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Abstract

Iceland experienced a financial crisis in 2008–2009 when its banking system collapsed, the currency lost half its value, most businesses became technically insolvent, house prices fell, and household debt increased due to indexation to foreign currencies or the price level. This paper tells the story of the crisis and maps the losses to households using a dataset from tax returns that includes all taxpayers in the country and contains the value of housing, mortgage debt, disposable income, and net worth. For relative losses in net worth, the results show that families with children, especially those with parents aged between 24 and 45 years, suffered the largest proportional losses in net worth. The losses were also greater in urban areas. The fall in net worth, measured in local currency, correlated with income and education level as well as the number of children and the urban area. Real disposable income fell by one third or more for a large fraction of the population, causing a further increase in the burden of debt, which increased most for the high-income groups before falling due to rising income and mortgage relief. Urban areas, where banks are located, experienced a boom-bust cycle, while the rural areas experienced this cycle to a much lesser extent. We find that net worth took many years to recover but that by 2019, net worth had recovered for all age groups.

JEL classifications: E6, G5

Keywords: Iceland, financial crisis, tax returns, household net worth, distribution of losses

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1. Introduction

The financial crisis of 2008–2009 had a severe impact on households in Iceland. This paper endeavors to determine which groups were hit hardest and how different groups recovered during the postcrisis period. We use a database containing the income tax returns of all taxpayers in the country from 2003 to 2019, both to provide a graphical illustration of the effect on different household types and to conduct econometric analysis to explore further the losses experienced by different groups during the crisis.

We are not the first to explore the effect of Iceland's financial crisis on household finances.[1] However, our data go further back, they include all households in the country, and they include data up to 2019. This enables us to map changes in wealth, debt, net worth, and debt burden (defined as the ratio of debt to disposable income) during the run-up to the 2008 collapse, its immediate aftermath, and the years that followed.

The paper begins with a discussion of how the financial crisis started, followed by a section describing the many forms of mortgage relief introduced by the government. Section 4 describes the data, and Section 5 conducts graphical analysis for different groups. Panel data analysis is then used in Section 6 to determine the effects the crisis had on different types of households. Section 7 summarizes the results and provides conclusions.

2. The rise and fall of the bubble economy

The prelude to the crisis started with the privatization of Iceland's banking system in 2003 in an era of low interest rates and low risk premia in international capital markets. This allowed the new owners of the banks to borrow from foreign banks, both to finance foreign investments (their own or those of related parties) and to expand credit domestically.

What set Iceland apart from some of the other crisis countries in 2008 was the expansion of the banks' balance sheets. By the time of the collapse, Iceland's banking sector was larger, in terms of income, than the fishing and agricultural sectors combined. From 2004 to 2008, average annual asset growth for the country's three largest banks—Glitnir, Kaupthing, and Landsbanki—ranged between 50% and 61%. The banking system's asset-to-GDP ratio quintupled in less than five years, rising from 1.74 to 8.64 between year-end 2003 and August 2008. Real house prices doubled between 2003 and 2008, and share prices increased by a factor of 10 due to the rapid expansion of credit.

[1] Olafsson and Vignisdottir (2012) find that most of the households that had negative net worth after the crisis were already in trouble before the crisis. They find that indebted families with children and foreign-denominated debt (FX borrowers) were more likely to experience financial distress than childless families with debt denominated in domestic currency. Young individuals and couples with children who had bought their first property in 2007 and early 2008 were especially vulnerable. At the end of 2010, approximately half of households in financial distress were from age groups within the 30–49 range.

Early in 2006, Icelandic banks' access to the European securities market grew tighter because of credit rating downgrades, pushing funding costs higher. In 2007, Edge and Icesave, foreign retail deposit accounts offered by Kaupthing and Landsbanki, respectively, were critical sources of funding when borrowing from foreign banks became more difficult (Benediktsdottir, Danielsson, and Zoega 2011). But in 2008, access to foreign capital dried up completely and the banking system was, to put it mildly, in trouble. In 2008, shortly before the fall of the banks, net national foreign debt totaled 356% of GDP, up from 62.6% of GDP in 2003, and the banks were unable to roll over their debt. This triggered a sudden stop of capital inflows, the fatal blow coming with the fall of Lehman Brothers on September 15. Between Monday, October 6, and Wednesday, October 8, 2008, the Icelandic banks collapsed, followed by a 75% decline in the lead stock market index. House prices declined, the currency lost half its value, output started to contract, and unemployment rose rapidly in the months thereafter (Halldorsson and Zoega 2010).

At the end of 2007, households were heavily leveraged, with debt averaging 225% of their disposable income and 100% of GDP, according to the Central Bank of Iceland (CBI). Approximately 80% of household debt was indexed to the consumer price index (CPI). This debt soared during the crisis due to the surging price level, leaving these households more indebted than before. Inflation measured 5.9% at the end of 2007 but had risen to 18.1% by the end of 2008—its highest rate since 1989, when it measured 25.2%. In 2009, inflation was 7.5% (Statistics Iceland n.d.1). Even more vulnerable were the 13% of households that had foreign-denominated debt (FX borrowers). The Icelandic krona depreciated by 48% from 2007 to 2009, severely affecting these FX borrowers by increasing their outstanding mortgage balances in local currency terms.

The CBI was unable to act as a lender of last resort for the Icelandic banks in 2008 because the banking sector was operating mostly in foreign currencies. Earlier, it had attracted capital inflows in the form of carry trade through high policy rates, which also created an incentive for domestic firms and households to borrow in foreign currencies. The combination of these dynamics created financial fragilities when the carry trade unwound in 2008, making the currency depreciate (Benediktsdottir, Danielsson, and Zoega 2011). When push came to shove, the CBI tried to help the domestic banks with domestic currency liquidity by accepting collateral that later proved worthless—bonds issued by other banks—and depleting its foreign reserves in the attempt to rescue them (Benediktsdottir, Danielsson, and Zoega 2011). These efforts were in vain. When it came to the solvency of the banks, any government assurances given to the banking sector would have been meaningless because the government was not financially strong enough to back up the oversized banking system. The banking sector had simply grown too fast, mushrooming from a medium-sized system in 2003 to one proportionally larger than Switzerland's by 2007 (Benediktsdottir, Eggertsson, and Þorarinsson 2019; Thomsen 2018).

Lane and Milesi-Ferretti (2011) find that growth during the crisis was lower in countries with higher income per capita, high precrisis credit growth, and current account deficits, all characteristics of Iceland's precrisis economy. They made a list of countries with the five worst performances in six categories during the financial crisis from 2008–2009—GDP growth, total demand growth, private consumption growth, investment growth, export growth, and import growth. Iceland was one of the few developed countries to appear on this list, and it did so for multiple reasons: total aggregate demand fell by

14.6% private consumption decreased by 11.3%; investment declined by 37.1%; and because the krona depreciated significantly in this period, it comes as no surprise that imports fell by 21.2%—a direct consequence of the collapse of the banking sector. The only other countries to share as many reasons for being on the list were Estonia and Latvia. Other developed countries found on the list were Lithuania, Malta, Italy, and Japan, the latter two because of a fall in export growth and not due to domestic reasons.

The government received assistance from the International Monetary Fund (IMF) in 2008. In order to prevent large changes in the currency exchange rate, the IMF program involved high interest rates, capital controls, and the use of foreign reserves (Halldorsson and Zoega 2010). The program featured contractionary monetary policy and the imposition of capital controls to stabilize the exchange rate, allowing the automatic stabilizers of fiscal policy to increase domestic demand and setting out a plan for debt restructuring and the reorganization of the banking system. An important objective of the restructuring was to shield the public sector from taking on the banks' losses, making the intervention a bail-in instead of bailout. The government took ownership of the program and opted for a combination of changes in taxes and expenditures that protected the most vulnerable households (Ólafsson et al. 2019). The program was a resounding success, underpinning the recovery that started in the summer of 2010 (Thomsen 2018).

3. Mortgage relief

After the banking sector collapsed in October 2008, many households faced severe financial difficulties. The economic plan aimed to redistribute income across income groups so that lower-earning households would be protected, and the government created numerous schemes for this purpose. These included increased mortgage interest subsidies, increased child support tax relief, and temporary suspension of the CPI indexation of mortgage loans. The rescheduling of mortgage repayments was made possible, and households could apply for a temporary freeze on repayments. More direct measures that were introduced thereafter reduced outstanding mortgage balances for those facing the greatest difficulties. One measure cut the value of mortgages to 110% of the value of the underlying property, a ratio that was lowered to 70% for the lowest-earning households. In 2014, the government took action to correct for the effect of inflation on outstanding local currency balances of CPI-indexed mortgages. This inflationary effect was measured as the deviation of inflation from the target in 2008 and 2009. The government's policy action took two forms. The first was a direct mortgage relief option that reduced the borrower's outstanding mortgage. If the mortgage was no longer outstanding, the taxpayer was instead provided a tax credit toward future tax payments. The mortgage relief applied only to borrowers who had an indexed mortgage on an owner-occupied residential property during 2008 to 2009. This measure benefited approximately 90,000 households, far more than any other form of mortgage relief provided during the crisis.[2] The direct relief was capped at approximately $300,000 per household. The reduction in outstanding mortgage loan balances was made in three parts between 2014 and 2016 and financed by levying a special tax on the banks' new owners, particularly to include foreign "vulture" funds.

[2] If a household had received assistance from the government through other programs, this assistance was deducted from the total sum the household was eligible to receive.

The second policy action was an authorization to apply (tax-free) private pension savings (third-pillar pension savings) to reduce an outstanding mortgage balance on any mortgage held during the crisis period, 2008–2009. This authorization did not require a specific type of mortgage and was available to all borrowers with private pension accounts. Homeowners who held non-indexed loans, and thus did not receive the direct government write-down of their mortgages, could use tax-free pension funds to reduce their outstanding principal. Also, first-time homebuyers and nonowners could use tax-free pension funds for current or future home purchases. This government scheme was originally expected to remain in effect from July 1, 2014, through June 30, 2017, but it was subsequently extended through June 30, 2021, and was then extended further.

The government's mortgage relief of 2014 was triggered by an earlier decision by the courts. In 2010, the Supreme Court of Iceland[3] ruled retroactively that loans denominated in the domestic currency but indexed to the exchange rate were illegal. The confusion was caused by unclear legislation passed in 2001 with the intention of aligning Icelandic law with European Union legislation. In effect, under the laws passed in 2001, it became legal to borrow in foreign currencies but not to take local currency loans indexed to the exchange rate. In the years that followed, until the crash in 2008, however, most household loans were of the latter type. When, in 2010, these loans were adjudged illegal, the decision provided a windfall for households that had taken on debt indexed to the exchange rate. In effect, this rewarded risk taking and called for a similar adjustment of CPI-indexed loans that were less risky.

4. Description of the data

The dataset is from Statistics Iceland and includes income tax returns dating back to tax year 1981. The most recent tax return data are from tax year 2019. This dataset was originally collected by Iceland Revenue and Customs and then submitted to Statistics Iceland.[4] We also have information on taxpayers' education. In addition to data on income,[5] wealth, and debt, the tax returns contain information on taxpayers' gender, age, domicile, and number of children. From 1996 to 2019, we also have information on the sector in which taxpayers were employed. It is possible to determine when individuals bought their first home.[6] Throughout this paper, all figures are expressed in the average price level of 2019 when relevant.

The dataset contains information on taxpayers' debt, assets, and disposable income, making it possible to calculate net worth. It also itemizes debt and assets, making it possible to see how much individuals owned (real estate, stocks, savings accounts, etc.) and how much they owed (e.g., mortgages and student loans). Because stocks and bonds are expressed in nominal value rather than market value, this complicates the interpretation of losses with these variables. The problem applies primarily to the interpretation of changes in net worth for wealthier segments of the population, which owned most of the financial assets. Real estate values are taken from Registers Iceland's

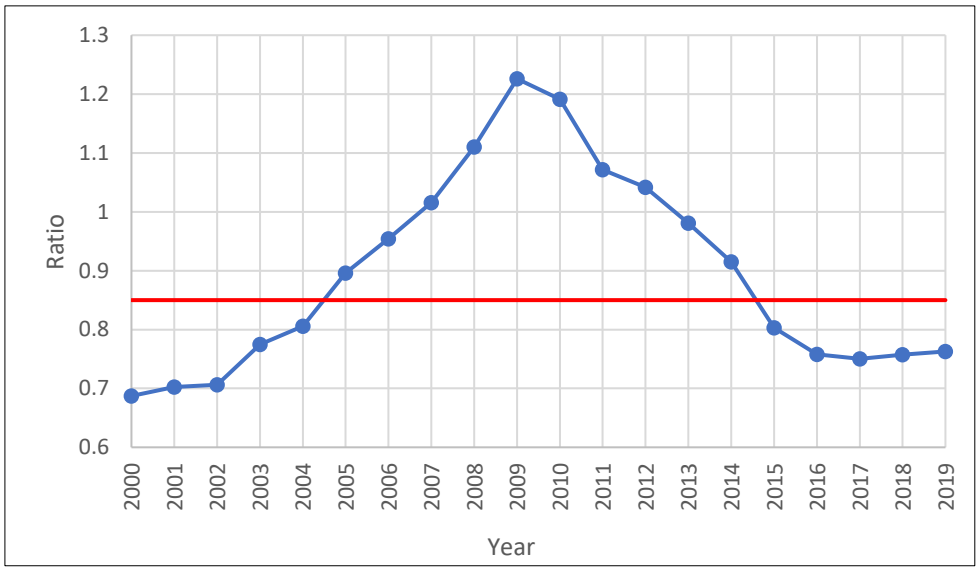
[3] Supreme Court of Iceland ruling No. 471/2010.
[4] The data are encrypted to ensure anonymity.
[5] Throughout this paper, disposable income includes capital income unless stated otherwise.
[6] If a taxpayer did not report real estate in their tax return the year before but did so in the present year, then it is assumed that the first property was bought in the present year.

real estate valuation, which follows market prices.[7] All calculations involving debt and jointly taxed individuals are expressed as the average debt for each couple.

5. Evolution of net worth and the burden of debt for different subgroups

Figure 1 shows household debt relative to GDP from 2000 to 2019, which shows the extent of domestic credit expansion before the crisis struck in 2008. The red horizontal line shows the threshold found by Cecchetti, Mohanty, and Zampolli (2011) to have an adverse effect on growth. From 2005 to 2014, the ratio exceeded the 85% threshold. From 2007 to 2013, it was over 100%. In recent years, this ratio has been much lower, and below the threshold, due to mortgage relief and increased household saving.

Figure 1: Households' Debt-to-GDP Ratio



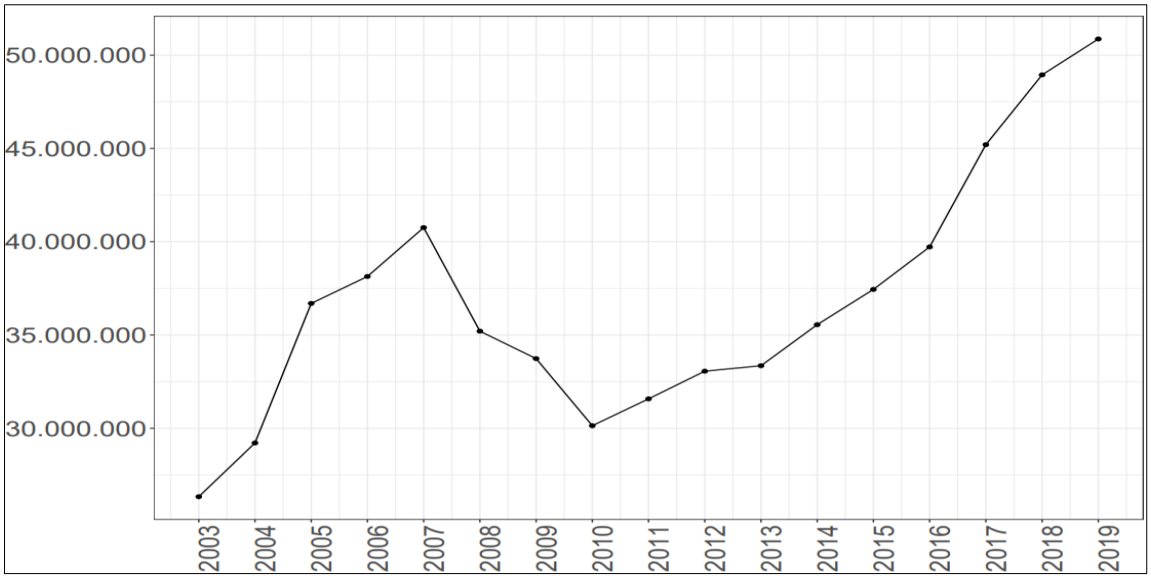
Sources: Statistics Iceland n.d.1; Statistics Iceland n.d.2.

In 2002, debt equaled 70% of Iceland's annual GDP. It rose above 85% by 2005 and continued to increase, peaking at more than 120% of GDP in 2009. Due to a combination of mortgage relief and increased saving, and helped by the economic recovery, the ratio then declined in the years following the crisis, reaching 75% of GDP by 2016.

Figure 2 depicts the evolution of house prices (in local currency) from the time the banks were privatized in 2003 until 2019. Prices rose until 2007 and then fell abruptly with the collapse of the banks, bottoming out in 2010. There followed a gradual recovery until 2016, when a rapid increase in the number of tourists pushed real house prices above their 2007 peak. This was caused by the sudden increase in the supply of Airbnb housing, which reduced the supply of apartments in the local rental market.

[7] Registers Iceland's real estate valuation is measured in February of the prior year.

Figure 2: Average Real Estate Prices, in Local Currency, Constant 2019 prices



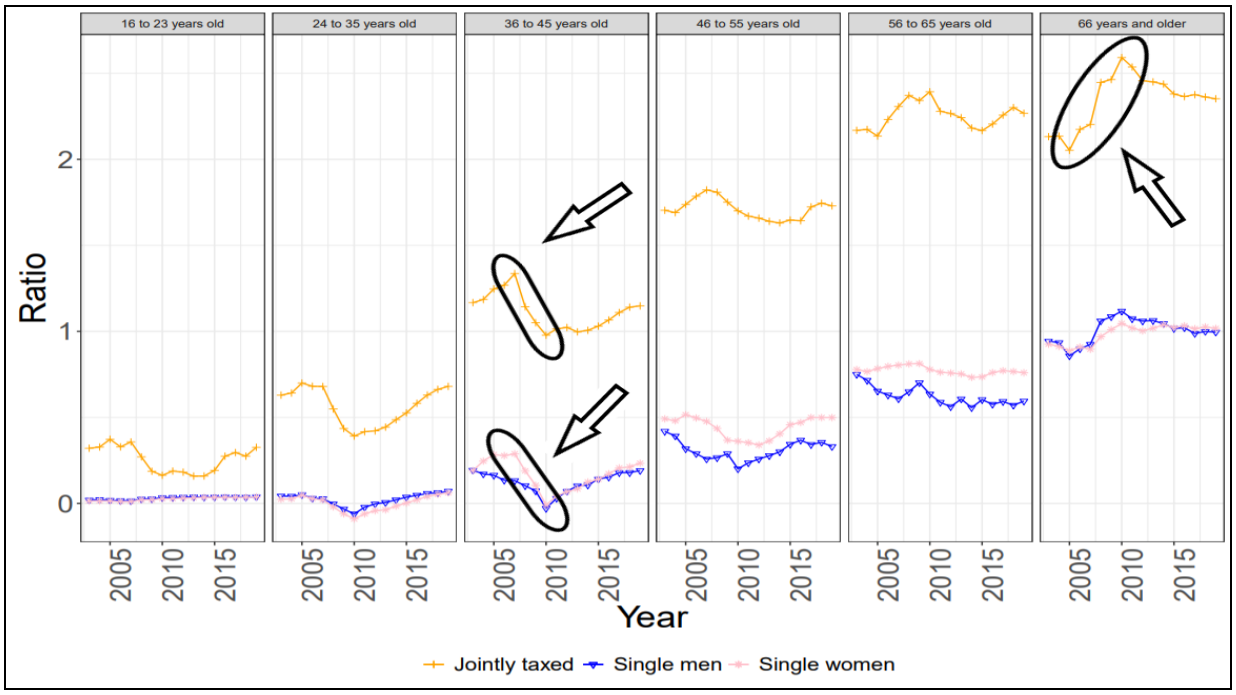
Source: Registers Iceland n.d.

We turn now to how the losses that occurred in the financial crisis affected households. The losses stemmed from several causes: house prices fell, equity securities became worthless, and outstanding mortgage balances soared in local currency terms because of indexation or foreign currency denomination. Although the market value of shares is not reported in the tax data for a given year, we can discern when shares became worthless because they then disappeared from the tax returns. Most households also suffered a reduction in disposable income.

Figure 3 shows how different groups' ratios of net worth to the mean for the country (measured as average net worth for all taxpayers aged 20–70 who had positive wage income) evolved between 2003 and 2019. The groups are defined by age and marital status. The jointly taxed include married couples and couples who have a child or children together.[8] For jointly taxed individuals, net worth is divided by two and is therefore comparable to that for single individuals. It is quite clear that for all age groups, the jointly taxed have much higher net worth than single people do, and the gap between the two groups widens with age.

[8] Couples who share a permanent address can apply to be registered as cohabitating and thus become jointly taxed. Some individuals who are married or in a civil partnership choose not to be jointly taxed with their partners, but this is rare.

Figure 3: Average Net Worth, by Marital Status, Relative to the Average Net Worth of All Taxpayers

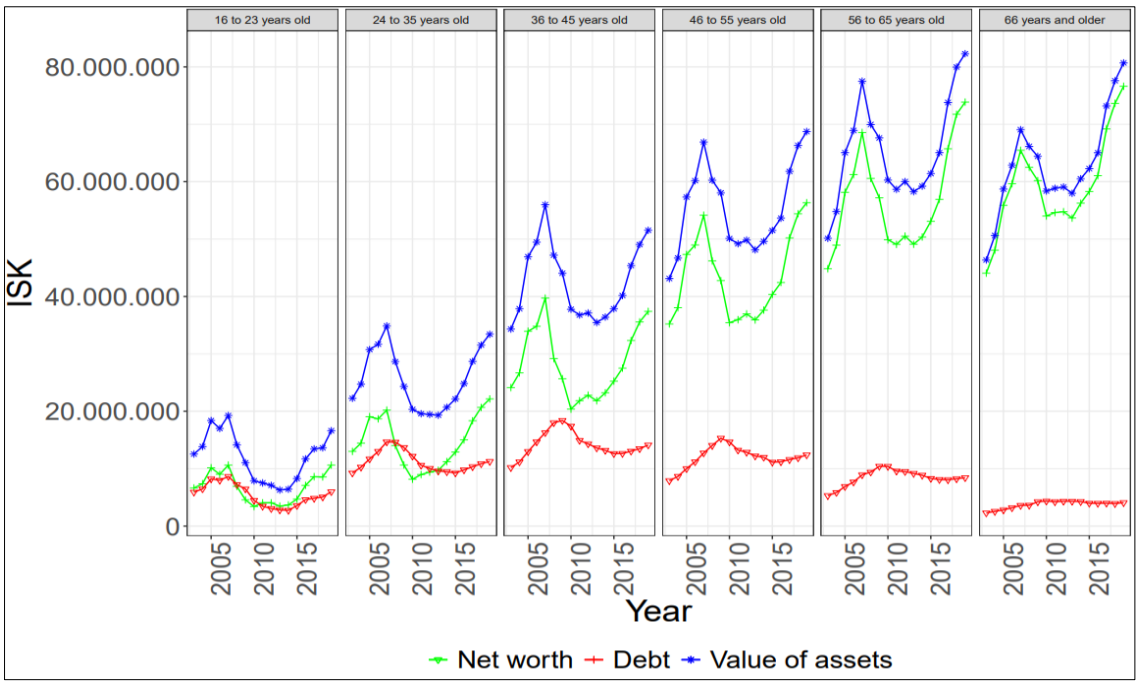


Source: Administrative data from tax returns available at Statistics Iceland.

Among jointly taxed individuals aged 24–55, relative net worth (i.e., relative to the average for all taxpayers) plummeted when the banking crisis hit the economy. Of these, individuals in the 36–45 age group suffered the severest blow to their net worth ratio during the crisis. The oldest group had the relatively best performance, as the ratio of their net worth to average net worth increased significantly during the crisis years, whereas most others experienced a decrease.

To determine the causes of developments in each age group's net worth, it is useful to show changes in debt and assets over the period. The assets include the market value of housing and land; the purchase price of cars less depreciation; and the nominal value of stocks, bonds, and bank deposits. The debt includes mortgage debt, car loans, overdraft, consumer loans, and student loans. Figure 4 illustrates how the average debt, assets, and net worth of jointly taxed individuals belonging to different age groups evolved from 2003 to 2019 (in domestic currency and at constant 2019 prices). Note that in Figures 3 and 4, individuals move between age groups as they grow older.

Figure 4: Average Net Worth, Debt, and Assets of Jointly Taxed Individuals, in Local Currency

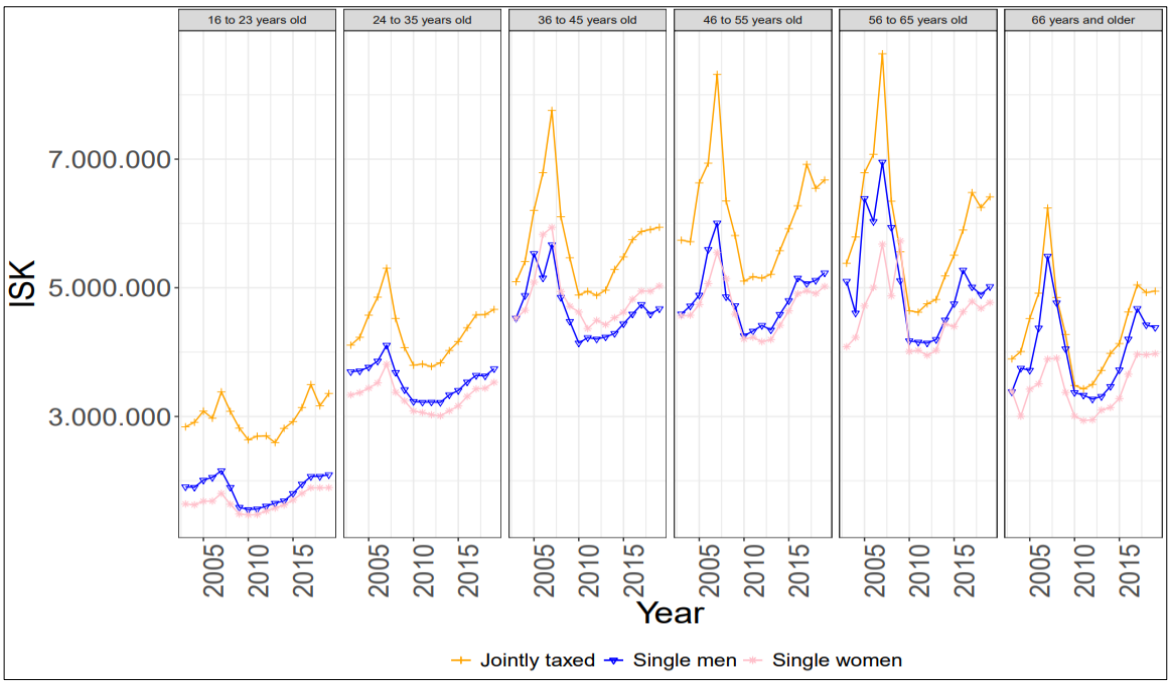


Source: Administrative data from tax returns available at Statistics Iceland.

In the tax returns, housing is valued at market prices. It follows that changes in house prices are the main cause of changes in the value of assets and in net worth. The increase in debt caused by indexation is not visible in 2008 in Figure 4 because the figures are expressed in constant prices, so that a rise due to indexation to the CPI does not show. At constant prices, debt increased before the crisis and then fell during the recovery. The increase was most pronounced for the 36–45 age group. In 2010, the Supreme Court ruled retroactively that loans indexed to the exchange rate were illegal. The implications of this decision became clear in 2011 when the affected loans were adjusted, and debt declined markedly for both single and jointly taxed individuals aged 24–65. Then, in 2014, CPI-indexed debt was reduced by the government, as described above. However, the effect of this program is not visible in the figure.

Figure 5 shows the evolution of disposable income by marital status and age. Income is higher for the jointly taxed than for single people, and somewhat higher for single men than for single women. Disposable income rose during the years before the 2008 crash but then fell drastically, to a level not seen since 2003. The plunge in disposable income increased the debt burden, compounding the effect of the indexation-induced jump in outstanding mortgage balances measured in local currency.

Figure 5: Average Annual Disposable Income, by Marital Status and Age, in Local Currency



Note: The sample comprises individuals with non-zero disposable income.
Source: Administrative data from tax returns available at Statistics Iceland.

The decline in disposable income was caused not mainly by a drop in wages but by inflation (itself a result of the depreciation of the currency) and reduced capital income. Note that real disposable income had not recovered its 2007 peak by 2019 for any group apart from the youngest and oldest age groups of single women, and it took until 2015–2016 for it to recover its 2003 level for most of the groups. The fall in 2007–2010 was large, as can be seen in Table 1.

Table 1: Percentage Change in Average Annual Disposable Income from 2007 to 2010, by Age Group

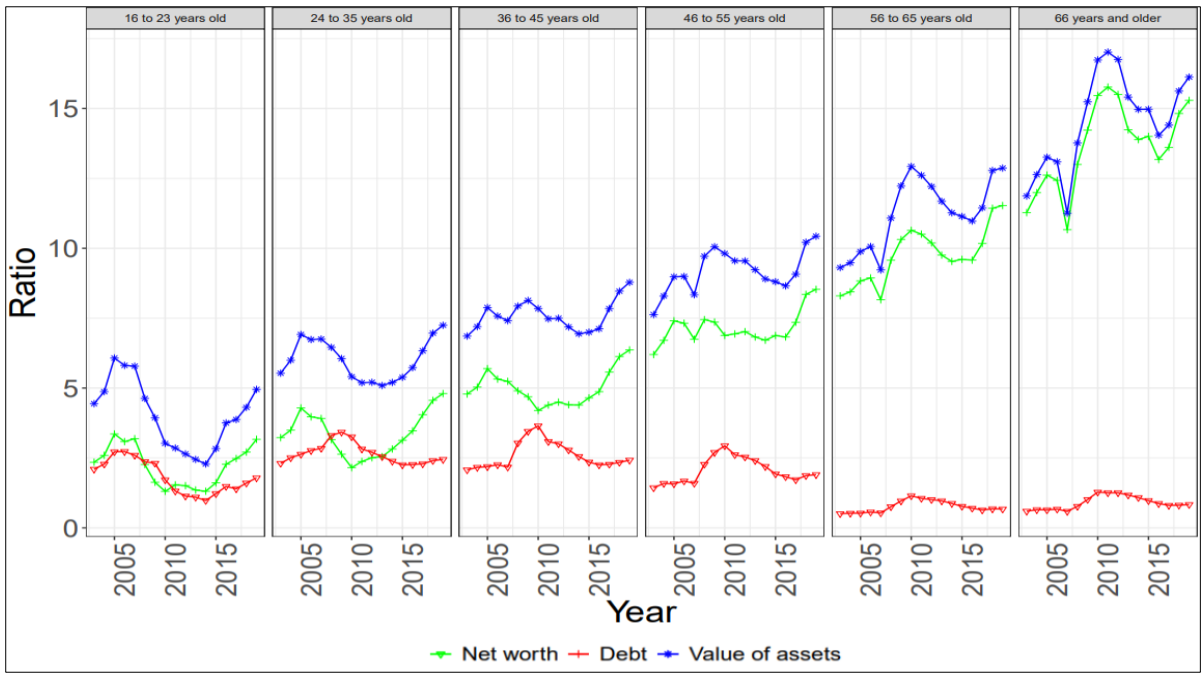
	Age in Years					
	16 to 23	**24 to 35**	**36 to 45**	**46 to 55**	**56 to 65**	**66 plus**
Jointly taxed	–22%	–29%	–37%	–39%	–47%	–44%
Single men	–28%	–21%	–27%	–29%	–40%	–39%
Single women	–18%	–19%	–22%	–24%	–29%	–23%

Source: Administrative data from tax returns available at Statistics Iceland.

The fall in real disposable income exceeded one-third for many groups and approached one-half for the jointly taxed aged 56–65. The effect was to increase the burden of debt because debt was indexed either to the price level or to foreign currencies, while wages were not indexed to the price level.

Figure 6 shows the ratio of value of assets, debt, and net worth to disposable income (median value).

Figure 6: Ratio of Debt, Net Worth, and the Value of Assets to Disposable Income for the Jointly Taxed (Average Ratio for Each Age Group)



Source: Administrative data from tax returns available at Statistics Iceland.

The debt burden jumped in 2008, compounding the effect of the fall in asset prices on the ratio of net worth to disposable income. Net worth took until 2016 to regain its 2003 level for the 45 years and younger groups, but the losses for the over 45 were smaller because their level of debt was lower. The jump in debt was greatest for the 24–55 age groups.[9] The increase in the debt burden for those over age 36 was very large, especially for the jointly taxed and single men. The ratio of debt to disposable income increased by more than 100% for the jointly taxed over the age of 55 and single men over the age of 35. Note that the debt burden appears to have fallen for the youngest group, aged 16–23, but this is explained by the entry of new cohorts who had limited access to credit because of the financial crisis. The relative change in the debt-to-income ratio—that is, the change in the ratio relative to its initial value—during the financial crisis is shown in Table 2.

[9] The same graphs for single men and women can be found in the Appendix. As was the case for the jointly taxed, the decline in asset values affected single taxpayers' net worth: single men aged 24–35 found themselves with negative net worth in 2008–2012, as did single men aged 36–45 in 2010. Single women aged 24–35 had negative net worth from 2008–2014, or two years longer than single men in the same age group. In 2010, the net worth of single women aged 36–45 was close to zero.

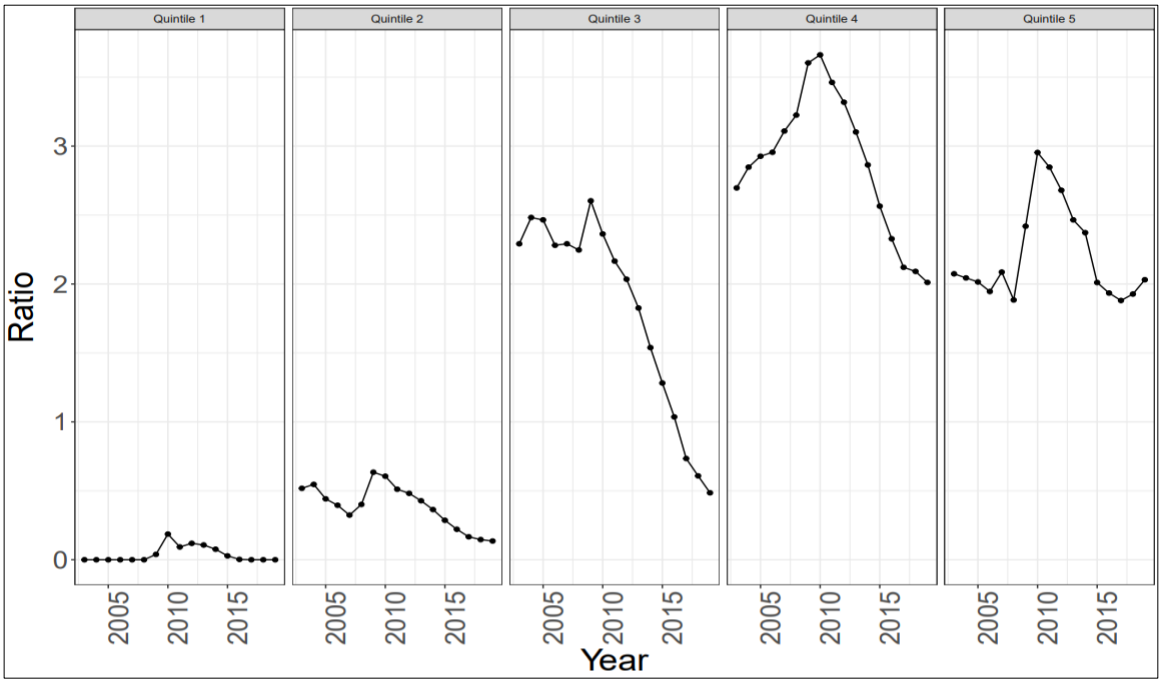
Table 2: Percentage Change in the Ratio of Average Debt to Average Disposable Income from 2007 to 2010, by Age Group

	Age in Years					
	16 to 23	**24 to 35**	**36 to 45**	**46 to 55**	**56 to 65**	**66 plus**
Jointly taxed	–34%	14%	68%	85%	110%	120%
Single men	–33%	20%	110%	110%	110%	150%
Single women	–37%	3.6%	31%	35%	65%	62%

Source: Administrative data from tax returns available at Statistics Iceland.

Figure 7 shows the median debt burden, defined as the ratio of debt to disposable income, by income quantile.[10] The increase was greatest for the top two quantiles (40%) of the income distribution, but the recovery was swift due to the rapid increase in disposable income.

Figure 7: Jointly Taxed—Median Ratio of Debt to Disposable Income, by Disposable Income Quantile



Source: Administrative data from tax returns available at Statistics Iceland.

[10] We use the median value of the ratio because the prevalence of low or zero income in the lowest-income quantile makes the average debt burden not representative for that quantile.

Table 3 shows the relative change in the ratio between 2007 and 2010.

Table 3: Percentage Change in the Ratio of Debt to Disposable Income (Median Value of the Ratio for Each Income Group), from 2007 to 2010

	Quantile 1	Quantile 2	Quantile 3	Quantile 4	Quantile 5
Change (%)	NA[11]	87%	3.1%	18%	42%

Source: Administrative data from tax returns available at Statistics Iceland.

The increase in the debt burden—measured as the absolute increase in the ratio of debt to disposable income—was greatest for the top income group, but the largest relative change—the proportional change in the debt to income ratio—was largest for the second income group. Moreover, in subsequent years, the ratio fell below its initial level for the third and the fourth income groups but not for the lowest and highest groups. The steep rise in the top groups is explained by the fact that real disposable income fell more in these groups than in the lower-income groups. This stemmed from two factors: on the one hand, the importance of capital income for these groups, and on the other hand, the government's redistribution policies, which aimed (successfully) at protecting the disposable income of the lower-income groups.

Nevertheless, there was a significant increase in financial hardship because the low-income groups found it more difficult to make ends meet. This effect peaked in 2010. The proportion of people in the lowest-income quantile facing financial hardship rose from 25% in 2007–2009 to 36% in 2010–2012.[12] See Ólafsson et al. (2019).

Table 4 shows the percentage movement from one net-worth decile to another between 2007 and 2010. The green diagonal in the table shows the proportion of individuals remaining in the same group during the period. For example, individuals in decile 5 in 2007 had a 16% chance of ending up in decile 1 in 2010. Only 39% of the individuals who were in the poorest group in 2007 were still in that group three years later. Among the wealthiest 50%, movement up or down by more than a decile was uncommon, whereas the 50% who were poorer in 2007 were more likely to experience larger movements than the wealthier 50%. The richest 10% were most likely to retain their position, while deciles 2 through 5 were more likely to move to another group. Large movements between groups were uncommon during this period, as the values decrease with greater distance from the green diagonal.

[11] Median value was equal to zero in 2007, which made the proportional change equal to infinity.
[12] Financial hardship is a composite measure based on income poverty, difficulties in making ends meet, and material deprivation.

Table 4: Movement between Net Worth Deciles, 2007–2010

	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10	Probability of an increase	Probability of a decrease
Decile 1	0.39	0.21	0.10	0.04	0.08	0.07	0.04	0.02	0.01	0.02	0.61	0.00
Decile 2	0.10	0.19	0.20	0.16	0.12	0.07	0.05	0.04	0.03	0.05	0.71	0.10
Decile 3	0.11	0.22	0.23	0.24	0.13	0.04	0.02	0.01	0.00	0.00	0.44	0.33
Decile 4	0.11	0.25	0.14	0.24	0.17	0.06	0.02	0.01	0.00	0.00	0.25	0.51
Decile 5	0.16	0.13	0.06	0.08	0.27	0.20	0.06	0.02	0.01	0.00	0.30	0.43
Decile 6	0.07	0.05	0.03	0.02	0.12	0.38	0.24	0.06	0.02	0.00	0.33	0.29
Decile 7	0.03	0.03	0.03	0.01	0.04	0.19	0.40	0.21	0.05	0.01	0.28	0.32
Decile 8	0.02	0.02	0.02	0.00	0.02	0.05	0.19	0.45	0.21	0.03	0.24	0.31
Decile 9	0.01	0.01	0.01	0.00	0.01	0.02	0.04	0.19	0.54	0.16	0.16	0.30
Decile 10	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.02	0.16	0.76	0.00	0.24

Source: Administrative data from tax returns available at Statistics Iceland.

6. Econometric analysis

The purpose of this section is to evaluate which groups suffered the greatest losses from the crisis, using econometric methods. In the following analysis, losses are measured as the change in net worth between year-end 2007 and 2010, as well as the rise in the debt burden. The starting point is 2007, when house prices peaked. Real house prices started to fall when the crisis struck in 2008 and did not stop falling until 2010. Using this period reveals the losses and gains that households suffered during the worst parts of the crisis. This section explores the effect on the level of net worth, as well as the percentage change in net worth and changes in the debt burden.[13]

Table 5 below lists the explanatory variables. All variables except 1) and 10) are binary variables. The 36–45 age group is the reference age group for binary age variables, and jointly taxed households are the reference group for marital/civil partnership status. The reference group for the first property purchase is those who bought property before 2000. The area between urban and rural—the suburbs of the capital city Reykjavík—is the reference group for households' area of residence, and the reference group for the education variable is those with less than secondary education.

[13] Individuals who were younger than 24 years old in 2007 were excluded from the population because this age group, on average, had few assets and low debt in the years leading up to the financial crisis.

Table 5: Explanatory Variables

Family characteristics:	**Education:**
1) Number of children	16) University education
2) Single men	17) Secondary education
3) Single women	18) Less than secondary education
4) Jointly taxed	
	Area of residence:
Age group:	19) Living in an urban area
5) Age 24–35	20) Living in a suburban area
6) Age 36–45	21) Living in a rural area
7) Age 46–55	
8) Age 56–65	**Sector of employment:**
9) Older than 65 or disabled	
Income and first property bought:	22) Working in the finance or insurance sector
10) Disposable income	
11) First property bought before 2000	
12) First property bought between 2000 and 2004	
13) First property bought between 2005 and 2007	
14) First property bought between 2008 and 2010	
15) Did not own property in 2000–2010	

Each observation is one household, and in the case of jointly taxed households, each binary explanatory variable corresponds to the oldest individual in the household. For jointly taxed couples, average net worth and average disposable income within the household are used, as this makes it possible to compare jointly taxed to single individuals.[14]

We estimate these cross-sectional models with iteratively reweighted least squares (IRLS), where we use the Huber estimation to put less weight on the outliers.[15] All numbers are expressed in the average price level for 2019.

[14] Here, it is important to use average net worth for jointly taxed couples because debt is listed under the older individual, whereas assets can be listed under both individuals. Therefore, if the couples are not matched together in the calculations, the net worth of the younger individual is overestimated if the couple are debtors.

[15] This estimation gives data points with smaller residuals greater weight, and higher residuals are assigned lower weight (Fox and Weisberg 2012).

The housing market changed significantly between the first and second time periods.[16] By the end of 2008, the financial crisis had begun to affect the housing market. Real house prices started to fall after 2007 and continued falling until 2010, when they hit bottom and subsequently began to rise (see Figure 2 above). Because of this, the last time period is from 2010.

We start by using the proportional change in net worth as a dependent variable and subsequently replace it with the absolute change in net worth. We then use the change in the ratio of debt to disposable income as a dependent variable in order to focus on the burden of debt. We think of the changes in these variables as reflecting vulnerability to the crisis.

6.1 Explaining the proportional change in net worth (model A)

This section reveals results from the IRLS estimation, where the dependent variable is the proportional change in net worth from 2007–2010. To check for robustness, the model was first regressed with the age group variables, then the family characteristics variables were added to the model, and so forth. The results are shown in Table 6.

The group that suffered the biggest relative-net-worth blow from the financial crisis was parents aged 24–45 with lower educational levels and living in an urban area who bought their first property between 2000 and 2007. Singles also suffered, especially those with children.

The relationship between the relative change in net worth and disposable income was statistically insignificant. The outcome for workers in the financial and insurance sector is interesting. Those workers suffered less severe losses in net worth relative to their initial level than others within Iceland did. However, as we will see in Table 7, they suffered greater absolute losses because they had more assets and debt.[17]

Interpretation of the same model also reveals groups that performed relatively better than other groups in 2008–2010. These households had the following characteristics: they did not have children living with them, bought their first property between 2008 and 2010 (i.e., after the crash), were jointly taxed, were over 65, lived outside an urban area, and had more than compulsory education.

[16] The choice of time periods when households bought their first property was decided based on economic conditions in the housing market during different years. In the first period, before 2000, the burden from monthly mortgage payments was not allowed to be more than 18% of gross income, although it was possible to give exemptions and increase the limit to 30%. In 1999, this rule was abolished. Thus, the mortgage market changed significantly between the first and second periods.

[17] Because we do not know the market value of shares, this group's losses may be underestimated.

Table 6: Results from Model A. Independent Variable Is a Proportional Change in Net Worth from 2007–2010. The Model Is Estimated with IRLS

	1st Horse Race			2nd Horse Race			3rd Horse Race			4th Horse Race			5th Horse Race			6th Horse Race		
	Estimate	t value		Estimate	t value		Estimate	t value		Estimate	t value		Estimate	t value		Estimate	t value	
(Intercept)	-0.49	-92.32	***	-0.40	-42.96	***	-0.53	-48.49	***	-0.51	-44.19	***	-0.53	-38.27	***	-0.53	-37.35	***
24 to 35 years old	-0.64	-90.62	***	-0.27	-30.95	***	-0.15	-15.90	***	-0.15	-15.00	***	-0.14	-14.17	***	-0.16	-16.51	***
46 to 55 years old	0.12	15.77	***	0.09	9.42	***	0.10	9.62	***	0.10	9.33	***	0.09	8.20	***	0.09	9.25	***
56 to 65 years old	0.22	26.53	***	0.18	16.44	***	0.20	17.06	***	0.20	16.60	***	0.19	15.45	***	0.19	15.82	***
66 years old and older + disabled	0.24	34.03	***	0.25	26.25	***	0.31	29.90	***	0.30	27.88	***	0.29	26.64	***	0.28	19.82	***
Number of children				-0.02	-6.62	***	-0.03	-8.44	***	-0.02	-5.81	***	-0.03	-7.54	***	-0.03	-7.14	***
Single man				-0.30	-37.76	***	-0.29	-34.99	***	-0.30	-33.88	***	-0.29	-32.35	***	-0.16	-16.68	***
Single woman				-0.12	-17.16	***	-0.06	-7.52	***	-0.07	-8.21	***	-0.04	-5.23	***	-0.20	-22.43	***
University education							0.20	24.95	***	0.18	21.84	***	0.24	28.34	***	0.24	27.75	***
Secondary education							0.13	19.52	***	0.12	17.44	***	0.15	21.29	***	0.15	19.03	***
Disposable Income										0.00	-0.40		0.00	0.14		0.00	0.35	
First real estate 2000-2004										-0.09	-10.94	***	-0.09	-10.72	***	-0.09	-10.46	***
First real estate 2005-2007										-0.03	-2.51	**	-0.04	-3.46	***	-0.02	-1.48	
First real estate 2008-2010										2.89	124.94	***	2.89	122.85	***	2.66	116.38	***
No real estate										0.14	12.86	***	0.12	10.74	***	0.21	17.56	***
Capital area													-0.07	-7.91	***	-0.05	-5.06	***
Rural area													0.21	20.22	***	0.17	15.94	***
Financial or insurance sector																0.04	2.92	**

Significance codes: 0.001 '***' 0.01 '**' 0.05 '*' 0.1 '.' 1 ' '

Notes: IRLS=iteratively reweighted least squares. Statistics for 6th Horse Race: P-value of Breusch-Pagan test: 0.4. Since the P-value is greater than 0.05, we cannot reject the null hypothesis that the model includes no linear heteroscedasticity. Thus, we infer that there is no heteroscedasticity and the standard errors, and the t-values, are unbiased.

Source: Administrative data from tax returns available at Statistics Iceland.

Table 7: Results from Model B. Independent Variable Is Level Change in Net Worth from 2007–2010. The Model Is Estimated with IRLS

	1		2		3		4		5		6	
	Estimate	z value	Estimate	z value	Estimate	z value	Estimate	z value	Estimate	z value	Estimate	z value
(Intercept)	- 7,919,751	-97.80 ***	- 8,001,651	-77.43 ***	- 6,677,089	-59.24 ***	-6,266,045	-38.24 ***	-5,680,218	-33.55 ***	-5,775,346	-17.26 ***
24 to 35 years old	4,490,679	47.52 ***	2,450,030	26.84 ***	2,458,699	26.97 ***	449,285	5.22 ***	530,580	6.30 ***	393,776	4.11 ***
46 to 55 years old	- 1,147,038	-9.55 ***	- 1,988,771	-17.23 ***	- 2,020,056	-17.55 ***	-801,055	-7.49 ***	-878,206	-8.62 ***	-954,096	-8.82 ***
56 to 65 years old	- 1,864,630	-13.30 ***	- 3,357,824	-24.19 ***	- 3,547,158	-25.61 ***	-1,333,964	-10.14 ***	-1,415,822	-11.26 ***	-1,541,184	-11.36 ***
66 years old and older + disabled	1,319,892	12.86 ***	- 1,144,299	-11.11 ***	- 1,733,087	-16.41 ***	-1,000,130	-10.17 ***	-930,655	-9.73 ***	-813,255	-5.76 ***
Number of children			- 1,535,236	-33.17 ***	- 1,554,011	-33.67 ***	-702,648	-16.15 ***	-848,900	-20.29 ***	-993,898	-19.60 ***
Single man			5,174,813	62.78 ***	4,942,888	59.79 ***	3,509,331	45.56 ***	3,699,049	49.00 ***	4,216,493	43.54 ***
Single woman			3,908,806	51.71 ***	3,711,405	49.14 ***	2,757,270	39.99 ***	3,265,713	48.39 ***	3,648,564	46.83 ***
University education					- 2,035,246	-22.70 ***	-687,031	-7.59 ***	557,480	6.30 ***	509,092	4.12 ***
Secondary education					- 1,514,698	-21.86 ***	-1,147,417	-17.87 ***	-495,163	-7.99 ***	-445,034	-6.20 ***
Disposable Income							-0.66	-23.82 ***	-0.65	-23.04 ***	-0.61	-8.91 ***
First real estate 2000-2004							1,401,605	15.22 ***	1,419,631	16.02 ***	1,380,794	12.97 ***
First real estate 2005-2007							2,296,252	19.10 ***	2,151,642	18.39 ***	2,518,588	19.10 ***
First real estate 2008-2010							10,539,919	47.93 ***	10,059,222	44.45 ***	9,752,915	37.03 ***
No real estate							6,175,663	71.68 ***	6,392,331	73.51 ***	6,240,740	37.94 ***
Capital area									-3,031,917	-39.80 ***	-3,100,070	-33.88 ***
Rural area									2,837,462	33.10 ***	2,859,138	29.04 ***
Fnancial or insurance sector											-533,372	-2.35 *

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Notes: IRLS=iteratively reweighted least squares. P-value of Breusch-Pagan test: less than 0.05. Since the P-value is less than 0.05, we reject the null hypothesis that the model includes no linear heteroscedasticity. Thus, we infer that there is heteroscedasticity and use robust standard errors to correct to get unbiased standard errors.

Source: Administrative data from tax returns available at Statistics Iceland.

6.2 Explaining the absolute change in net worth (model B)

The results from the IRLS regression with level change in net worth from 2007–2010 are somewhat different from the results when we use the proportional change in net worth, although as before, those living in urban areas lost more, as did those with children. Not unexpectedly, losses in absolute terms correlated with high disposable income as well as higher education. In this instance, those in the financial sector lost more in absolute terms. In our view, the relative change in net worth model captures the suffering associated with the losses better than the level change model does.

6.3 Explaining the rise in debt burden (model C)

Table 8 explains the rise in the debt burden, defined as the ratio of debt to disposable income, from the end of 2007 to the end of 2010. We find that the following attributes had positive and significant coefficients: the 24–35 age group, the number of children, university education, first real estate purchase in 2008–2010 (or, to a lesser extent, 2000–2004), urban area, and employment in the financial sector. Thus, young people who had children and worked in urban areas saw their debt burden increase the most.

Workers in the financial sector experienced a large drop in their disposable income, which explains their positive and significant coefficient in the regression. In contrast, older people, single women, those living in rural areas, and those who did not own real estate had a negative coefficient, which should not come as a surprise. Again, the relationship between the relative change in net worth and disposable income was statistically insignificant.

We conclude that the increase in the debt burden hit young families with children the hardest, which is consistent with our above-described results on the proportional decline in net worth.

Table 8: Results from Model C. Independent Variable Is Level Change in the Ratio of Debt to Disposable Income from 2007–2010

	1			2			3			4			5			6		
	Estimate	t value		Estimate	t value		Estimate	t value		Estimate	t value		Estimate	t value		Estimate	t value	
(Intercept)	0.52	56.80	***	0.55	42.01	***	0.53	35.49	***	0.31	27.55	***	0.32	23.38	***	0.33	18.42	***
24 to 35 years old	0.16	13.78	***	0.03	2.31	*	0.04	2.96	***	-0.06	-6.52	***	-0.07	-6.81	***	-0.05	-4.48	***
46 to 55 years old	-0.08	-6.16	***	-0.09	-6.55	***	-0.09	-6.55	***	-0.03	-2.82	***	-0.03	-2.66	***	-0.05	-4.15	***
56 to 65 years old	-0.20	-14.04	***	-0.22	-13.33	***	-0.22	-13.26	***	-0.11	-8.74	***	-0.11	-8.68	***	-0.14	-9.07	***
66 years old and older + disabled	-0.38	-31.82	***	-0.39	-28.09	***	-0.39	-27.00	***	-0.21	-19.93	***	-0.22	-20.08	***	-0.14	-7.90	***
Number of children				-0.01	-1.20		-0.01	-1.80		0.03	6.71	***	0.03	7.20	***	0.02	3.28	***
Single man				0.05	4.04	***	0.06	5.63	***	0.01	0.68		0.00	0.40		0.01	0.56	
Single woman				-0.09	-9.28	***	-0.09	-8.48	***	-0.07	-9.40	***	-0.08	-10.65	***	-0.08	-7.29	***
University education							0.05	4.11	***	0.00	35.67	***	0.00	34.45	***	0.00	39.95	***
Secondary education							0.03	3.05	***	-0.04	-4.91	***	-0.07	-7.76	***	-0.09	-7.82	***
Disposable Income										0.01	1.41		0.00	-0.35		0.00	0.22	
First real estate 2000-2004										0.08	8.97	***	0.08	8.89	***	0.06	5.25	***
First real estate 2005-2007										-0.04	-3.73	***	-0.04	-3.48	***	-0.11	-6.83	***
First real estate 2008-2010										2.52	116.62	***	2.53	115.90	***	2.70	97.40	***
Not real estate										0.00	-0.35		0.00	-0.51		-0.04	-3.18	***
Capital area													0.04	4.59	***	0.04	3.66	***
Rural area													-0.06	-6.18	***	-0.09	-6.34	***
Financial or insurance sector																0.15	7.54	***

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Notes: IRLS=iteratively reweighted least squares. Statistics for 6th Horse Race: P-value of Breusch-Pagan test: 0.4. Since the P-value is greater than 0.05, we cannot reject the null hypothesis that the model includes no linear heteroscedasticity. Thus, we infer that there is no heteroscedasticity and the standard errors, and the t-values, are unbiased.

Source: Administrative data from tax returns available at Statistics Iceland.

7. Conclusions

Our results show that the 24–45 age groups had relatively the worst performance during the crisis and were therefore vulnerable. Within these groups, urban households with children were the most vulnerable to the crisis, especially those headed by a single parent. Econometric analysis supports the results of the graphical analysis. It also shows that households with lower levels of education suffered relatively larger losses than those with higher levels of education, and that those who had bought their first home between 2000 and 2007 lost relatively more than others.

The debt burden, defined as the ratio of debt to disposable income, jumped in 2008, compounding the effect of the fall in asset values. Net worth took until 2016 to return to its 2003 level for the 45 years and younger groups. However, the recovery in net worth was quicker for the over 45 years groups because losses for these groups were smaller and their level of debt was lower. For most age groups, it took until 2015–2016 for real disposable income to return to its 2003 level, and by 2019, it had not returned to its peak 2007 level.

The 2008–2009 crisis, brought about by a fragile and bloated banking system, affected families with children most severely. While most survived financially to benefit from the subsequent recovery of house prices and mortgage relief, others were not so lucky. In spite of the government's best efforts, the households that were most vulnerable before the crisis did, in many cases, not manage to hold on to their property. Thousands of families were forced to leave their homes in the aftermath of the financial crisis and did not benefit from the postcrisis recovery of house prices. This lesson supports future use of macroprudential policies creating buffers to limit the number of households at the margin of insolvency and illiquidity.

The banking expansion that took place from 2003 to 2007 was plagued by deregulation, lack of macroprudential regulation, mistakes in monetary policy, lax accounting standards, and self-dealing by the owners of the banks. The banks' collapse affected the general population, especially families with children. It goes without saying that financial market regulation and proper conduct of monetary and macroeconomic policy in general are of pivotal importance for the well-being of a nation.

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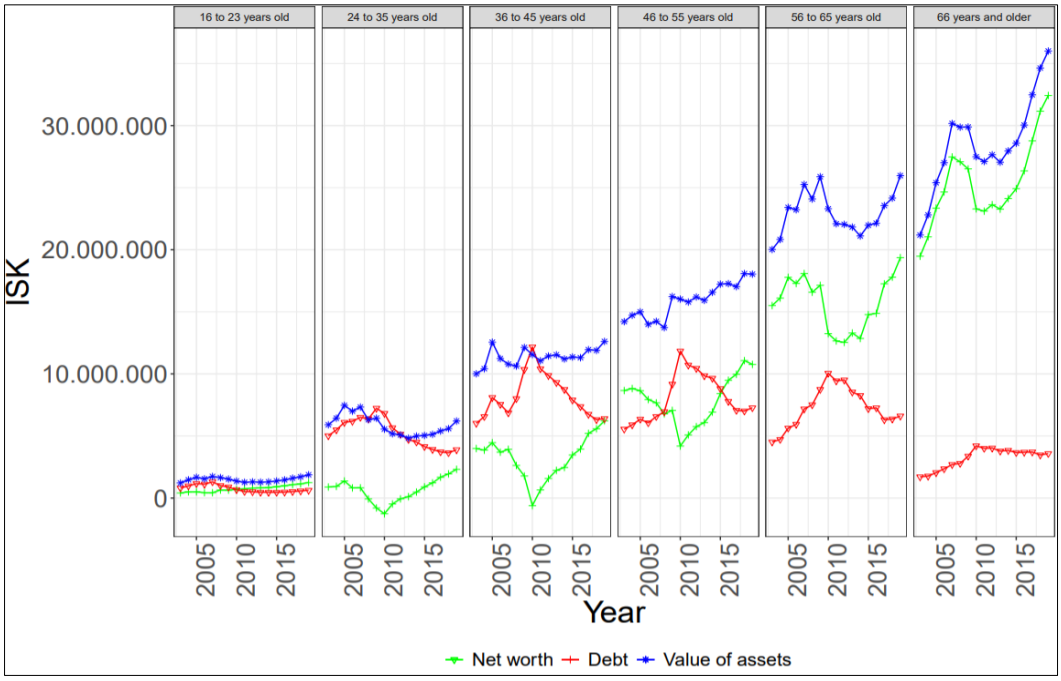
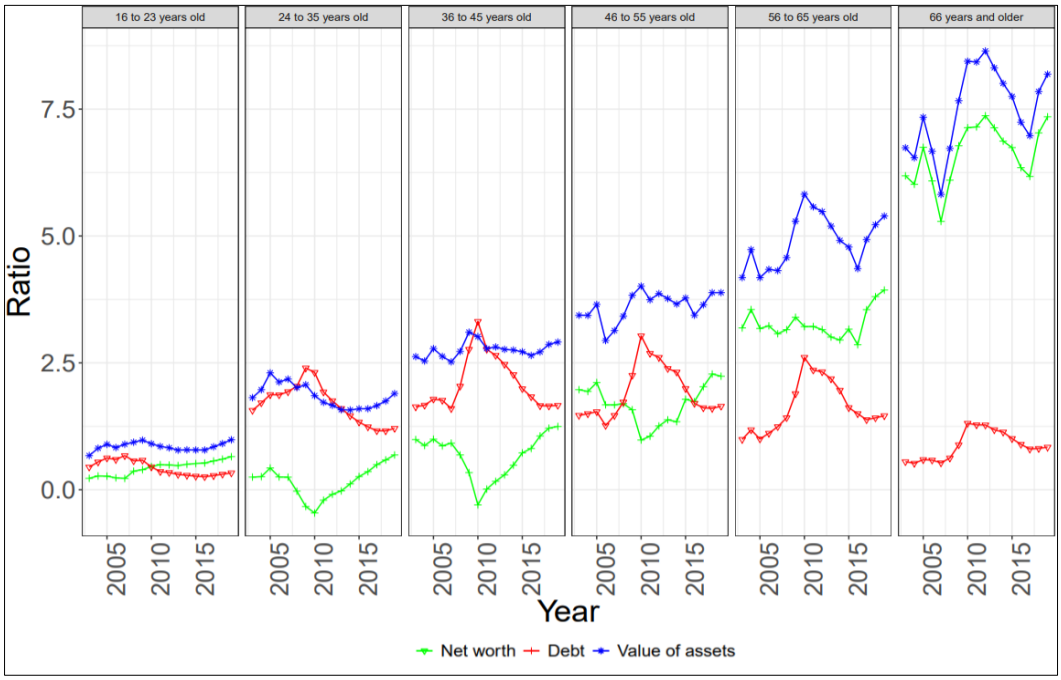
Appendix

Figure 8: Average Net Worth, Debt, and Assets for Single Men, in Local Currency, Constant 2019 Prices



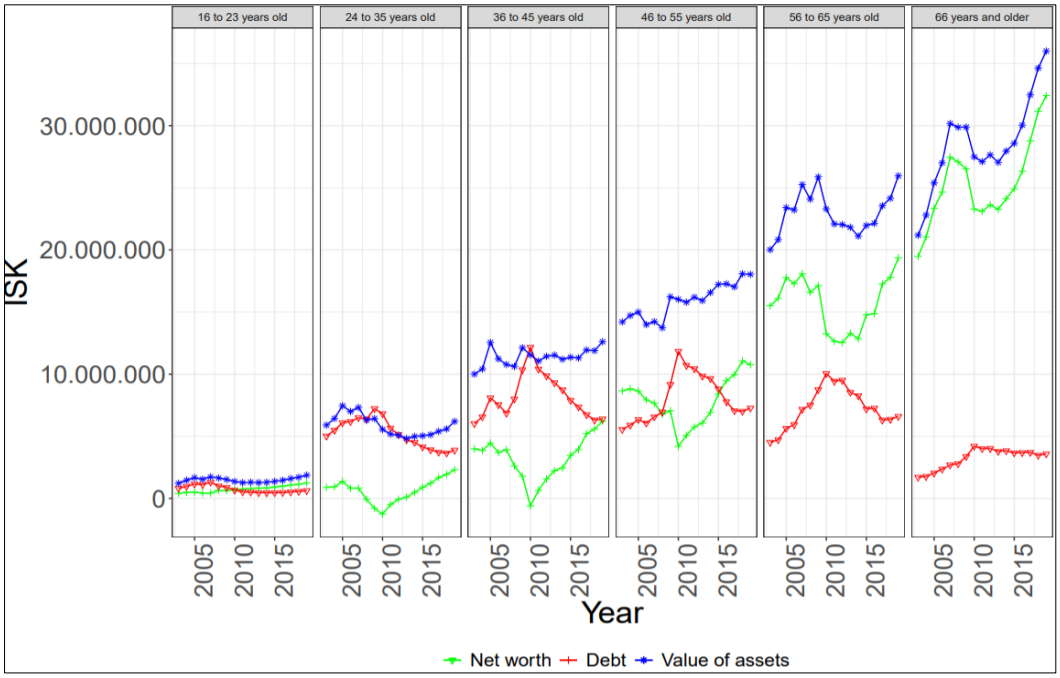
Source: Administrative data from tax returns available at Statistics Iceland.

Figure 9: Ratio of Debt, Net Worth, and Assets to Disposable Income for Single Men (Median Value)



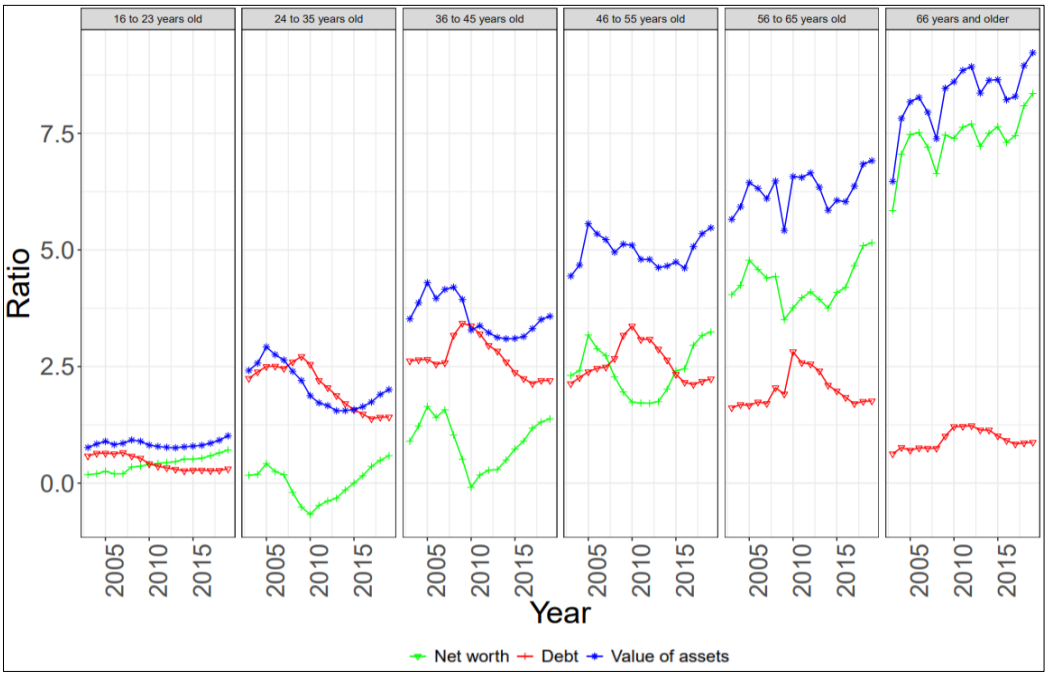
Source: Administrative data from tax returns available at Statistics Iceland.

Figure 10: Average Net Worth, Debt, and Assets for Single Women, in Local Currency, Constant 2019 Prices



Source: Administrative data from tax returns available at Statistics Iceland.

Figure 11: Ratio of Debt, Net Worth and Assets to Disposable Income for Single Women (Median Value)



Source: Administrative data from tax returns available at Statistics Iceland.