Consumer Finances (SCF) and the Household Finance and Consumption Survey (HFCS). The seven EFH survey waves (2007, 2008, 2009, 2010, 2011, 2014, 2017) covered 21,319 urban household interviews, with an over representation of richer households (which is common also in other countries). To adequately correct for the over representation of wealthier households, all the statistics in this article use expansion factors (or population weights), meaning each observation is weighted with a number f_i representing the statistical number of households equivalent to i. Since the survey sample was randomly selected according to a predetermined characteristic (the appraisal value of the household residence for tax purposes, this information is valid from administrative records and available whether the household is a homeowner or rents the property from someone else), then all the sample statistics are consistent once the sample expansion factors are applied (Madeira, 2018).

Due to the absence of a single administrative credit register that includes all the non-banking lenders, the EFH survey is the only micro data source in Chile with information on household loans from all types of lenders and with extensive detail on the characteristics of borrowers (Madeira, 2019a). The survey has detailed measures of income, assets (financial portfolio, vehicles and real estate) and debts, including mortgage, educational, auto, retail and banking consumer loans (including credit cards, lines of credit or loan contracts). In order to cover debts exhaustively, the survey elicits the loan terms (debt service, loan amount, maturity) for the 4 largest mortgages (including both the main mortgage and associated unsecured loans for related expenses such as contract fees, appraisal or remaining home payments) and the 3 main loans for each category of debt (loan categories include credit cards and installment loans with banks, retail stores, labor and credit unions, auto loans, education loans, and informal lending). The survey also asks for each mortgage about "whether the household has refinanced, renegotiated or modified some of the original loan terms since the start of the loan" and "for what reason". Therefore the mortgage refinancing studied in this article corresponds to a very broad definition of refinancing or renegotiation, since it includes all the renegotiations and modifications implemented as a mutual agreement between borrower and lender, besides the exercise of the refinancing options in the original contract.

The survey also elicits the identity of the bank or financial institution with whom the borrower contracted its mortgage and consumer loan contracts. For simplicity, I will represent the results in terms of 4 groups of banks. The first category corresponds to the Large Banks, which includes Banco de Chile, Banco Estado, BCI and Banco Santander. A second category corresponds to Median or Mid-sized Banks which are smaller than the Large Banks, but still command a significant market share, especially among higher income households. The Median or Mid-sized Banks category includes BBVA, Itau-Corpbanca and Scotiabank. The third category corresponds to banks that are part of a larger business holding that also includes retail stores and therefore these banks are largely specialized in small consumer loans, but also sell mortgages. This third category of Retail Banks includes three institutions: Falabella, Paris and Ripley. Finally, the fourth category corresponds to small banks and includes the banks BICE, Security, Penta, plus other banks. Finally, in the case of mortgages there is a significant share of non banking players, which include State Credit (loans directed at low income households from the Ministry of Housing), Labor Unions[5], Insurance companies, and Credit Cooperatives (often popular among farmers and small businesses).

The EFH survey has little information on financial education. However, the Survey of Financial Capabilities (in Spanish, *Encuesta de Capacidades Financieras*, hence on, ECF) measured in 2016 an extensive set of financial literacy indexes for 1,224 Chilean households, using the same methodology applied to other members of the OECD/ INFE (International Network on Financial Education) network (Atkinson and Messy, 2012). It is therefore possible to impute the financial literacy indexes for each EFH respondent using the mean indexes of similar ECF individuals, based on age (10 year dummies), gender, education level and household income quintile. Table 1 shows the mean levels of 4 different financial literacy indexes: Financial Attitudes, Financial Behavior, Financial Knowledge, and Search Behavior for Financial Information. Financial Attitudes measures on a scale from 0 to 5 whether households prefer to spend money instead of saving it. Financial Behavior measures on a scale from 0 to 8 a set of behaviors such as thinking before making a purchase, paying bills on time, budgeting, saving or borrowing to make ends meet. Financial Knowledge measures on a scale from 0 to 8 the basic knowledge of a range of

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[5] For workers with formal contracts in Chile it is compulsory to be a member of one of the labor unions. Labor Unions in Chile can extend loans to their members, but have some restrictions relative to other lenders. In particular, unions cannot charge different interest rates according to the borrower profile (that is, union loans can have different interest rates according to its maturity and loan amount, but the same offer must be given to all borrowers). However, unions have the advantage that the credit can be paid directly from a fraction of the wage transfers of the employer, therefore unions will receive some payment even if the borrower chooses to engage in strategic default.

Table 1

Mortgage refinancing during the past life of the loan and financial literacy by education and income of the households that had a mortgage (currently or in the past).

Household income quintile (poorest = 1, wealthiest = 5)	Financial Literacy Indexes					Mortgage refinancing (%)		
	Attitude	Behavior	Knowledge	Search	Education	Any home	Main home	Other
1	3.3	5.2	4.9	0.8	10.9	12.2	11.7	8.8
2	3.2	5.3	4.9	0.9	11.2	10.6	10.1	7.8
3	3.1	5.6	5.1	1.1	11.8	10.4	10.3	7.2
4	3.0	5.8	5.2	1.3	12.3	11.5	11.3	10.1
5	2.9	6.3	5.4	1.5	13.2	19.5	17.7	14.7
All households	3.0	5.8	5.2	1.3	12.3	14.3	13.4	12.2
Never renegotiated mortgage	3.0	5.8	5.2	1.2	12.2	0	0	0
Renegotiated some mortgage	3.0	6.0	5.3	1.4	12.7	100	94.4	58.3
Elementary education	3.4	4.8	4.6	0.7	10.1	7.4	7.3	3.7
Secondary education	3.1	5.6	5.1	1.1	11.8	12.5	12.1	8.5
Technical or Some college	2.8	6.0	5.5	1.5	12.9	14.1	14.2	5.6
College education	2.9	6.4	5.5	1.5	13.3	16.1	14.4	16.0
Post-graduate education	2.7	6.4	5.3	1.6	13.3	30.7	27.9	20.5

Sample size: a total of 6,088 households from the EFH survey (2007 to 2017 waves).

financial topics, such as division, risk-return trade off, inflation, interest rates, and asset diversification. The Search Behavior for Financial Information measures on a scale from 0 to 3 measures how much information the household gathers on different financial products and financial institutions, the diversity of its information sources on financial products (internet, financial advisors whether in person or by phone, friends, newspapers...) and how frequently the household has borrowed over the last year. In a developing economy like Chile, the Attitudes index is not strongly related to households with better financial management, but it rather shows a more conservative spending among the least educated and lower income. The other 3 indexes - Behavior, Knowledge and Search - are all increasing in the income and education of the household. An overall Financial Education Index is therefore given by the sum of the Behavior, Knowledge and Search sub-indexes[6]. The Financial Education overall index is strongly increasing in income, going from 10.9 for the lowest income quintile to 13.2 for the highest. Mortgage refinancing probabilities are also increasing in education and income, with values going from 7.4% for household heads with Elementary school to 16.1% and 30.7% for the college educated and postgraduate, respectively. Around 19.5% of the borrowers in the highest income quintile have renegotiated a mortgage. However, the mortgage refinancing probabilities are much lower for the other income quintiles, with values between 10.4% and 12.2%. Mortgage refinancing probabilities are slightly higher for the main home (13.4% of the borrowers with mortgages for their main home) than for Other properties (12.2% of the borrowers with mortgages from other properties) and such a pattern is similar across all income levels. This can be explained by main homes being typically more expensive and with larger loans and longer maturities, which increases the absolute value of renegotiating (Agarwal et al., 2013).

Table 2 shows the fraction of borrowers and the refinancing probabilities by lending institution. 71.7% of all home mortgages were issued by banks, with the four Large Banks representing 56% of the borrowers. Mid-sized banks represented 12% of all mortgages, while the Retail and Other Banks represented just 3.6% of the borrowers. State Credit is the second largest player with almost 25% of all mortgages. Unions, cooperatives and insurance companies are minor players, representing just 3.3% of all mortgages. Refinancing probabilities are highly heterogeneous among different institutions. For banks and cooperatives around 17.1% and 17.6% of the borrowers have refinanced their mortgages at some point in the past, while for insurance, state credit and unions the probability is only 12.1%, 10% and 6.5%, respectively. However, the probability is also highly heterogeneous among different bank types, being only 8.0% for Retail banks.

3. Legislation description and empirical strategy

The Financial Portability Law aims to reduce two costs for the mortgage refinancing and bank switching (Chilean Congress, 2020): i) to lower the monetary fixed cost of a mortgage refinancing from 24.1 UF (around 1,015 USD) to 8.7 UF (around 365 USD), saving 15.4 UF (650 USD) for the borrowers; ii) to reduce the time span and complexity of the process. The reduction of the monetary fixed cost implicated by the law involves easing 3 steps of the refinancing process: one, it erases the need for the lender to provide copies of the house deed (saving 3.1 UF, around 130 USD); two, it reduces the notary costs for signing the house deed (saving 2.7 UF, around 114 USD); and three, only the borrower and the new lender need to register the new loan at the Real Estate Registrar office, therefore the former lender is no longer required to update the status

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[6] In the original definition of Financial Literacy of the OECD/ INFE network, Education was the sum of all the Attitude, Behavior, Knowledge and Search indexes. In developed economies, the Attitude questions are related to households that prefer "savings" over "debt" financial products. Since in Chile the Attitude index is more related to the conservative spending background of the low income and less educated households that lack access to debt, then I opted to exclude it from the overall Financial Education index. All the results in the article, however, are very similar, whether in quantitative terms and statistical significal levels, if the analysis uses the total sum of the financial literacy indexes that was suggested in the original OECD/ INFE article (Atkinson and Messy, 2012).

Table 2
Mortgage refinancing by type of lending institution.

Mortgage Institutions	Fraction of mortgage borrowers			Mortgage refinancing (%)		
	All homes	Main home	Other properties	All homes	Main home	Other
Non-Banks:						
State Credit	24.9	28.0	9.5	10.0	9.9	3.9
Labor Union	1.3	1.4	0.9	6.5	5.2	2.4
Insurance	0.4	0.5	0.2	12.1	10.6	13.9
Credit cooperative	1.6	1.7	0.9	17.6	17.4	12.9
Bank type:						
Large	56.2	54.1	67.6	16.5	14.9	10.7
Retail	1.1	1.1	1.0	8.0	7.0	9.0
Median	12.0	11.2	16.2	19.8	15.4	19.1
Other banks	2.5	2.1	3.7	20.7	15.6	24.6
All banks	71.7	68.4	88.5	17.1	14.9	12.8

Bank:	Fraction of bank mortgage borrowers			Mortgage refinancing (%)		
	All homes	Main home	Other properties	All homes	Main home	Other
Banco de Chile	11.0	8.3	16.1	16.2	10.9	16.4
Banco Estado	46.7	41.2	31.7	14.8	14.4	6.1
Scotiabank	8.5	6.9	8.5	15.8	12.0	16.9
BCI	5.2	4.3	5.7	22.4	17.4	18.3
Corpbanca	2.6	1.6	4.1	19.9	11.5	34.5
BICE	0.7	0.5	1.3	33.7	17.9	26.9
Santander	14.8	11.6	20.4	23.2	19.6	16.6
Itaú	1.0	0.7	1.3	16.9	17.7	5.2
Retail banks	1.4	1.1	1.0	7.9	7.7	8.5
BBVA	5.0	4.1	6.2	31.1	26.1	25.3
Other Banks	3.0	19.0	3.6	19.7	13.8	27.0

Sample size: a total of 6,088 households from the EFH survey (2007 to 2017 waves).

of the old loan (saving 9.6 UF, around 405 USD). Furthermore, the Financial Portability Law reduces the number of days required for the mortgage refinancing, by saving 10 days that were required before for a custody letter of the mortgage deeds and documents with the former lender and it also saves 20 days that were required at the notary to modify the loan of the former lender (since now both the modification of the past loan and the registry of the new loan are completed by the new lender in a single step and it does not require intervention of the former lender). By saving 30 days from the time processing and erasing the requirement of 2 steps (the custody letter, plus the notary modification of the old loan by the previous lender), the new law should benefit households that were unable to complete the previous procedures due to their complexity. Finally, the law also facilitates the comparison of different financial offers and customers' understanding of the total costs of the mortgage refinancing and switching of other financial accounts by requiring lenders to provide a standardized and simple format describing all the fees and interests to be charged.

Both the pecuniary and time savings of the changes implied by the Law are expressed in the background documentation of the law sent to the Parliament during the legislative discussion (Chilean Congress, 2020). These estimates of the pecuniary and time savings of the law are also published in the Financial Portability Law's government website to inform the media and consumers about its advantages: https://www.gob.cl/portabilidadfinanciera/. Similar websites with easy instructions and procedures for customers to benefit from the Financial Portability Law were created by each bank. It is possible that the time and pecuniary savings predicted by the legislation do not translate exactly into the savings obtained by the consumers, since banks and notaries may increase the prices of other products to gain extra revenue, but at the very least there was widespread information about the new legislation's intended benefits.

To estimate the potential impact of the Financial Portability Law in Chile, I consider a discrete choice model of whether a household i at time t has ever renegotiated its mortgage or not ($Y_{i,t} \in \{0, 1\}$, with 1 representing a mortgage refinancing at some point in the life of the loan):

$$Y_{i,t} = F(\beta x_{i,t} + \varepsilon_{i,t}), \tag{1}$$

with $x_{i,t}$ denoting the explanatory variables, $\varepsilon_{i,t}$ an idiosyncratic error (or unobserved preference of household i at time t for renegotiating) and $F(.)$ being a parametric function, such as the logit or probit. I chose the logit function throughout the article, since the logit function has a closed-form solution for computing the marginal effects and its estimation in finite-samples is robust to the inclusion of fixed-effects (Wooldridge, 2010), such as dummies for year or banks.

The vector of explanatory variables $x_{i,t}$ includes some measures of the benefits of refinancing from the optimal closed-form solution in Agarwal et al. (2013). I consider that households are more likely to renegotiate not only if it is optimal to do so (i.e., $r_t + ADL_{i,c(i),t} < r_{c(i)}$), but also for how long it has been optimal to renegotiate (time-dependent inaction) and how large are the gains of refinancing (state-dependent inaction), as suggested in Gomes et al., 2021). Therefore $x_{i,t}$ includes two characteristics of the optimal mortgage refinancing rule, which are the Months for refinancing$_{i,c(i),t}$ and the Present Value

of refinancing$_{i,c(i),t}$ (which is accounted in terms of its log value, $\ln(PV_{i,c(i),t})$, plus its squared value, $\ln(PV_{i,c(i),t})^2$). The appendix at the end of the article explains exhaustively how these variables are calibrated for each mortgage borrower. Note that both the Months for refinancing$_{i,c(i),t}$ and the Present Value of refinancing$_{i,c(i),t}$ are complex non-linear functions, which take into account several aspects of the mortgage contract, including the value of the mortgage, its interest rate and the time still left to pay down the mortgage. The vector $x_{i,t}$ also includes household characteristics such as the household head's Financial Education$_i$ and the household's current monthly Debt Service to Income Ratio (DSR$_{i,t}$). Since Financial Education is likely to matter for the correct understanding of the mortgage contract, I also include the interaction between Financial Education and the optimal refinancing rules: Financial Education$_i$ × Months for refinancing$_{i,c(i),t}$, ln (Present Value of refinancing$_{i,c(i),t}$). Finally, as a robustness check to account for the issue that some lending institutions may make it harder to renegotiate mortgages, I include characteristics of the bank with mortgage $c(i)$, such as its size (measured by the logarithm of its total assets, ln (bank assets$_{c(i)}$)), profitability (Bank $c(i)$'s Return on Assets, i.e., ROA), plus dummy variables for the type of banking institution (Retail Bank$_{c(i)}$, Median Bank$_{c(i)}$, Other Bank$_{c(i)}$, with Large Bank$_{c(i)}$ being the baseline category). I also include two time-varying variables that measure aggregate credit conditions faced by the Chilean banks: Supply factors$_t$ and Demand factors$_t$. To obtain these variables I use the Senior Loan Officers Survey (SLOS), a quarterly survey of senior loan managers of the Chilean commercial banks[7]. The survey answers are used to build two perception indicators of composite supply and demand conditions for each bank, with positive values implying, respectively, looser supply conditions and higher credit demand. The aggregate banking system indicators are given by the cumulative level from the first wave until the current period, with banks weighted by their market share (Jara et al., 2017).

4. Results of the mortgage refinancing models

Table 3 shows the results of the Mortgage refinancing model, estimated from the pooled sample of the EFH survey (all waves between 2007 and 2017). The same model is estimated for Any mortgage refinancing of the household, for the mortgage of its main home, and for other properties (whether held as an investment for future sale or to rent) owned by the household. Note that since some households may have more than one mortgage, then the subscript $i, c(i), t$ can denote different mortgages. However, that is rare, since 87.9% of the mortgage borrowers have only one mortgage[8]. For the main home by definition the household has only one mortgage. For the models estimated for "any mortgage" and for mortgages in "other properties", the mortgage contract variables denoted by $i, c(i), t$ use the values for the oldest mortgage of the household.

The models in Table 3 include all lenders, therefore the bank specific controls are omitted. The results show that the mortgage refinancing probability increases with the number of past months with a positive refinancing opportunity. The log of the Present Value of refinancing ($PV_{i,c(i),t}$) has a quadratic form, with an increasing effect on the refinancing probability for higher values. This makes sense because for low values of the gains of refinancing perhaps the households can feel the gain is not worthwhile the hassle (Keys et al., 2016), since in Chile the whole process of refinancing takes one month or longer. For higher values of the Present Value of refinancing then it becomes less likely that households decide to ignore such gains. The quadratic function for the impact of the log of $PV_{i,c(i),t}$ shows that the Present Value has a stronger positive impact on the probability for refinancing other properties. Perhaps the higher significance of the present value in the refinancing probability of other properties is due to the business motivation of such borrowers, therefore paying more attention to positive refinancing opportunities. The debt service ratio (DSR$_{i,t}$, a proxy of liquidity needs), financial education and the log of the household's permanent income ($\ln(P_{i,t})$) are also strongly associated with higher refinancing probabilities, as expected. The only exception is that the Months for refinancing and the Debt Service Ratio are not statistically significant for the refinancing probability of other properties, while the financial education is also not significant once the log of the permanent income is accounted for. Again, perhaps this is due to the owners of other properties being more business motivated in the purchase of units for renting, therefore financial constraints measured by debt service and a lack of financial education may be less relevant for this group. Another explanation could be the smaller sample size of the other properties' group.

Adding interaction effects with financial education to the models, the results in Table 4 confirm again that the permanent income, debt service and financial education are strongly associated with higher refinancing probabilities. The interaction

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[7] The Chilean SLOS survey is similar to the ones implemented in the USA, Japan, Canada, Europe and other countries. The SLOS asks about the perceptions of market conditions relative to the previous quarter, in terms of supply lending standards (with five options: strongly loosened, moderately loosened, unchanged, moderately tightened, strongly tightened) and credit demand (with five options: strongly higher, moderately higher, unchanged, moderately weaker, strongly weaker). Bank managers provide their perceptions in terms of supply and demand factors for each market segment: corporate loans (for large companies, small and medium companies, and the construction sector), consumer loans, and household mortgages. Mortgage supply conditions are measured for the following aspects: Risk of the loan portfolio (delinquency, loan loss provisions), Competition from other banks and non-banking lenders, Regulatory changes, Loan terms (which includes the maximum size of the loan payment relative to the borrower's income, maximum size of the complementary credit loan relative to the morgage, fees or loan spread relative to banks' funding costs, lowest credit score standards, number of loans granted to subprime customers). Mortgage demand factors measure the following aspects: Income and employment conditions of the borrowers, customers' easiness of substitution between bank and non-bank lending, attractiveness of the interest rates.

[8] Among EFH mortgage borrowers, 92.9% have a mortgage on their main home, 18.5% have a mortgage on another property and 11.5% have mortgages both on their main home plus on another property. Since the EFH survey counts both the main home and up to three other properties of the household, then a few wealthy households can report up to 4 mortgages. In the pooled EFH sample, 87.9% of the mortgage borrowers have only one mortgage, 10.7% have 2 mortgages, 1.1% have 3 mortgages, and 0.3% have 4 mortgages. For households with mortgages in other properties, 88.9% have one mortgage, 8.7% have 2 mortgages, and 2.3% have 3 mortgages on other properties.

Table 3

Mortgage refinancing models (Logit model): all lenders.

Variables	Refinanced a mortgage$_i$		Main home$_i$		Other properties$_i$	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Months for	0.002**	0.004***	0.003***	0.004***	−0.003	−0.001
refinancing$_{i,c(i),t}$	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
$\ln(PV_{i,c(i),t})$	−0.222***	−0.163***	−0.271***	−0.222***	−0.122	−0.066
	(0.053)	(0.054)	(0.058)	(0.059)	(0.123)	(0.126)
$\ln(PV_{i,c(i),t})^2$	0.041***	0.027***	0.044***	0.032***	0.043**	0.029
	(0.009)	(0.009)	(0.009)	(0.010)	(0.021)	(0.021)
$\ln(P_{i,t})$		0.516***		0.392***		0.582***
		(0.061)		(0.066)		(0.132)
$DSR_{i,t}$	0.789***	1.070***	0.754***	0.949***	0.024	0.331
	(0.148)	(0.152)	(0.158)	(0.162)	(0.335)	(0.343)
Financial	0.375***	0.112**	0.358***	0.154***	0.288***	−0.005
Education$_i$	(0.039)	(0.049)	(0.041)	(0.052)	(0.107)	(0.124)
Pseudo R2	0.066	0.079	0.059	0.066	0.081	0.098
Observations	6,088	6,088	5,589	5,589	1,375	1,375

Other Controls: dummies for the year of the survey wave.
Robust Standard-errors in (), ***, **, * denote 1%, 5% and 10% statistical significance.

Table 4

Mortgage refinancing models (Logit) with Financial Education interactions: all lenders.

Logit model Variables	Any mortgage$_i$			Main home$_i$	Other properties$_i$
	Model 1	Model 2	Model 3	Model 3	Model 3
Months for	0.013	−0.011	0.004***	0.005***	−0.001
refinancing$_{i,c(i),t}$	(0.015)	(0.008)	(0.001)	(0.001)	(0.003)
$\ln(PV_{i,c(i),t})$	−0.839**	−0.135**	−0.651***	−0.599***	−0.960
	(0.393)	(0.056)	(0.196)	(0.210)	(0.588)
$\ln(PV_{i,c(i),t})^2$	0.021**	0.021**	0.020**	0.027***	0.024
	(0.009)	(0.009)	(0.009)	(0.010)	(0.022)
$\ln(P_{i,t})$	0.513***	0.517***	0.514***	0.391***	0.590***
	(0.061)	(0.061)	(0.061)	(0.066)	(0.132)
$DSR_{i,t}$	1.103***	1.086***	1.101***	0.973***	0.358
	(0.153)	(0.153)	(0.153)	(0.162)	(0.343)
Financial	0.057	0.078	0.058	0.114**	−0.097
Education$_i$	(0.052)	(0.051)	(0.052)	(0.056)	(0.134)
Fin. Education$_i$ ×	−0.001	0.001*			
Months for refin.$_{i,c(i),t}$	(0.001)	(0.001)			
Fin. Education$_i$ ×	0.054*		0.040***	0.031*	0.069
$\ln(PV_{i,c(i),t})$	(0.029)		(0.015)	(0.016)	(0.044)
Pseudo R2	0.080	0.080	0.080	0.067	0.100
Observations	6,088	6,088	6,088	5,589	1,375

Other Controls: dummies for the year of the survey wave.
Robust Standard-errors in (), ***, **, * denote 1%, 5% and 10% statistical significance.

coefficients show that financial education increases significantly the marginal impact of the present value of renegotiating. The financial education of the borrowers is again not significant for explaining the refinancing of other properties. Perhaps this effect is due to the business orientation of the owners of other properties and therefore a lack of financial education is less relevant in that group.

For the bank mortgages models, the results in Table 5 show that the number of past months with a positive refinancing opportunity, the debt service ratio, financial education and Other Banks are strongly associated with a higher refinancing probability. The quadratic terms for the effect of the log of the Present Value of Refinancing keep the same signs as before, but these coefficients are only statistically significant for the main home. Perhaps the lack of significance of these terms for other properties could be due to the small sample size. Median and Other banks are also positively associated with renegotiating other properties. In terms of aggregate shocks, the impact of supply factors is small and statistically insignificant. However, the demand factors are strongly associated with a higher refinancing probability, especially for main homes. Therefore refinancing activity is mostly driven by borrowers' needs and it is not hindered by capital requirements or balance-sheet restrictions of lenders.

The online appendix includes robustness checks such as models that use the logarithm of the Months for refinancing or models that are linear (instead of quadratic) in terms of the logarithm of the Present Value of Refinancing, but the results are broadly similar to Tables 3–5.

Table 5
Refinancing of bank mortgages (Logit model).

Logit model Variables	Any mortgage$_i$ Model 3	Main home$_i$ Model 3	Other properties$_i$ Model 3
Months for refinancing$_{i,c(i),t}$	0.003***	0.003***	−0.002
	(0.001)	(0.001)	(0.003)
$\ln(PV_{i,c(i),t})$	−0.106	−0.144**	−0.046
	(0.065)	(0.070)	(0.148)
$\ln(PV_{i,c(i),t})^2$	0.016	0.021*	0.030
	(0.011)	(0.012)	(0.026)
$\ln(P_{i,t})$	0.530***	0.395***	0.576***
	(0.075)	(0.080)	(0.150)
$DSR_{i,t}$	1.073***	0.927***	0.327
	(0.180)	(0.190)	(0.382)
Financial Education$_i$	0.116*	0.161**	0.035
	(0.061)	(0.066)	(0.144)
$\ln(\text{bank assets}_{c(i)})$	0.128	0.123	0.342*
	(0.093)	(0.102)	(0.184)
Bank's ROA$_{c(i)}$	−8.552	−14.13	11.68
	(8.666)	(9.082)	(20.12)
Retail Bank$_{c(i)}$	0.032	0.375	
	(0.518)	(0.520)	
Median Bank$_{c(i)}$	0.078	0.029	0.844***
	(0.144)	(0.154)	(0.293)
Other Bank$_{c(i)}$	0.256	0.101	0.845**
	(0.188)	(0.209)	(0.368)
Supply factors$_i$	−0.069	−0.043	0.051
	(0.062)	(0.072)	(0.123)
Demand factors$_i$	0.100***	0.111***	0.065
	(0.038)	(0.043)	(0.079)
Pseudo R2	0.065	0.051	0.105
Observations	4,041	3,694	1,125

Other Controls: dummies for the year of the survey wave.
Robust Standard-errors in (), ***, **, * denote 1%, 5% and 10% statistical significance.

Banks are multi-product firms (Farrell and Klemperer, 2007, Brunetti et al., 2016, Degryse et al., 2019), therefore an easier mortgage refinancing and changing the mortgage's bank can increase competition for other bank products. Chilean banks apply the mortgage collateral to all the other credits (consumer installment loans, credit cards, lines of credit) of the customer, therefore I tested how mortgage refinancing affects bank switching for consumer loans. Using the Panel EFH survey samples of 2011–2014 and 2014–2017 (about one third of the survey's sample), I find that 69.3% of the banking consumer borrowers change bank after three years, therefore switching banks for consumer loans is common in Chile. Only 45.6% of the borrowers who refinanced a mortgage in the past and that have banking consumer loans will switch their consumer loan bank in three years time, which is much lower than the 71.7% bank switching probability for the borrowers that never refinanced. Estimating a logit model for the decision of switching banks for consumer loans (results available in the online appendix), I find that mortgage refinancing is not statistically significant after financial education and other controls are included. Perhaps this is because the refinancing borrowers became more satisfied with their bank. Another explanation is that mortgage borrowers may have more bargaining power and the incentives to choose a good bank relationship from the very start. In any case, the high probability of bank switching for consumer loans in Chile does not show that mortgage refinancing is a strong obstacle.

5. Counterfactual impact of the new policy

5.1. Mortgage refinancing before and after the law

Now I consider some counterfactual exercises for how the Financial Portability law may change the mortgage refinancing probability and its implied welfare gains according to different scenarios S:

$$RP_i^S = E\left[Y_{i,t}|\beta, x_{i,t}^S\right] = F(\beta x_{i,t}^S), \tag{2}$$

with $Y_{i,t}$ being the refinancing decision (0 or 1) and β denoting the coefficients of the refinancing logit model in the previous section. Then I compute the average refinancing probability in each scenario S for each group of borrowers g:

$$RP_g^S = \frac{1}{n_g}\sum_{i\in g}RP_i^S, \tag{3}$$

with n_g being the number of household borrowers in each group g.

The counterfactual exercises involve a scenario with: i) a pure reduction in the fixed pecuniary costs of mortgage refinancing from 24.1 UF (around 1,015 USD) to 8.7 UF (around 365 USD); ii) both a reduction in financial costs and a reduction in complexity which is calibrated as an increase in the financial education of each household, with Financial Education$_i^{After-Law}$ = Financial Education$_i + \sigma_{FE}$. This increase in practice of the "financial education" of the households is reasonable, because the law standardizes all the fees and costs of the refinancing in a single document, reduces the time processing in at least 30 days, and erases the requirement of two steps (the custody letter, plus the notary modification of the old loan by the previous lender). In the baseline calibration the parameter σ_{FE} is taken to be one standard-deviation of the financial education across the population (see Table 1): $\sigma_{FE} = 1.19$. As a robustness check, I also present the results for other calibrations which increase financial education by a smaller amount such one quarter, a half or 3 quarters of a standard-deviation: $0.25 \times \sigma_{FE}$ (equal to 0.2975), $0.50 \times \sigma_{FE}$ (equal to 0.595), $0.75 \times \sigma_{FE}$ (equal to 0.8925). Since the Financial Portability Law applies to all private institutions, the counterfactual exercise uses all lenders (banks and non-banks), except for the state credit (which is a government policy that has not been extended in recent years, although some borrowers are still benefitting from old mortgages granted by the housing state department).

In total the counterfactual exercises consider 6 scenarios, $S = 1, 2, 3, 4, 5, 6$. Each scenario S changes three variables of the vector $x_{i,t}^S$: ln(Months for refinancing$_{i,c(i),t}$), ln (Present Value of refinancing$_{i,c(i),t}$) and the Financial Education$_i$. Scenario 1 is the baseline "Before the Law" environment and uses the observable $x_{i,t}^{S=1} = x_{i,t}$ from the EFH dataset. Note that the variables Months for refinancing$_{i,c(i),t}$ and Present Value of refinancing$_{i,c(i),t}$ in this baseline scenario 1 "Before the Law" use the fixed pecuniary cost $F_t = 24.1UF$ (around 1015 USD), as detailed in the appendix. Scenarios 2 to 6 are labelled as "After the Law", but apply slightly different parameters. In all the Scenarios 2 to 6 the variables Months for refinancing$_{i,c(i),t}^S$ and Present Value of refinancing$_{i,c(i),t}$ are calibrated with the fixed pecuniary cost $F_t = 8.7UF$ (around 365 USD). The Scenario 2 is labelled as "After the Law: Lower pecuniary costs", since it has no further changes besides reducing the fixed cost from $F_t = 24.1UF$ (in the baseline scenario 1) to $F_t = 8.7UF$. For the scenarios 1 (baseline, "Before the Law") and 2 ("After the Law: Lower pecuniary costs"), the variable Financial Education$_i$ remains the same as the index calculated for each household in the EFH dataset and which is used in the estimation for the logit models in the previous section. The scenarios 3 to 6, besides the lower fixed cost $F_t = 8.7UF$, also increase the Financial Education of each borrower by a certain constant as: Financial Education$_i^S$ = Financial Education$_i + \alpha^S \times \sigma_{FE}$, with $\alpha^{S=3} = 0.25, \alpha^{S=4} = 0.50, \alpha^{S=5} = 0.75, \alpha^{S=6} = 1,$. Therefore the scenarios 3 to 6 are labelled as "After the Law: Lower pecuniary costs plus cognitive costs reduction $\alpha^S \times \sigma_{FE}$".

According to the OCDE-INFE study in 2016, the difference in Financial Education between Chile and the OECD average is 0.4, while the difference between Chile and the country with the highest financial education (France) is 1.6 (OECD, 2020). Therefore the Financial education implied in Scenario 3 would still see the Chilean borrowers as less sophisticated and capable than in the average OECD country, while Scenario 4 would see the Chilean borrowers comparable in financial capabilities as the average OECD country. Scenario 5 would imply that the Chilean borrowers would be similar in financial capabilities to the citizens of Austria and Portugal. Finally, Scenario 6, with an increase of 1.19 in the financial education index, would imply an increase in financial capabilities similar to the citizens of South Korea, Hong Kong and New Zealand, although the Chilean households would still be below France, Finland, Norway or Canada (OECD, 2020)[9].

Table 6 shows the mortgage refinancing probability before and after the law, by applying model 2 in Table 3 estimated using the mortgage contracts for all lenders and all properties. Using this baseline model, the mortgage refinancing probability would increase from 18% of all borrowers before the Law to 21.1% after the Law if we just consider the effect of the lower fixed monetary costs of the refinancing. However, the refinancing probability could increase to 29.2% if one considers the additional boost in financial understanding of the process. This increase in mortgage refinancing happens across all income levels and home values. If one considers just the effect of the lower fixed costs, then the law increases the refinancing probability by 1.5% in quintiles 1 (the lowest income), 2% in quintile 2, 3.1% in quintile 3, 3% in quintile 4, and 3.1% for the quintile 5 (the richest households). When considering both the reduction in fixed costs and increased financial understanding, then the law implies an increase in the refinancing probability of 8% for the lowest income (quintiles 1 and 2), 10.4% for the middle class (quintile 3), 11% for quintile 4, and 12.9% for the upper income (quintile 5) households. Middle and high income households are more likely to benefit from the law, either with just pecuniary costs or pecuniary plus cognitive costs.

Across home values in Table 6 there is a similar pattern. A reduction in pecuniary costs increases the refinancing probability by 2% for homes with lower value (percentiles 1 to 50, i.e., below the median), 3.3% for the middle value homes (percentiles 51 to 80, i.e., above the median home appraisal), and 3.5% for the top valued homes (percentiles 81 to 100). Again, considering both lower pecuniary and cognitive costs, the law would increase the refinancing probability in 10%, 11.3% and 12.8% for the low, middle and top valued homes, respectively. The law has a stronger impact on main homes. With just lower

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[9] Unfortunately, the calibration of the increase in financial capabilities after the new Law cannot take as a reference a time-series variation in Financial Education. The reason is that the OECD changes its financial education index over time and this index is only measured every 4 years. The comparison in this section refers to the OCDE-INFE survey implemented in 2016 (of which, Chile was a part), which used the OECD/INFE 2015 Toolkit. This Toolkit differs slightly from the index used in 2012 OCDE-INFE survey and it differs substantially from the most recent Toolkit applied to the OCDE-INFE survey in 2020 (OECD, 2020), therefore it is hard to analyze the increase in financial education of a certain country over time. Chile, in particular, was only a part of the 2016 measurement. For this reason, the calibration of the counterfactuals after the Law take as a reference the dispersion in financial education between different households in Chile: $\alpha^S \times \sigma_{F.E.}$. This increase in financial education can be seen also as the Chilean households approaching the capabilities shown in the more developed OECD countries.

Table 6
Refinancing probability (in %) before and after the law - Model 2, Table 3.

	Panel A: a) Before the law; b) After the Law (lower pecuniary costs only); c) After the Law (lower pecuniary costs and lower cognitive costs of σ_{FE})								
	a) Before the law			After the law					
				b) Lower pecuniary costs			c) Plus cognitive costs (σ_{FE})		
Group	Any home	Main	Other	Any home	Main	Other	Any home	Main	Other
All households	18.0	16.6	16.9	21.1	19.4	19.3	29.2	26.8	24.6
Household Income Quintile:									
1	13.0	12.2	13.7	14.5	13.6	14.2	21.0	19.5	18.5
2	12.3	11.8	11.1	14.3	13.6	12.4	20.7	19.4	16.3
3	14.6	13.8	13.3	17.7	16.6	15.2	25.0	23.3	19.6
4	17.1	16.1	14.9	20.1	18.9	17.2	28.1	26.2	22.1
5	21.9	20.2	18.3	25.5	23.3	21.0	34.8	31.8	26.6
House value strata:									
1 (percentiles 1–50)	14.2	13.3	15.6	16.2	15.1	17.4	23.2	21.4	22.2
2 (percentiles 51–80)	16.8	16.2	16.2	20.1	19.4	18.5	28.1	26.8	23.6
3 (percentiles 81–100)	22.0	20.1	18.5	25.5	23.2	21.3	34.8	31.6	27.1

	Panel B: c. After the Law (lower pecuniary and cognitive costs); lower cognitive costs by $0.25 \times \sigma_{FE}$ (c.1), $0.50 \times \sigma_{FE}$ (c.2), $0.75 \times \sigma_{FE}$ (c.3)								
Cognitive improvement	c1) $0.25 \times \sigma_{FE}$			c2) $0.50 \times \sigma_{FE}$			c3) $0.75 \times \sigma_{FE}$		
Group	Any home	Main	Other	Any home	Main	Other	Any home	Main	Other
All households	22.9	21.1	20.5	24.9	22.9	21.8	27.0	24.8	23.2
Household Income Quintile:									
1	15.9	14.9	15.2	17.5	16.3	16.2	19.2	17.9	17.3
2	15.7	14.9	13.3	17.3	16.3	14.2	18.9	17.8	15.2
3	19.3	18.1	16.2	21.1	19.7	17.3	23.0	21.5	18.4
4	21.9	20.6	18.3	23.9	22.4	19.5	25.9	24.3	20.8
5	27.7	25.3	22.3	29.9	27.3	23.6	32.3	29.5	25.1
House value strata:									
1 (percentiles 1–50)	17.8	16.5	18.5	19.5	18.0	19.6	21.3	19.6	20.9
2 (percentiles 51–80)	21.9	21.1	19.7	23.9	22.9	20.9	25.9	24.8	22.2
3 (percentiles 81–100)	27.7	25.1	22.7	29.9	27.2	24.1	32.3	29.3	25.5

pecuniary costs, the refinancing probability increases by 2.8% for main homes and 2.4% for other properties. With lower pecuniary and cognitive costs, the refinancing probability increases by 10.2% for main homes and 7.7% for other properties.

As a robustness check, alternative scenarios with a smaller increase in financial education still implicate a strong impact of the new law on refinancing probabilities. In particular, the refinancing probability for any home would increase in 4.9%, 6.9% and 9%, respectively, with a change in financial understanding of 0.25, 0.50 and 0.75 fractions of a standard-deviation (σ_{FE}), respectively.

In summary, the cognitive cost channel could potentially be the more powerful channel of the new law, with the number of refinancings increasing by 17% for lower pecuniary costs ($\frac{21.1\%}{18\%}$) and increasing by 62% ($\frac{28.6\%}{18\%}$) with both lower pecuniary and cognitive costs.

5.2. Welfare gains

Now I apply the estimated refinancing model to obtain the expected refinancing gains for the borrowers, denoted by the present value of the refinancing (in UF) times the probability that the borrower decides to renegotiate to earn those gains[10]:

$$Refinancing - gains_i^S = E\left[Y_{i,t}PV_{i,c(i),t}|\beta, x_{i,t}^S\right], \tag{4}$$

with $Y_{i,t}$ being the refinancing decision (0 or 1) and $PV_{i,c(i),t}$ the present value of refinancing at time t for household i with mortgage obtained at time $c(i)$. I also compute the average refinancing gains in each scenario S for each group of borrowers g:

$$Refinancing - gains_g^S = \frac{1}{n_g}\sum_{i\in g}Refinancing - gains_i^S, \tag{5}$$

with n_g being the number of household borrowers in each group g. While the analysis is for the mean rather than the median or other quantiles, I provide a description of different groups across income levels and also according to the value of their homes to account for borrower heterogeneity.

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[10] This option can be justified by either a linear utility function or a linear approximation of any function with continuous derivatives. For moderate amounts of risk, the linear approximation should be reasonable.

The welfare increase implied by the law relative to before the law can be expressed as:

$$Welfare - increase - Law_g^S = Refinancing - gains_g^S - Refinancing - gains_g^{S=1}, \text{for } S \geqslant 2. \tag{6}$$

I also define the sum of the gains or welfare for a group g as $Sum - Refinancing - gains_g^S = n_g Refinancing - gains_g^S$ and $Sum - Welfare - increase - Law_g^S = n_g Welfare - increase - Law_g^S$.

The refinancing gains and welfare increase are computed for the population of all mortgage borrowers and not just for those who refinance. The reason is to consider two sources in which the law presents a welfare increase. The first welfare gain component is that each borrower i gains from an increased probability of refinancing even if the present-value of refinancing remained constant ($PV_{i,c(i),t}(E\left[Y_{i,t}|\beta, x_{i,t}^S\right] - E\left[Y_{i,t}|\beta, x_{i,t}^{S=B}\right])$). The second welfare gain component is that borrowers who refinance (i.e., $Y_{i,t} = 1$) get a higher value equal to $\frac{15.4UF}{1-\tau_i}$ (see appendix).

Table 7 summarizes the refinancing gains obtained by the mean borrowers across different demographic groups (the $Refinancing - gains_g^S$, as in Eq. (5)). The expected gains of the refinancing option for borrowers in Chile are significant, with the average borrower showing gains around 43.8 UF (around 1,845 USD)[11] before the law. The average borrower's gains increase slightly to 48.6 UF (around 2048 USD) with the lower pecuniary costs of the law and possibly to 65.2 UF (around 2,747 USD) with both lower pecuniary and cognitive costs, a value almost 50% higher than the period before the law. Even if one considers a smaller increase in the financial education or capabilities among the borrowers, we see that the value of renegotiating any home has an increase of roughly 4 UF with each 25% of σ_{FE} for the borrowers after the law. Values of the refinancing gains are substantially higher for other properties than main homes, especially among families of higher income (quintile 5), which is due to other properties representing more recent home purchases and therefore with higher mortgage amounts. It is noticeable that the value of refinancing for households for the main homes in the quintiles 1 to 4 is similar or higher than for the other properties. However, the value of refinancing other properties is very high for the richer households (i.e., the quintile 5) and it is only among that group that the value of refinancing is higher for other properties than for the main homes. Across both all homes, main homes and other properties, most of the value of refinancing is captured by the homes of higher value (strata 3, that is, the homes in the top 20 percentiles of value).

Table 8 summarizes the welfare implications of the new law in terms of the $Welfare - increase - Law_g^S$ (Eq. (6)). The welfare increase after the law relative to the period before the law is expressed both in UF for the average borrower and as a fraction of the GDP in 2017 (the most recent year of the EFH survey). Note that the welfare increase in UF is simply the difference between the expected refinancing value after the law and before the law from the Table 7. In Table 8 I focus on the welfare increase for all homes, since this is the most comprehensive value from a welfare perspective. The results show that just with lower pecuniary costs there is a gain of 4.8 UF (around 202 USD) for the average borrower, but these gains increase around 4 UF (around 169 USD) with each $0.25\sigma_{FE}$ increase in financial education up to 21.4 UF (around 902 USD) in the scenario S6. Across all scenarios, the welfare increase (in absolute terms in UF) is bigger for the households of higher income or owners of higher value homes, increasing from 1.7 UF for the lowest income (quintile 1) to 7.3 UF for the highest (quintile 5).

In terms of the welfare increase as a percentage of the GDP, Table 8 shows that just with pecuniary gains the borrowers gain 0.08% of the GDP after the new law and this value increases roughly in 0.07% of GDP with each $0.25\sigma_{FE}$ increase in financial education up to a value around 0.35% GDP in the most optimistic scenario (S6). This helps to motivate that the gains of the law are significant not just for the average borrower, but also in aggregate terms for the entire economy. Obviously, the welfare gains as a percentage of the GDP are concentrated among the households of higher income, since those households have both more mortgages and mortgages of higher value. The top income quintile of the households concentrates more than half of the total welfare increase as a share of the GDP, whatever is the scenario under consideration, receiving 0.05% of the GDP under a pecuniary cost reduction only (scenario S2) and 0.22% of the GDP under both a pecuniary and a $1\sigma_{FE}$ cognitive cost reduction (scenario S6).

5.3. Other concerns: other fees and monetary policy

Some issues left to be analyzed in terms of the law are whether there could be unintended consequences, such as lenders charging other fees to compensate losses in refinancing. Banks may be tempted to charge other fees in order to compensate for the loss of revenue from naive customers that fail to refinance optimally. However, it is not clear that lenders could do this if the mortgage market becomes more competitive as a result of the Financial Portability Law and with better informed borrowers. In other countries the mortgage contracts created by FinTechs tend to have both a much higher probability of refinancing and more convenience for borrowers (Vives, 2019), therefore new market entrants may prevent banks from arbitrarily increasing fees. Furthermore, part of the risk of the mortgages for lenders is that borrowers are highly heterogeneous about their choice to exercise the refinancing option (Deng et al., 2000), therefore if the Financial Portability Law makes consumers more predictable then this can induce a decrease in the risk for lenders. The decrease in search costs for borrowers, the increased transparency of mortgage contracts and the decrease in risk for lenders could enhance mortgage markets and induce higher amounts (Vives, 2019).

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[11] I apply the conversion of 42.13 USD per 1 UF, which was the average value between 2010 and 2019.

Table 7
Expected refinancing gains (*Refinancing − gains$_g^S$*) for the mean borrower (in UF).

	Panel A: a) Before the law; b) After the Law (lower pecuniary costs only); c) After the Law (lower pecuniary costs and lower cognitive costs of σ_{FE})								
Model 2, Table 3	a) Before the law			After the law					
				b) Lower pecuniary costs			c) Plus cognitive costs (σ_{FE})		
Group	Any home	Main	Other	Any home	Main	Other	Any home	Main	Other
All households	43.8	33.6	59.6	48.6	37.5	64.1	65.2	50.5	78.4
Household Income Quintile:									
1	16.8	15.9	18.8	18.5	17.4	20.1	26.1	24.4	26.3
2	11.3	10.7	6.9	13.3	12.6	8.2	18.7	17.6	10.4
3	16.8	15.9	15.2	19.5	18.3	17.4	26.9	24.9	22.0
4	24.1	21.8	17.7	28.1	25.3	21.5	38.4	34.4	27.1
5	78.1	57.5	80.5	85.4	63.2	85.7	113.5	84.2	104.5
House value strata:									
1 (percentiles 1–50)	18.7	17.3	21.0	21.0	19.4	23.2	29.2	26.8	28.7
2 (percentiles 51–80)	24.3	25.1	39.5	28.0	28.6	43.5	38.1	38.7	52.7
3 (percentiles 81–100)	84.3	60.4	104.2	92.2	66.3	110.6	122.5	88.3	135.6

	Panel B: c. After the Law (lower pecuniary and cognitive costs); lower cognitive costs by $0.25 \times \sigma_{FE}$ (c.1), $0.50 \times \sigma_{FE}$ (c.2), $0.75 \times \sigma_{FE}$ (c.3)								
Model 2, Table 3	After the law: Lower financial and cognitive costs								
Cognitive improvement	c1) $0.25 \times \sigma_{FE}$			c2) $0.50 \times \sigma_{FE}$			c3) $0.75 \times \sigma_{FE}$		
Group	Any home	Main	Other	Any home	Main	Other	Any home	Main	Other
All households	52.5	40.5	67.5	56.6	43.7	71.1	60.9	47.1	74.7
Household Income Quintile:									
1	20.2	19.0	21.5	22.1	20.7	23.0	24.1	22.5	24.6
2	14.5	13.7	8.6	15.8	14.9	9.2	17.2	16.2	9.8
3	21.2	19.8	18.4	23.0	21.5	19.5	24.9	23.2	20.7
4	30.5	27.4	22.8	33.0	29.6	24.2	35.7	32.0	25.6
5	92.1	68.1	90.2	99.1	73.4	94.9	106.2	78.8	99.6
House value strata:									
1 (percentiles 1–50)	22.8	21.0	24.5	24.9	22.8	25.8	27.0	24.8	27.3
2 (percentiles 51–80)	30.3	30.9	45.6	32.8	33.4	47.9	35.4	36.0	50.3
3 (percentiles 81–100)	99.4	71.5	116.6	106.9	77.0	122.8	114.6	82.6	129.2

Table 8
Welfare increase of the Law (with pecuniary plus cognitive costs reduction) relative to the period before the Law (Any home) - Model 2, Table 3.

	For the mean borrower (in UF) Welfare − increase − Law$_g^S$						For the group of borrowers (in % of GDP) Sum − Welfare − increase − Law$_g^S$				
Group/ Scenarios	S2	S3	S4	S5	S6		S2	S3	S4	S5	S6
Cognitive cost reduction:	0	$0.25\sigma_{FE}$	$0.50\sigma_{FE}$	$0.75\sigma_{FE}$	$1\sigma_{FE}$		0	$0.25\sigma_{FE}$	$0.50\sigma_{FE}$	$0.75\sigma_{FE}$	$1\sigma_{FE}$
All households	4.8	8.7	12.8	17.1	21.4		0.08	0.14	0.21	0.28	0.35
Household Income Quintile:											
1	1.7	3.4	5.3	7.3	9.3		0.00	0.00	0.01	0.01	0.01
2	2	3.2	4.5	5.9	7.4		0.00	0.01	0.01	0.01	0.02
3	2.7	4.4	6.2	8.1	10.1		0.01	0.01	0.02	0.02	0.03
4	4	6.4	8.9	11.6	14.3		0.02	0.03	0.04	0.05	0.06
5	7.3	14	21	28.1	35.4		0.05	0.09	0.13	0.17	0.22
House value strata:											
1 (percentiles 1–50)	2.3	4.1	6.2	8.3	10.5		0.01	0.02	0.03	0.05	0.06
2 (percentiles 51–80)	3.7	6	8.5	11.1	13.8		0.02	0.04	0.05	0.07	0.08
3 (percentiles 81–100)	7.9	15.1	22.6	30.3	38.2		0.04	0.07	0.11	0.14	0.18

Another aspect is that lenders receive correspondingly lower interest income when households refinance, therefore refinancing involves a transfer from lenders to borrowers. Thus, the aggregate effect of the refinancing channel on the economy depends on the relative Marginal Propensity of Consumption (MPC) by households versus bank shareholders (Amromin et al., 2020). Since bank shareholders are likely to be wealthy individuals with a low MPC, then a higher mortgage refinancing activity is likely to increase the monetary policy effect on the households' consumption and improve the central bank's ability to manage a recession. Wong (2021) estimates that the effect of monetary policy on consumption in the USA would be substantially enhanced by moving to a variable-rate mortgage structure. This can be particularly important in a zero lower bound world where central banks are trying to find additional means for expansionary policies (Rebucci et al., 2021). The pass-through of monetary policy to real mortgage interest rates is incomplete due to default or liquidity risk from household loans and also because the monetary policy rate is a short-term interest rate while mortgages have a maturity of 20 years or more (Pedersen, 2016). Nevertheless, some empirical studies in Chile estimate a pass-through coefficient of 0.25 from mon-

Table 9
Refinancing gains ($Sum - Refinancing - gains_g^S$) as a share of the GDP (in %) for a given set of mortgage interest rates for new loans (r_t) - Model 2, Table 3.

Group	Mortgage Interest Rate (in %)	Before Law S1	S2 Pecuniary cost reduction only	S3	S4	S5	S6	Optimal ADL refinancing
				After the Law				
				Pecuniary + cognitive cost reduction				
				$0.25\sigma_{FE}$	$0.50\sigma_{FE}$	$0.75\sigma_{FE}$	$1\sigma_{FE}$	
All	0.50	2.3	2.5	2.7	3.1	3.4	3.8	10.4
All	1.25	1.8	2.0	2.2	2.4	2.7	3.0	6.1
All	2.50	1.1	1.2	1.4	1.6	1.7	1.9	2.4
All	3.50	0.7	0.8	0.9	1.0	1.1	1.2	2.0
Young	0.50	0.4	0.4	0.5	0.5	0.6	0.6	1.9
Young	1.25	0.3	0.3	0.4	0.4	0.5	0.5	1.0
Young	2.50	0.2	0.2	0.2	0.2	0.3	0.3	0.3
Young	3.50	0.1	0.1	0.1	0.1	0.1	0.2	0.2
Middle	0.5	1.7	1.8	2.0	2.2	2.5	2.8	6.9
Middle	1.25	1.3	1.5	1.6	1.8	2.0	2.2	4.4
Middle	2.50	0.9	0.9	1.1	1.2	1.3	1.5	1.8
Middle	3.50	0.6	0.6	0.7	0.8	0.9	1.0	1.6
Old	0.50	0.2	0.2	0.3	0.3	0.3	0.4	1.6
Old	1.25	0.2	0.2	0.2	0.2	0.3	0.3	0.7
Old	2.50	0.1	0.1	0.1	0.1	0.2	0.2	0.3
Old	3.50	0.1	0.1	0.1	0.1	0.1	0.1	0.3

All indicates all the households with mortgages. Young indicates households with heads aged 18 to 34 years. Middle indicates households with heads aged 35 to 64 years. Old indicates households with heads aged 65 and above.

etary policy to household mortgages (Pedersen, 2016). In Chile the mortgage real interest rate for new loans has moved from 3.48% in December of 2017 to 1.99% in October of 2019, before increasing again to values between 2.30% and 2.90% during the global pandemic[12]. Therefore it is interesting to evaluate how much consumers could have obtained from mortgage refinancing according to different interest rates in the business cycle if the new law was implemented.

In Table 9 I apply the same benchmark model of the previous section (Model 2, Table 3) to obtain the value of the refinancing gains (that is, $Sum - Refinancing - gains_g^S$) as a percentage of the GDP in 2017 (the most recent year of the EFH survey) for different values of an aggregate interest rate r_t (which differs from the individual interest rate $r_{c(i)}$ each borrower obtained for its mortgage in the past) and for the different scenarios before (S1) and after the law (S2). The values for the mortgage interest rate go from 3.50% (the value observed in December of 2017) to 2.50% (a value frequently observed between July of 2019 until April of 2021) and even lower values such as 1.25% and 0.50%, which could potentially be observed in some future in which Chile hits the zero lower bound (Rebucci et al., 2021)[13]. Table 9 also shows how the refinancing gains are distributed among young (aged 34 and below), middle (aged 35 to 64) and old households (aged 65 and above). While it is difficult to evaluate the precise impact of the refinancing gains on consumption, since the MPC can be influenced by household's age or wealth and can also differ if the economy is in a recession or not, some studies show that these refinancing gains can be used by households to boost their consumption, especially for hand-to-mouth households (Wong, 2021). Since the households' MPC must be by definition below 1, then the values in Table 9 can be seen as an upper bound for the effect of a given mortgage interest rate for the households' consumption.

Table 9 shows that the Financial Portability Law may significantly increase the resources available for households under a monetary policy expansion. For instance, before the law (S1) the refinancing gains for households would go from 0.7% to 2.3% of the GDP if the interest rate would move from 3.50% to 0.50%. For a 3.50% mortgage interest rate, the value of the refinancing gains would increase by 0.1% of the GDP even with a pecuniary cost reduction only and further increase by 0.1% of the GDP for each $0.25\sigma_{FE}$ increase in financial education. In the most optimistic scenario after the law (S6) there would be 1.2% of the GDP available to households for spending, significantly more than the 0.7% of GDP before the law. There is a similar pattern for other interest rate levels. Households would obtain 1.1% and 1.8% of GDP in refinancing gains before the law for a mortgage interest rate of 2.50% and 1.25%, respectively, but such gains would be boosted by an additional 0.2% to 0.3% of GDP with each $0.25\sigma_{FE}$ increase in financial education. The gains of the new law could be even higher under an hypothetical case of a low real mortgage rate such as 0.50%. The gains in such a case could increase from 2.3% before the law up to 3.8% of the GDP after the law if there was a reduction in cognitive costs of $1\sigma_{FE}$. Besides the scenarios S1 to S6, the Table 9 also shows the refinancing gains available to consumers after the Law if each agent behaved in a rational way and without frictions as in the ADL model (Agarwal et al., 2013), which is described in the appendix. The optimal ADL refinancing households would be able to obtain 2% of the GDP for an interest rate of 3.50% for the new mortgage loans. The refinancing gains of the optimal ADL borrowers could further increase to 6.1% and even 10.4% of the GDP for a mortgage interest rate of 1.25% and 0.50%, respectively. This shows that the gains to be obtained from better educated borrowers or "smarter" refinancing contracts

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[12] This information is available from time series in the Central Bank of Chile's website.

[13] It is worth noting, however, that the lowest historical value for the real mortgage interest rate in Chile is 1.99%, therefore such low values for the mortgage interest rate are a counterfactual possibility only.

in Chile could be substantial. Separating the refinancing gains effect across different age levels, I find there is a higher impact on the middle aged households which have the mortgages of highest value, while the old households are little impacted by the law, since their mortgages are close to being fully paid.

6. Conclusions

Most borrowers across several countries fail to take advantage of mortgage refinancing opportunities, foregoing substantial wealth (Keys et al., 2016,Gomes et al., 2021). Financial Portability Laws are a recent regulatory attempt to ease the mortgage refinancing process and allow households to take better advantage of such gains. Chile just implemented such a law in 2020, following the legislatory experience of other countries, such as Mexico, France, Spain and Italy, in recent years. This law aims to reduce both the fixed pecuniary costs of refinancing, but also to standardize the fees and costs for easier understanding of the borrowers and to reduce the number of procedures and the time processing required. This article estimates an empirical model of the refinancing decision from Chilean survey data and then uses it to calibrate the impact of the new Financial Portability Law.

Mortgage refinancing is positively associated with financial education, liquidity needs, the number of past months in which a positive refinancing opportunity was observed, plus a quadratic function of the present value of refinancing. I also find a positive interaction effect between financial education and either the present value of refinancing or the number of past months with a positive refinancing opportunity. Furthermore, I show that aggregate credit demand factors drive up the mortgage refinancing, which confirms refinancing as a source of liquidity.

A counterfactual exercise shows the refinancing probability and welfare gains for the scenarios in which the law simply reduces the pecuniary costs of refinancing and also for a reduction in both the pecuniary and cognitive costs of the process. Accounting just for the reduction in pecuniary costs, the households' refinancing probability increases from 18% before the law to 21.1% after the law, with a welfare increase of 202 USD per borrower. However, accounting for both a reduction in pecuniary and cognitive costs could increase the refinancing probability to 29.2% and a welfare increase of 902 USD. The increase in the refinancing probability happens across all income levels, but the welfare gains in absolute terms are concentrated on the owners of higher priced homes which have larger debts. High income borrowers with second properties receive large benefits from this law, which is an important result due to the increasing share of such households with second properties as investment vehicles in Chile and other countries in recent years (Bhutta, 2015). The higher refinancing probability and welfare increase from the lower cognitive costs of the law implies that borrower behavior is important, so that households take advantage of the monetary gains available to them instead of foregoing financial gains due to inaction (Keys et al., 2016).

One important aspect of mortgage modification is that it represents an additional liquidity tool for distressed borrowers and may help them prevent default (Agarwal and Zhang, 2018) and the large costs of foreclosures (Das and Meadows, 2013). Easing the process of mortgage refinancing could therefore improve financial stability by lowering default and bankruptcy risks (Das and Meadows, 2013,Agarwal and Zhang, 2018) and also improve the efficiency of monetary policy through its transmission channel to consumption (Gomes et al., 2021,Wong, 2021). The refinancing choice model estimated in this article implies that after the Financial Portability Law households should get substantially more gains during periods of lower mortgage interest rates, therefore increasing the potential of monetary policy to impact consumption in Chile.

Finally, the goal of reducing the complexity of household financial contracts (Woodward and Hall, 2012,Campbell, 2013, Gomes et al., 2021) and increasing competition for credit markets (Degryse et al., 2019) has received more attention from policy makers in recent years. Therefore a standardization of financial contracts' fees and costs can be important to improve welfare, especially for groups with fewer product options and lower financial education (Gomes et al., 2021).

CRediT authorship contribution statement

Carlos Madeira: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - original draft, Writing - review & editing, Visualization, Supervision, Project administration, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Calibrating the Present Value and the required interest rate fall of an unconstrained rational agent (Agarwal et al., 2013)

Agarwal et al. (2013) use a real-option model to derive a closed formula for the interest rate value at which a household should refinance its mortgage and also for the present value of the gains of refinancing. This formula considers that refinanc-

ing a mortgage is a real-option that a rational borrower unconstrained by credit frictions can exercise before the end of the credit.

For the case of Chile with Fixed-Rate Mortgages in real monetary units, the same formulas of Agarwal et al. (2013) apply with a zero inflation rate to account that the value of the mortgage does not change with inflation. In the case of our sample of households, the value of renegotiating depends on factors such as the current mortgage interest rate at time t, the marginal tax rate of household i, plus the interest rate and mortgage value of their mortgage contracted at time $c(i)$. Let r_t denote the mortgage interest rate currently observed at time t, while $r_{c(i)}$ represents the mortgage interest rate made by household i at time $c(i)$ (with $c(i)$ in the past, $c(i) < t$).

Agarwal et al. (2012) show that an agent with no liquidity frictions should refinance when the current interest rate falls by an amount of $ADL_{i,c(i),t}$ or more relative to the contractual rate:

$$ADL_{i,c(i),t} = \frac{1}{\psi_{c(i),t}}\left[\phi_{i,c(i),t} + W(-e^{-\phi_{i,c(i),t}})\right], \tag{A.1}$$

where $W(.)$, is the Lambert W-function, $\psi_{c(i),t} = \frac{\sqrt{2(\rho+\lambda_{c(i),t})}}{\sigma}$ and $\phi_{i,c(i),t} = 1 + \psi_{c(i),t}(\rho+\lambda_{c(i),t})\frac{\kappa_{i,c(i),t}}{M_{c(i)}(1-\tau_i)}$. Table A.1 summarizes all the parameters required for the ADL formula. $\lambda_{c(i),t}$, the expected real repayment rate of the mortgage, is calibrated as $\lambda_{c(i),t} = \mu + \frac{r_{c(i)}}{e^{r_{c(i)}\Gamma_{c(i),t}}-1} + \pi$, where $\mu = 0.05$ is the probability of a household moving to another home in each year and $\Gamma_{c(i),t}$ is the remaining maturity (in years) at time t of the mortgage contract of household i.

ρ is the agent's real discount rate and it is calibrated as 0.05 (as in Agarwal et al., 2013 and in several papers of the macroeconomics literature), τ_i is the marginal tax rate faced by the main head member of the household i[14], $M_{c(i)}$ is the total debt of the mortgage contract $c(i)$ of household i, and σ represents the annual standard-deviation of the mortgage real interest rate and it is calibrated as 61 basis points, i.e. 0.0061[15]. The standard-deviation σ is smaller than for the US, because in Chile all mortgage contracts are defined in real monetary unit value (UF). The mortgage interest rate in Chile is a fixed real interest rate contract and not a fixed nominal rate as in the US, therefore it is not affected by inflation volatility. The fixed real interest rate contracts implemented in Chile are a good intermediate combination between the trade-off implied by the income risk (given by the volatility of the nominal payments) in Adjustable Rate Mortgages (ARMs) versus the wealth risk (given by inflation volatility) in Fixed Rate Mortgages (FRMs), as suggested in Campbell (2013).

$\kappa_{i,c(i),t}$ represents the present value for household i at time t of the total refinancing costs of the mortgage $c(i)$ net of the future tax benefits, with

$$\kappa_{i,c(i),t} = F_t + fM_{c(i)}\left[1 - \frac{\tau_i}{\theta+\rho+\pi}\left[\left(\frac{1-e^{-(\theta+\rho+\pi)N}}{N}\right)(\frac{\rho+\pi}{\theta+\rho+\pi}) + \theta\right]\right], \tag{A.2}$$

where $N = 20$ is the maturity (in years) of a new mortgage contract after refinancing (according to the EFH survey more than 46% of the mortgages in Chile have a maturity of 20 years), $f = 0.01$ is a variable cost of refinancing proportional to the loan value (which in Chile is around 1%, similar to the US, Agarwal et al., 2013), and $\theta = 0.01 + \mu$ is an exogenous probability of refinancing due to a decision of moving to another house, death of a relative or an unexpected liquidity demand. In both expressions $\pi = 0$ because in Chile the contracts are in real terms and therefore the future payments do not fall in real value. Finally, F_t is the fixed cost of refinancing a mortgage and this is the parameter targeted by the new Financial Portability Law. Therefore I calibrate $F_t = F^{S=1} = 24.1$ UF (around 1015 USD) before the Financial Portability Law ($t < July$ 2020) and $F_t = F^{S=2} = 8.7$ UF (around 365 USD) after the Financial Portability Law ($t \geqslant July$ 2020), which are the pecuniary costs targeted by the legislatory change. The superscript S in F^S denotes the time before the law ($S = 1$) and after the law ($S = 2$).

One can also use a second-order Taylor approximation to the Agarwal et al. (2013) formula: $ADL_{i,c(i),t} \approx \sqrt{\frac{\sigma}{1-\tau_i}\frac{\kappa_{i,c(i),t}}{M_{c(i)}}}\sqrt{2(\rho+\lambda_{c(i),t})}$. I apply the full optimal rule in this article, although the results are not much affected by either option.

After calibrating the above parameters, I obtain the value for the number of months in which the borrower could have refinanced its mortgage at a new interest rate (r_t) that is lower than the contractual interest rate ($r_{c(i)}$) by an amount $ADL_{i,c(i),t}$:

$$\text{Months for refinancing}_{i,c(i),t} = \sum_{j=c(i)}^{t} 1(r_j + ADL_{i,c(i),j} < r_{c(i)}). \tag{A.3}$$

I also obtain the Present value of refinancing ($PV_{i,c(i),t}$) as the difference between the new and the previous interest rate payments ($(r_{c(i)} - r_t)M_{c(i)}$) discounted over the life of the mortgage ($\rho + \lambda_{c(i),t}$) minus the net refinancing costs ($\frac{\kappa_{i,c(i),t}}{1-\tau_i}$):

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[14] The marginal personal income tax in Chile is 0% for an annual income between 0 and 8,038,926 pesos, 4% from 8,038,926 to 17,864,280 pesos, 8% from 17,864,280 to 29,773,800 pesos, 13.5% from 29,773,800 to 41,683,320 pesos, 23% from 41,683,320 to 53,592,840 pesos, 30.4% from 53,592,840 to 71,457,120 pesos, 35% above 71,457,120 pesos.

[15] The standard deviation for the monthly differences of the average mortgage interest rate between January of 2003 and January of 2020 is 0.0017624, which gives under a Brownian motion assumption $\sigma = .0017624\sqrt{12} = 0.0061$.

Table A.1
Parameters of the Agarwal, Driscoll and Laibson (2013) refinancing model.

Output variables	
$ADL_{i,c(i),t}$	Minimum value for which the current interest rate must fall relative to the contractual mortgage rate
$PV_{i,c(i),t}$	Present value of refinancing for borrower i with contract $c(i)$ in period t
Months for refinancing$_{i,c(i),t}$	Number of months until t in which the borrower could have refinanced
Input parameters	
r_t	Current interest rate
$r_{c(i)}$	Contractual interest rate (fixed) of the mortgage of borrower i
$N = 20$	Maturity (in years) of a new mortgage contract after refinancing
$M_{c(i)}$	Total (nominal) debt of the mortgage contract $c(i)$ of household i
$\Gamma_{c(i),t} \leqslant 20$	Remaining maturity (in years) at time t of the mortgage contract $c(i)$
τ_i	Marginal tax rate faced by the household i
π	Inflation rate that affects mortgage value, $\pi = 0$ (for real contracts)
ρ	Real discount rate, $\rho = 0.05$
σ	Annual standard-deviation of the mortgage real interest rate
$\mu = 0.05$	Exogenous annual probability of a household moving to another home
$\theta = 0.01 + \mu$	Exogenous annual probability of refinancing
$\lambda_{c(i),t} = \mu + \frac{r_{c(i)}}{e^{r_{c(i)}\Gamma_{c(i),t}} - 1} + \pi$ Expected annual real repayment rate of the mortgage	
$f = 0.01$	Variable cost of refinancing proportional to the loan value
$F^{S=1} = 24.1UF$	Fixed cost of refinancing before the Portability Law
$F^{S=2} = 8.7UF$	Fixed cost of refinancing after the Portability Law

Table A.2
Gains of the law for the borrowers who refinance, according to their tax bracket.

Marginal tax rate (in %)	Fraction of the population of mortgage borrowers (in %)	Gains of the law for the refinancing borrowers (in UF) $PV^{After-the-Law}_{i,c(i),t}(F^{S=2}) - PV^{Before-the-Law}_{i,c(i),t}(F^{S=1})$
0	36.3	15.4
4.0	32.3	16.0
8.0	14.4	16.7
13.5	8.1	17.8
23.0	3.9	20.0
30.4	2.4	22.1
35.0	2.6	23.7
All the households	100	16.6

Sample size: a total of 6,088 households from the EFH survey (2007 to 2017 waves).

$$\text{Present Value of refinancing}_{i,c(i),t} = PV_{i,c(i),t} = \max_{c(i),...,t} \frac{(r_{c(i)} - r_t)M_{c(i)}}{\rho + \lambda_{c(i),t}} - \frac{\kappa_{i,c(i),t}}{1 - \tau_i}. \tag{A.4}$$

Note that by ignoring the probability of refinancing (say, a borrower that would refinance in any case), then the difference in the present value of the refinancing gains before and after the law is given by the difference in fixed-costs of the new law divided by the post-tax margin $(1 - \tau_i)$:

$$PV^{After-the-Law}_{i,c(i),t}(F^{S=2}) - PV^{Before-the-Law}_{i,c(i),t}(F^{S=1}) = -\frac{F^{S=2}_t - F^{S=1}_t}{1 - \tau_i} = \frac{15.4UF}{1 - \tau_i}. \tag{A.5}$$

This simple result is obtained, because for a given borrower i all the other parameters apart from F_t in the expression for the present value of refinancing ($PV_{i,c(i),t}$) in equation A.4) remain the same before and after the legislation. In Chile the marginal tax rate varies between 0% (for tax-payers with less than 8 million pesos of annual income, which is roughly 11,150 USD) and 35% (for tax-payers with over 71.5 million pesos of annual income, which is roughly 99,110 USD). According to Table A.2 around 36.3% of all mortgage borrowers pay a tax rate of 0%, while 32.3% pay a tax rate of 4% and less than one third of the mortgage borrowers pay marginal tax rates of 8% or higher. The gains of the law for a refinancing borrower change from 15.4 UF to 23.7 UF as the marginal tax rate increases from 0% to 35%. Therefore in absolute value the legislation's gains are bigger for higher income households which are subject to higher tax rates.

Appendix B. Supplementary material

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.jimonfin.2021.102455.

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