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A Vulnerability Analysis for Mortgaged Irish Households

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Abstract

This note assesses the vulnerability of mortgaged Irish households to financial shocks. It uses the Central Bank of Ireland's Loan Loss Forecasting internal model and employs loan level data provided by the five main mortgage lenders. The model calculates a vulnerability index for currently performing mortgages under a certain adverse scenario which involves movements in the unemployment rate, house prices and interest rates. The model predicts that the most vulnerable households are those with high current loan-to-value ratios, multiple loans, loans that originated between 2004 and 2009 and those in South-East, Midland and Border region.

1 Introduction

During the global financial crisis, Irish households had to cope with significant falls in income and wealth. Since 2013, the Irish economy has experienced a recovery with unemployment falling, domestic demand growing strongly, house price growth and a decline in the number of non-performing loans and mortgage arrears. However, despite this progress, some households remain vulnerable to domestic and external shocks. The bulk of household assets consist of real estate, while mortgages constitute their largest liability (Lawless *et al.*, 2015). This note looks to gain an understanding of the degree of vulnerability of various segments of the household sector at December of 2016. In particular, this note focuses on performing loans and examines the potential risks to financial stability.

Previous research on the Irish mortgage market (McCarthy, 2014; Kelly and O'Malley, 2014; Kelly and McCann, 2015) has looked at factors associated with mortgage defaults. The key findings of the previously mentioned research on the sources of mortgage default suggest that unemployment shocks, the accumulation of non-mortgage debt, higher originating

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loan-to-value and loan-to-income ratios, measures of mortgage affordability and weak housing equity positions all have an important explanatory role. This note uses available loan level data as of December 2016, the most recent point for which usable granular data was available at time this analysis was carried out, and follows closely the approach of the International Monetary Fund (IMF) Country Report (2016) which performed a vulnerability analysis for each mortgage in Ireland as of December 2014.

Analysis of the performance and vulnerability of loans in the mortgage market is vital for a broader understanding of Irish financial stability. Figure 1 shows that 65 per cent of Irish retail banks' exposures were mortgages, as of September 2017.¹ Within the mortgage segment, 83 per cent were for principal dwelling house (PDH) purposes while the remaining 17 per cent were for buy-to-let (BTL) or holiday home purposes according to Central Bank of Ireland statistics. Figure 2 displays the evolution of mortgage arrears among PDH mortgage accounts between September 2009 and September 2017. At September 2017, 6.9 per cent (by number) of PDH mortgages in arrears of greater than 90 days past due. This corresponds to approximately 10 per cent in terms of outstanding balances. Figure 3 presents the debt-to-income (DTI) ratio for selected European countries to provide a benchmark for Ireland's position internationally. Notwithstanding the significant reduction in recent years, Ireland's DTI ratio stood at 140.9 per cent in Q4 2016, which was the fourth highest in this comparison group, implying that Irish households remain more vulnerable to financial shocks in an aggregate sense than households in most European countries.

Figure 4 illustrates that approximately 85 per cent of Irish households' total borrowing was for house purchase in September 2017. This percentage remained relatively stable over the period from March 2003 until September 2017, while it peaked in December 2015 at 86.4 per cent. This confirms that analyzing mortgage vulnerability provides a comprehensive view of the overall financial vulnerability of the Irish sector.

To examine households' vulnerabilities, this note performs an analysis of mortgaged households in Ireland by calculating a vulnerability index (VI) using information on current mortgage characteristics and coefficients from a mortgage default model of the Central Bank of Ireland. Specifically, this note tests for vulnerabilities among various Irish households under a European Banking Authority (EBA) adverse scenario that includes house price falls, unemployment increases and interest rates shocks. Relative to studies that focus on the share of loans in arrears or default, the current framework provides additional information by calculating a vulnerability measure for all loans that were currently performing, as of December 2016. The main finding of this note is that some households are more vulnerable to macroeconomic shocks than others. The most vulnerable households to shocks are those with:

- high current loan-to-value ratios,
- multiple loans,
- loans that originated between 2004 and 2009 and

¹The corresponding share of mortgages in September and December 2016 was the same as in September 2017.

- those in the South-East, Midland and Border region.

The rest of the note is structured as follows: Section 2 analyses the methodology and reviews the current state of household balance sheets using loan-by-loan level data; Section 3 presents analysis on the defaulted ratio; Section 4 assesses the vulnerability of the Irish household under the 2016 EBA stress test adverse scenario; Section 5 concludes.

2 Methodology and Data

This notes calculates a VI for all performing PDH loans as of December 2016. To estimate the VI this note uses the Central Bank of Ireland's Loan Loss Forecasting (LLF) model that employs loan-level data provided by the five main mortgage lenders: Allied Irish Bank (AIB), Bank of Ireland (BOI), KBC Bank Ireland (KBC), Ulster Bank Ireland Ltd (UBIL) and Permanent TSB (PTSB). The model is used to support assessments arising from large scale stress testing exercises such as those conducted by the EBA every two years. Additionally, the model is used for assessments of financial sector vulnerabilities and for broader monitoring of existing and emerging financial stability risks. The model follows a standard credit risk modeling framework where expected losses (EL) under a given adverse scenario are derived from the product of probability of default (PD), exposure at default (EAD), and loss given default (LGD).

The VI is equivalent to one-year PD under an adverse economic scenario. The framework behind the PD model is outlined in detail in Kelly and O'Malley (2016) and Jackson (2011). The reported VI across groups of loans is driven by the composition of loans within each group and in this sense VI is unconditional. The VI for each loan is influenced by a set of explanatory variables with *loan specific*, *at origination* and *macroeconomic* characteristics.

More specifically, the *loan specific* variables include: (i) interest rate type, (ii) a multi-loan flag, which is an intercept adjustment for loans secured on property with more than one loan, (iii) a modification flag, which is an intercept adjustment for any loan having ever received a mortgage modification, whether temporary or permanent in nature.

The explanatory variables with *at origination* characteristics are: (i) a buy-to-let (BTL) flag, which is an intercept adjustment for BTL and PDH mortgages and (ii) house price misalignment, which is an estimate of over or undervaluation in Irish house prices at the time of a loan's origination. This estimate provides a proxy for the degree of overheating in the Irish property and mortgage markets at the time of loan origination, which the authors believe also acts to capture the quality of underwriting standards. The model average of estimates for house price misalignment were drawn from Kennedy *et al.* (2016) and vary at a quarterly frequency.

The variables with direct links to *macroeconomic* variation are: (i) the unemployment rate, that vary by region and quarter and (ii) current loan-to-value at property level, which moves as a function of changes in regional house prices and (iii) the ratio of current instalment

to instalment at origination, which measures changes in repayment burden and will be affected by movements in the interest rate environment. More information regarding all the explanatory variables can be found in Gaffney and McCann (2018).

The initial loan-level data amount to 699,452 mortgage loans in Ireland. However, this note calculates the VI for PDH only, meaning that BTL properties are excluded. Furthermore, for the households with more than one loan, VI is reported only for the largest loan in value. The aim is to treat each household as a separate entity, rather than each loan. The final data set contains 533,589 loans, totaling €75.7 billion at the end of 2016.

Table 1 reports the composition of the sample under study. The majority of the loans were originated between 2006 – 2007 and 2004 – 2005. Mortgages on standard variable rate (SVR) interest rate contracts are 48 per cent while approximately 41 per cent are on tracker loans and just under 11 per cent were on fixed rate contracts. Only 1 per cent of the sample have LTV of greater than 150 per cent while 53.3 per cent have LTV of less than 61 per cent. The most common age categories are between 36–45 and 46–55 which together account for 73.2 per cent of the sample. The majority of mortgages, 87 per cent, represent single-loan facilities. Approximately 70 per cent of the loans in the sample are outside Dublin.

3 Defaulted Ratio at December 2016

This section presents the analysis of the defaulted ratio as of December 2016 by calculating the stock of non-paying loans across different segments of the market. A defaulted loan is defined as a loan with an arrears balance of greater than 90 days past due.² This implies that some loans that have been modified, but have not yet exited their probationary period outlined by prudential regulation, will not be included as defaulted in our analysis, but would still be considered non-performing from a regulatory point of view. Default rates are reported on a count basis rather than the balance-weighted default basis, more familiar to banking and stress testing practitioners. This is because the current analysis focuses on vulnerability across households, rather than across monetary volumes of mortgages.

Table 1 focuses also on the defaulted ratio that captures the vulnerability of stressed households by showing how defaults are distributed across the sample of the Irish mortgage market at the end of 2016. Significant differences in default propensity are uncovered depending on the date of origination. Mortgages originated before 2010 generally have a higher default ratio. In particular, the default ratio is 9.2 per cent for loans initiated over the period 2006 – 2007, while only 0.8 per cent for the loans that were originated over the period 2010 – 2014.

Among interest rate types, SVR and tracker mortgages have the largest default ratios. A

²This definition differs from the EBA Implementing Technical Standards (ITS) definition of a non-performing loan. According to EBA-ITS, non-performing loans may include some loans with arrears less than 90 days past due. Similarly, this definition is not in line with the definition under Article 158 of the Capital Requirements Regulation, which also specifies that loans can be classified in default when not in arrears of 90 days, but where it is deemed unlikely that the borrower will continue making full repayments.

small fraction of fixed mortgages has defaulted, only 2.3 per cent.

The distribution of default across current LTV categories highlights a positive relationship with sharp non-linearities. Mortgages in positive equity generally have default ratios between 2.8 per cent and 7.5 per cent. However, for mortgages in negative equity, i.e. for loans between 101–120, 121–150 and 150+ per cent LTV ratios, the default ratio ranges from 10.9 to 67.7 per cent.

The age distribution also exhibits important differences in default propensity. Mortgages for which the borrower age is between 46 and 55 years have a default ratio of 6.5 per cent, while those under 36 years of age have a default ratio of 4.5 per cent. This pattern partially reflects the relationship between borrower age and the housing and credit cycles: 57 per cent of the sample in the age group of under 36 have had their mortgage originated since 2010, by which point banks' credit standards had tightened considerably, and housing values had declined. Of those in the 46–55 age category, on the other hand, 64.5 per cent originated between 2004 and 2008, the years in which house prices were at their most overvalued.

Small differences in default propensity are uncovered across different facility types. Multi-loan facilities have a default ratio of 6.5 per cent, while single-loan facilities have a default ratio of just below 6 per cent.

Finally, there is some variation across different regions. Mortgages in the Midland, Border and South-East regions have default ratios of 7.6, 6.6 and 6.2 per cent respectively. This is relatively higher in comparison with the other regions for which the default ratio ranges between 4.4 per cent and 6.0 per cent.

4 Forward-Looking Vulnerability Analysis

To assess the vulnerability of Irish households to macroeconomic shocks, this note employs a scenario analysis as outlined in the EBA's 2016 European Union (EU) wide stress testing exercise. A summary of EBA's adverse scenario indicators is reported in Table 2. The cumulative scenario inputs feed directly into the LLF's framework to affect the values for interest rates, unemployment and house prices, which affect the loan-level interest rate, regional unemployment and loan-level LTV ratio, respectively. Then the model calculates VI over a one-year horizon from December 2016 by employing the three-year cumulative shocks for interest rates, unemployment and house prices, as reported in Figure 5. This note reports one-year VI once for each household and for all the performing loans as of December 2016, as mentioned in Section 2. The model assumes that an increase on interest rates fully passes through to mortgages with tracker and SVR interest rate type, while fixed mortgages remain unaffected.

Figure 5 displays the distribution of VI among various groups. It visualizes five summary statistics (the median, two hinges and two whiskers). The lower and upper hinges correspond to the first and third quartiles (the 25th and 75th percentiles). The upper/lower whiskers

extend from the hinge to the largest/smallest value of the index respectively.³

Figure 5a reports the VI by date of origination. Loans with the highest VI were originated between 2004 and 2009, the years in which house prices were at their most misaligned. The median value for the loans that were originated between 2004 and 2009 varies from 1.1 to 1.3 per cent, while for all the other groups the median value is between 0.5 and 0.7 per cent.

The study finds that there is a strictly increasing relationship between LTV groups and the VI, Figure 5b. At LTV ratios above 150 per cent, there are far larger increases in VI, with the median index in this group climbing above 6 per cent. Even though the proportional interest rate effect on LTV is the same for all the mortgages, the level interest rate effect is larger for mortgages with high LTVs. More specifically, the recorded average interest rate at year 0, before feeding any of the two scenarios into the model, is 4.6 per cent for the over 150 per cent LTV group and 4.0 per cent for the 91 – 100 per cent group. Hence the over 150 per cent LTV group faces higher interest rate shocks in absolute terms, with a reflection on the VI, in comparison with the other groups.

SVR mortgages have a more dispersed VI distribution than mortgages on other interest rate types, Figure 5c. In both the forward-looking vulnerability analysis as well as in the default ratio analysis, fixed rate loans are less risky, Table 1. For the forward-looking analysis, the low riskiness of the fixed mortgages is partially mechanical as there is no impact on monthly instalment (interest rate is fixed). Whereas tracker loans are shown to have a similar vulnerability to SVR mortgages in the defaulted stock analysis, the picture is different when projecting forward using the LLF model. Hence, due to the far lower interest rate on tracker loans relative to SVRs, the VI inter-quartile range is projected to be 1.53 per cent on SVR loans and 1.16 per cent on trackers. More specifically, the third quantile is projected to be 2.2 per cent for SVR loans and 1.8 per cent for trackers. It is important to reiterate that the model assumes that an increase on interest rates fully passes through to mortgage with SVR interest rates; in practice, this pass-through will be determined by banks' market power and decisions on pricing.

Figure 5d displays the VI variation among different regions. The highest median values for VI are noticed for South-East, Midland and Border regions. In particular, the median VI are close to 1.3 per cent for the South-East, and slightly above 1.1 per cent for Midland and Border, while all other regions have median VI between 0.7 and 1.0 per cent. Furthermore, South-East, Midland and Border are the regions with the largest third quantile which are close to 2.8, 2.5 and 2.1 respectively. Given that we are reporting the average VI across regions, these differences variation in fundamental factors such as unemployment and house prices in these regions, along with other compositional features of each region's mortgage portfolio.

Variation in borrower age is examined in Figure 5e. The under 35 age group is less vulnerable than all the other groups. More specifically, in the forward looking analysis the third

³The largest/smallest value of the whisker is no further than $1.5 * IQR$ from the hinge, where IQR is the inter-quartile range, or distance between the first and third quartiles.

quantile for the under 35 age group is slightly above 1.4 per cent, while for all the other groups it ranges between 1.9 and 2.2 per cent. Furthermore, the median VI for the 36 – 45 age group is projected to be slightly below 1.1 per cent, while for all the other groups the median VI ranges between 0.8 and 0.9 per cent

Single facility loans have smaller VI dispersion than multi-loan facilities, as is shown in Figure 5f. More specifically, the inter-quartile range for single facility loans is 1.2 per cent with the third quantile at 1.7 per cent, while the multi facility loans have inter-quartile range of 3.2 per cent with the third quantile at 3.9 per cent. Furthermore, the median VI is projected to be over 1.1 per cent for multi-loan facilities and close to 0.9 per cent for single-loan facilities.

5 Conclusion

This note estimates the vulnerability of mortgaged Irish households to financial shocks. It performs an analysis by calculating a VI, while it uses aggregate data and loan level data by five main mortgage lenders in Ireland. To estimate the VI this note employs the coefficients from a mortgage default model of the Central Bank of Ireland. The current study provides additional information, relative to previous studies, by calculating a vulnerability measure for all loans that are currently performing, as of December 2016.

The analysis highlights that segments of households are particularly susceptible to economic shocks. In particular, borrowers with high LTV ratios, date of origination between 2004 and 2009 and multiple loans are found as the segments that are relatively more vulnerable to adverse shocks. Furthermore, borrowers in the South-East, Midland and Border regions are more vulnerable in comparison with other regions, reflecting the weaker economic performance in these regions.

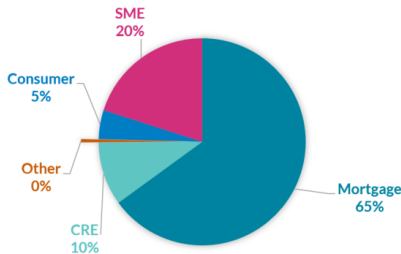
A natural extension of the existing model would be the vulnerability analysis on other segments of the market. For example, future research could follow a similar approach to analyze the vulnerability of households with consumer loans or credit card debt. Additionally, alternative methodologies focussing on the realised repayment burdens of households, and the vulnerability of these burdens to interest rate movements, represent important avenues for future analysis.

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Figures and Tables

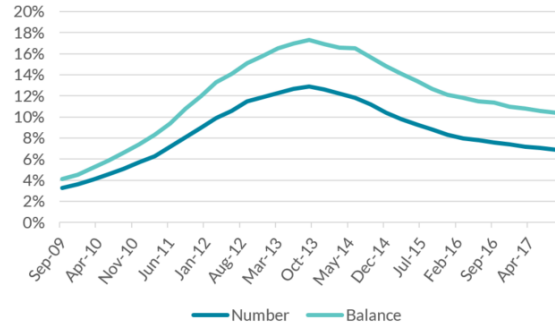
Figure 1 | Exposure of Irish retail Banks (Sept 2017)



Source: Central Bank of Ireland, QFSR Irish retail banks

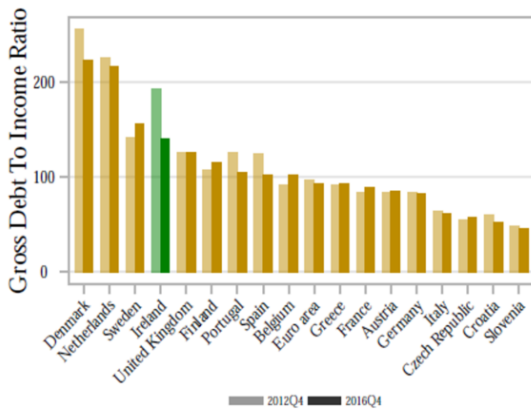
Note: Data are consolidated and are collected in accordance with the Central Bank of Ireland’s QFSR reporting requirements. Lending is represented by drawn exposures.

Figure 2 | Percentage of PDH loan accounts in arrears for more than 90 days past due



Source: Central Bank of Ireland, [Statistics](#)

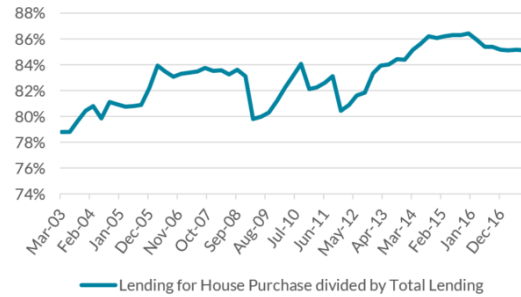
Figure 3 | Debt-to-Income Ratios Across Countries, Q4 2012 and Q4 2016



Source: Source: Central Bank of Ireland, Quarterly Financial Accounts and ECB Statistical Data Warehouse (SDW).

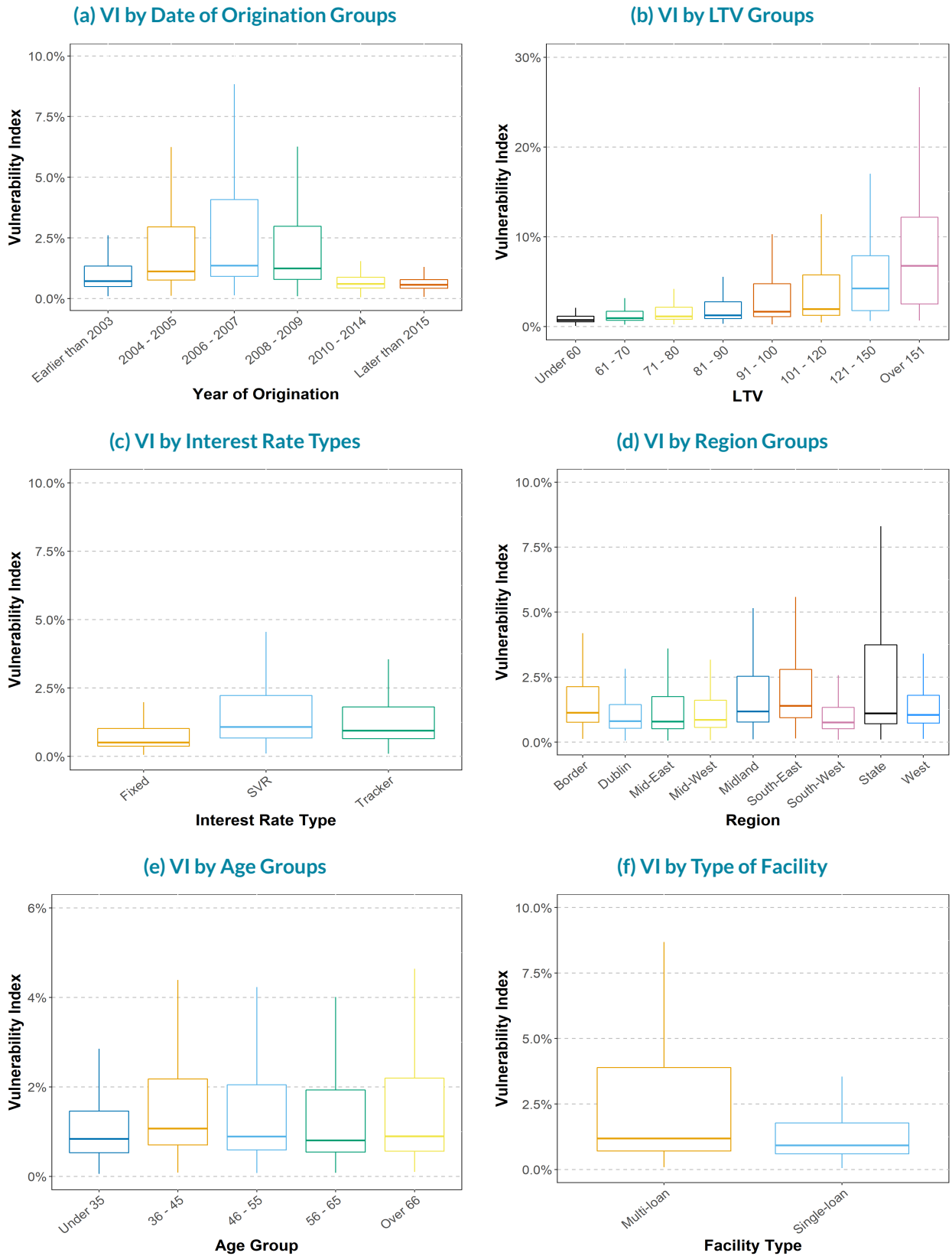
Note: Debt-to-income ratios excluding Ireland taken from ECB SDW.

Figure 4 | Irish Private Households Lending for House Purchase



Source: Central Bank of Ireland, [Statistics](#)

Figure 5 | One-Year Vulnerability Index for all Performing Loans in Ireland as of December 2016



Source: Central Bank of Ireland

Table 1 | Composition on a Count Basis and Default Ratio of PDH Mortgages in December 2016

	Composition on a Count Basis	Default Ratio
Date of Origination		
Earlier than 2004	18.8%	4.6%
2004 – 2005	20.0%	6.8%
2006 – 2007	26.8%	9.2%
2008 – 2009	14.5%	7.2%
2010 – 2014	13.3%	0.8%
Later than 2014	6.5%	0.2%
Interest Rate Type		
Fixed	10.8%	2.3%
SVR	48.0%	6.4%
Tracker	41.2%	6.1%
Current LTV		
Under 61%	53.3%	2.8%
61 – 70%	10.4%	3.6%
71 – 80%	9.0%	4.6%
81 – 90%	7.9%	5.5%
91 – 100%	5.9%	7.5%
101 – 120%	8.7%	10.9%
121 – 150%	3.9%	27.8%
Over 150%	1.0%	67.7%
Age Group		
Under 36	12.3%	4.5%
36 - 45	42.5%	5.5%
46 - 55	30.7%	6.5%
56 - 65	12.9%	6.1%
Over 65	1.7%	5.2%
Type of Facility		
Multi-loan Facility	13.0%	6.5%
Single-loan Facility	87.0%	5.8%
Region		
Border	10.4%	6.6%
Dublin	29.5%	4.6%
Mid-East	13.9%	6.0%
Midland	5.8%	7.6%
Mid-West	9.8%	5.6%
South-East	8.1%	6.2%
South-West	13.5%	4.4%
West	9.1%	4.7%

Source: Central Bank of Ireland

Table 2 | Shocks to property prices, long-term interest rates and unemployment in Ireland

	Property Prices (Level)	Long-term Interest rate (Level)	Unemployment (Level)
Year 0	100	1.2%	9.5%
Year 1	98	2.1%	9.7%
Year 2	97	2.4%	11.1%
Year 3	96	2.3%	12.7%
Cumulative	-4%	1.1%	3.3%

Source: EBA* and CSO**

* The Baseline and the Adverse scenarios are obtained from [EBA 2016 EU-wide stress test results](#). Year 2015 of EBA's results is treated as Year 0 in our analysis.

** The unemployment rate for Year 0 is reported from [Central Statistic Office \(CSO\) database](#).

