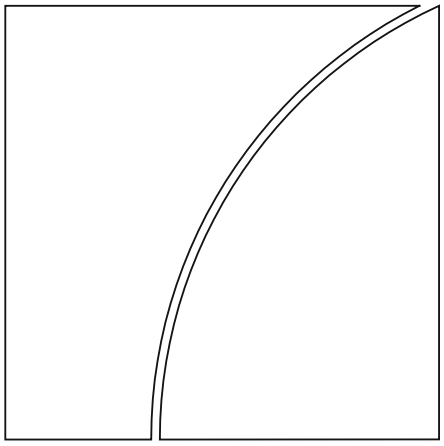

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JEL classification: E12, G51

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Lending to vulnerable households and consumption: Evidence from Korea*

Jieun Lee† and Ilhyock Shim‡

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Abstract

Using a large quarterly consumer credit panel dataset from Korea covering 2017−2023, we present four key findings on the characteristics, lending sources, and macroeconomic consequences of vulnerable borrowers—namely, delinquent borrowers whose debt repayment is overdue at least 30 days, and borrowers whose debt service ratio is higher than 50% but who are not delinquent ("zombie borrowers"). First, zombie borrowers persist over time and rarely switch to delinquency, and hold large amounts of mortgage and other secured loans and thus are asset-rich. Second, we find evidence of continued extension and rollover of loans ("evergreening") to zombie households driven by non-banks. Third, zombie borrowers experience slower consumption growth over three years than normal borrowers, while delinquent borrowers' consumption growth is slower over two years but recovers in three years. Moreover, when interest rates increase, vulnerable borrowers' consumption is more negatively affected than that of normal borrowers. Finally, when the share of zombie borrowers increases in a city, the city's consumption growth significantly declines, driven by low-income and young borrowers. Given that zombie borrowers have a substantial impact on aggregate consumption dynamics in Korea, it is important to introduce stringent and comprehensive regulation on the debt service ratio applied to all types of financial institutions, and design debt relief programs which balance mitigating consumption slowdown and reducing moral hazard.

JEL Codes: E12 , G51.

Keywords: bank, consumption, debt service ratio, delinquency, household debt, non-bank financial institution, zombie borrower.

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1 Introduction

After early 2000s, household indebtedness measured by the household debt-to-GDP ratio reached very high levels in many countries, mostly in advanced economies. The Great Financial Crisis of 2007-09 was a manifestation of the financial stability and real sector impacts of the unwinding of imbalances in housing markets and household debt. Since then, household indebtedness has increased in other economies, particularly in many Asia-Pacific economies and some advanced economies, on the backdrop of globally low interest rates and financial liberalization. However, high levels of household indebtedness have not generated significant financial instability in these economies. Instead, many of them have witnessed weak consumption and GDP growth. This has generated interest in gauging the impact of rising or high levels of household indebtedness on consumption and GDP, especially over the medium to long run (e.g., Mian and Sufi 2018; Mian, Sufi, and Verner 2017; Lombardi, Mohanty, and Shim 2022).

A large literature has shown that the prevalence of zombie firms —defined as those unable to cover debt-servicing costs from current profits —tend to adversely affect economic performance and aggregate productivity (e.g., Acharya et al. 2019, Caballero et al. 2008). However, the notion of borrower vulnerability related to household debt repayment at the individual borrower level has received far less attention.[1] This paper investigates the characteristics of vulnerable borrowers — those with high debt service burdens (zombie borrowers) or difficulties in debt repayment (delinquent borrowers) —and examines their credit access and macroeconomic implications using granular lender type–borrower-level data from Korea.

Korea has had a relatively high level of household indebtedness since mid-2010s. Despite various macroprudential measures introduced over the past few decades (such as loan-to-value (LTV) and debt service-to-income (DSTI) restrictions) (e.g., Jung and Lee 2017; Lee and Jung 2023), household indebtedness has continued to increase and remained high. The overall default rate of household loans has been relatively low, but increasing household indebtedness means that a growing share

[1]Banerjee et al. (2022) report that, beyond aggregate measures of the typical borrower, understanding the distribution of vulnerabilities across borrowers —requiring granular borrower-level data —is crucial for assessing financial stability. However, such disaggregated data with long historical coverage remain scarce in many countries.

of households are likely to be under pressure in repaying debt. In a similar vein, Sufi (2023), using aggregate data, proposes the "credit-driven household demand channel", focusing on the sharp rise in household indebtedness in China and Korea up to 2021, and concludes that while both countries are unlikely to experience a financial crisis, consumer spending could remain weak. Yet few studies have examined borrower vulnerability at the individual borrower level. Leveraging the lender type-, borrower level- and account-level data from Korea's Consumer Credit Panel (CCP) provided by the NICE credit bureau (Kim et al. 2018),[2] we analyze the behavior of vulnerable borrowers in Korea.

The main focus of our paper is to understand the causes, sources of lending, and the macroeconomic consequence of vulnerable borrowers. Specifically, we address the following three questions: First, what causes household borrowers to become financially distressed and fall into the zombie or delinquent status? Second, do financial institutions continue to extend loans to vulnerable borrowers? If so, which types of lenders support them? Third, what is the impact of vulnerable household borrowers on consumption growth in Korea in the short and medium run?

Using a large cross-section quarterly panel of individual borrower-level data from Q1 2017 to Q4 2023, this paper investigates what aspects of borrowers make them vulnerable, including the composition of their loans and lender types. For the empirical analysis, we classify vulnerable borrowers into two groups: (i) zombie household borrowers whose debt service ratio (DSR) exceeds 50, 70 or 90% —indicating an unsustainable debt burden —yet who avoid delinquency by borrowing from banks or non-bank financial institutions (NBFIs); and (ii) delinquent household borrowers with debt repayments overdue by more than 30 days.

We compare zombie and delinquent borrowers in five aspects. First, by calculating the transition probability, we find that zombie borrowers tend to persist (that is, remain zombie) over time and rarely switch to the delinquency status. Second, delinquent borrowers tend to have a much larger share of consumer loans than that of the other types of loan, while zombie households a much larger share of mortgage and non-mortgage secured loans than that of the other types of loan, indicating

[2]This dataset includes information on lender types (e.g., banks, non-bank depository financial institutions (NBDs), and other non-bank financial institutions (NBOs)), loan types (e.g., mortgage loans and consumer loans) and borrower types (e.g., age, self-employed households, and home owners).

that the latter are more likely to be asset-rich. Third, zombie borrowers tend to be more indebted yet have higher credit scores and income than delinquent borrowers, increasing their likelihood of maintaining credit access. Fourth, the share of self-employed borrowers in zombie borrowers is smaller than that in delinquent borrowers. Finally, zombie and delinquent borrowers rely more heavily on loans from NBFIs than normal households do. Overall, these distinct characteristics may lead to different outcomes for credit access and consumption responses.

To investigate the borrowing and consumption behavior of vulnerable borrowers, we use dummy variables for zombie and delinquent borrowers throughout the paper. In addition, we conduct an event-study type analysis by comparing changes in the loan amount, income and credit score of borrowers around the time when their status changes from normal to either zombie or delinquent.

To examine how vulnerable borrowers maintain their status, we test the possibility of evergreening by financial institutions at the lender type-borrower level. Previous studies provide mixed evidence on evergreening. Weakly capitalized banks may either extend credit to zombie or financially distressed households at lower rates to avoid regulatory repercussions (Acharya et al. 2024; Caballero et al. 2008), or reduce such exposure by raising loan rates or ceasing to extend loans, thereby increasing default risk (Favara et al. 2024). Our empirical evidence supports both hypotheses. When normal borrowers turn into zombies, their loan amount slowly increases over the next year indicating the possibility of evergreening. At the same time, we find that zombie borrowers tend to increase total loan amounts at a slower pace than normal households do, indicating a prudential approach to lending to zombie borrowers. When we consider lender types for vulnerable borrowers, we find that vulnerable borrowers tend to increase the share of NBFI loans faster and decrease the share of bank loans faster than normal households. This may be because banks are subject to stricter regulations and may be reluctant to lend to vulnerable households, these households seek additional borrowing from NBFIs.

As the main question of this paper, we investigate the role of vulnerable borrowers in consumption growth over the short and medium term, first at the individual borrower level. Zombie borrowers with higher DSRs exhibit lower future consumption growth than the other borrowers.

This is consistent with evidence on the "wealthy hand-to-mouth"behavior, in which asset-rich borrowers face liquidity constraints and consequently reduce their consumption like hand-to-mouth consumers. Delinquent borrowers also experience lower consumption growth within one to two years, but not after three years. This rapid recovery in consumption is likely linked to government support programs for delinquent low-income households or to borrowers'reluctance to remain in delinquent status, which could hinder their future financial activities. We further find that the adverse impacts of vulnerable household borrowers on consumption growth are more pronounced when the policy rate increases, indicating that vulnerable borrowers' consumption responds strongly to higher debt service burden due to higher interest rates. By contrast, the positive impact of rising house prices on the consumption growth of vulnerable households appears limited, supporting "wealthy hand-to-mouth"behavior rather than "housing wealth effects".

To assess the macroeconomic implications while taking advantage of city-level cross-sectional data on consumption and house prices, we extend the analysis to the regional level by linking city-level outcomes to the city-level share of vulnerable borrowers. We find that cities with higher shares of vulnerable borrowers tend to experience lower future consumption growth. Even though the share of vulnerable borrowers is modest (around 17% of total indebted borrowers), it can significantly dampen city-level consumption, underscoring the importance of the presence of vulnerable household borrowers for macroeconomic conditions at the regional and national levels. These patterns are consistent with earlier findings from using the individual borrower-level data.

These findings provide a few policy implications. First, they highlight the need for policymakers to pay attention to zombie households in addition to delinquent households, especially their consumption dynamics. Second, it is important to have in place stringent regulatory limits on the debt service ratio, which will reduce the probability of a normal household borrower turning into a zombie. Third, given that zombie borrowers tend to rely on NBFIs to continue borrowing, more stringent and comprehensive debt service limits applied to all types of financial institutions are warranted. Finally, debt relief programs on deeply zombie, young and low-income households may help to boost consumption but the attendant moral hazard aspect should be carefully considered.

Related Literature

This study builds on and extends previous research in five areas: zombie household borrowers; the evergreening behavior of financial institutions; the macroeconomic impact of high levels of debt; Korea's household debt using micro data; and wealthy hand-to-mouth households.

First, there is an extensive literature on zombie firms and their impact on investment and GDP growth. The prevalence of zombie firms slows productivity growth by crowing out resources and hindering their efficient resource allocation (e.g., Caballero et al. 2008; Banerjee and Hofmann 2022; Acharya et al. 2019; Adalet McGowan et al. 2018). However, to our best knowledge, this is the first paper to systematically consider the impact of zombie households on consumption.

Second, this paper is part of research on evergreening behavior of financial institutions. It tests the possibility of zombie evergreening at the household level. Weakly capitalized banks may extend more lending to zombie or financially troubled households (either households that transition into zombie status or already zombie households), charge lower loan rates and reduce the default probability of zombies in order to avoid regulatory repercussions and shift risks (as Acharya et al. (2024) show for European banks' credit provision to zombie firms). By contrast, they may reduce their exposure to zombie households, charge higher loan rates and increase the default probability of zombies (as Favara et al. (2024) show for US banks' credit provision to zombie firms), which suggest that banks do not drive a proliferation of zombie households and their survival. Our dataset at the lender type-borrower level enables us to test evergreening behavior of financial institutions in Korea.

Third, many recent papers consider the macroeconomic effects of high levels of debt in the short and long run. Cecchetti et al. (2015) consider the GDP impact of high levels of government debt. Lombardi et al. (2022) focus on the GDP and consumption impact of high levels of household debt. Cecchetti et al. (2011) consider the impact of high levels of corporate debt on GDP growth.

Fourth, several papers use household panel data in Korea and Japan to consider the behavior of household borrowers' consumption. In particular, using Korea Labor and Income Panel Study (KLIPS) data covering 8,716 households from 2017 to 2021, Oh et al. (2022) find that when the DSR increases by 1 percentage point, the average consumption of all households fall by 0.37% annually. They also find that when the DSR rises, consumption falls more for high- and middle-income households than for low-income households because low-income households have low shares of discretionary consumption and thus cannot

easily reduce consumption further, while high-income households have high shares of discretionary consumption and thus ample room to reduce consumption further. Nakajima (2020) estimates the impact of household debt on consumption using survey data from the Japanese Preference Parameters Study. He finds that household income elasticity of consumption is significantly higher for highly-indebted Japanese households than for those with little-to-no debt, and that this result is only significant for negative income changes. He interprets the result as evidence pointing to a significant precautionary saving motive by Japanese households. Existing papers mainly use survey data, where the tails of the income distribution are poorly represented (Ampudia et al. 2018) and lack of detailed sources of loans either from banks or non-bank financial institutions. Our credit bureau dataset, which provides quarterly measures of consumption and household loans, further contributes to the literature by offering borrower-level data with fewer measurement errors than survey data.

Finally, recent studies on wealthy hand-to-mouth households in the United States document a high marginal propensity to consume (MPC) among wealthier consumers who nevertheless hold little liquid wealth and therefore behave like liquidity-constrained households (Kaplan et al. 2014; Kaplan and Violante 2014; Kaplan, Violante, and Weidner 2014; Jappelli and Pistaferri 2020). Despite owning sizable housing assets, many Chinese mortgage borrowers have low liquid wealth and thus behave as wealthy hand-to-mouth consumers, making their consumption highly sensitive to changes in mortgage payments and disposable income induced by interest-rate shocks (Agarwal et al. 2022). Park (2017) similarly examines Korean wealthy hand-to-mouth households whose wealth is concentrated in illiquid assets such as housing and real estate. By contrast, the wealth-effect hypothesis argues that rising house prices stimulate consumption by increasing perceived housing wealth or by easing liquidity constraints faced by indebted households (e.g., Case et al. 2005; Zhou and Carroll 2012). Our evidence points to the presence of wealthy hand-to-mouth households in Korea, in particular among zombie borrowers, who are asset-rich yet exhibit weak consumption, consistent with the evidence of liquidity constraints by highly indebted households.

The remainder of the paper is organized as follows. Section 2 describes data sources, key variables and sample construction. Section 3 presents the characteristics of vulnerable households in Korea. Section 4 presents the empirical results on evergreening loans to vulnerable households. Section 5 analyses the relationship between vulnerable households and consumption growth. Finally, Section 6 concludes the paper and provides some policy implications.

2 Data sources, key variables and sample construction

This paper relies on quarterly Korean consumer credit panel (CCP) data at the individual and household borrower and loan level, including loan and lender types, obtained from the NICE Information Service, a credit bureau, over the 28 quarters from Q1 2017 to Q4 2023 as our main dataset. The CCP dataset is subject to minimum sample selection bias because it is extracted from the credit bureau data through a simple random sampling method.[3] In addition, the dataset is more accurate than self-reported survey data.[4] More specifically, the sample includes de-identified (i.e. anonymized) data on household debt, credit card spending, and individual borrower characteristics variables (e.g., credit score, age, sex, estimated income), covering about 40% of randomly selected 235 million individual borrowers who have credit history (about 4.2% of the total population). We can also track whether borrowers experience delinquency. A borrower's income is estimated by the NICE Information Service based on past proven income, credit card usage, job information, and real estate information (Kim et al. 2018). The main variables of interest are consumption, debt service amount, household loan amount, estimated income, and delinquency. We winsorize the variables on consumption, estimated income, and debt service ratio (DSR) at the upper 2% level to reduce the influence of extreme values on empirical results.

In line with prior studies (e.g., Ganong and Noel 2020; Agarwal et al. 2022), we use credit card spending as the proxy of consumption because credit card spending captures a large share of consumption as a prevalent and important method of household spending in Korea. In addition, the right-hand panel of Figure A.3.2 in Appendix A.3 shows that the growth rate of credit card spending in the sample and that of official consumption are highly correlated with the correlation coefficient of 0.9 at the aggregate level. This indicates that credit card spending can be a good proxy for consumption, especially in Korea.

Importantly, the CCP dataset provides loan-level data (e.g., loan amount by loan category, lender type and number of loan accounts) and the estimated amount of household income, which enable us to measure borrowers' repayment capacity via the debt service-to-income (DSTI) ratio or DSR of individual borrowers. We use DSR as a barometer of household leverage and financial resilience.

[3]The CCP dataset may contain access issues, errors, and outliers arising from the credit information registration process at financial institutions. It is a nationally representative random sample of approximately 2.35 million individuals (4.2% of the population). However, when the data are disaggregated by industry, product type, or region, the representativeness of the sample may be reduced.

[4]Existing research primarily relies on survey data from households, but often fails to adequately present the tails of income distributions (Ampudia et al. 2018).

It should be noted the CCP dataset provides detailed information on the amortization method (such as the full amount of the principal amortized equally over the maturity of the loan; no amortization (i.e., the full amount of the principal is repaid at maturity); and a mixture of these two) for 10 types of household loan. In our baseline scenario, the debt service amount includes both the repayment of loan interest and amortization (that is, total debt service).[5] [6]

Furthermore, the loan account-level data provide information on the terms of lending such as loan maturity, repayment methods (e.g., lump sum payments or equal installments of the principal, equal installments of the principal and interest), and actual principal and interest payments. It is important to note that a household borrower can have many types of loan such as housing mortgages, home-equity loans, credit card loans, non-mortgage secured loans, other consumer loans, student loans and auto loans. If a household borrower has multiple loans, or a household has many borrowers who have different loans, we need to aggregate all these loans within a household to calculate the household-level DSR.[7] [8]

The sample of this paper consists of all household borrowers who have loan information in at least three consecutive years and full information on consumption, household debt, and income. We exclude households whose total loan amount is greater than KRW 10 billion and have histories of negative income and consumption. The final sample covers on average around 432,000 borrowers for each quarter from Q1 2017 to Q4 2023 (28 quarters) randomly chosen from 235 million borrowers in the CCP dataset (Table 1).

In addition to household- or loan-level data, we employ city-level and macroeconomic variables such as house prices and interest rates, respectively. Since house prices are not available for the whole sample period at the borrower level, we combine house price index at the city level with borrower-level data. If

[5]As an alternative definition of a debt service amount, we can use loan interest payment only as the debt service amount. The average total DSR for each status of households (normal, zombie and delinquent) is around 3-4 times the average interest-only DSR. It should be noted that this interest-only DSR is in line with the calculation of the DSR in Korea's DSTI rules.

[6]Given that we have accurate information on the amortization terms of each loan, we can calculate the required amount of scheduled debt service accurately. Similarly, Ringo (2024) shows how to calculate the debt service amount for each household using data from the New York Fed/Equifax Consumer Credit Panel. When such loan-level or credit bureau data are unavailable, previous papers (e.g. Drehmann and Juselius 2012, Dynan et al. 2003) used estimates of the aggregate debt service ratio calculated under strong assumptions.

[7]Please refer to Appendix A.2 for the detailed explanations for computing DSR in this paper.

[8]For example, US households paid in 2023 roughly the same amount of interest on mortgages and other kinds of debt such as credit cards and student loans, according to the Bureau of Economic Analysis in 2023. See the following Bloomberg article: https://www.bloomberg.com/news/articles/2024-03-05/americans-now-pay-as-much-interest-on-other-debt-as-on-mortgages?sref=HTaPrP6T. In our final sample, a significant share (10% of normal households and 21% of vulnerable households) of observations is for self-employed individuals or very small-sized firms (Table 1).

city-level house price data are missing, we use the average house price index for all regions from the Korea Real Estate Board.[9]

3 Vulnerable households in Korea

3.1 Identifying vulnerable households

This paper defines vulnerable borrowers as either highly indebted borrowers or delinquent borrowers.[10] In particular, we use the term "zombie borrowers" for highly indebted household borrowers. There is no formal definition of zombie households in the literature, in contrast to many studies on zombie firms. Simply speaking, zombie borrowers in this paper are household borrowers whose debt service burden is non-viably high but are able to avoid delinquency or default. Specifically, we consider household borrowers whose DSTI (debt service-to-income) ratio or DSR is above 50%, 70%, or 90%. Johnson and Li (2010) find that based on US household survey data, households with the DSR in the top two quintiles of the distribution —generally above 20% —are more likely to experience financial distress than the other households. In a similar vein, this paper adopts the top 20% of the DSR distribution, which corresponds to the DSR threshold of approximately 50%, as the primary cutoff when analyzing household vulnerability (see Figure A.3.1 in Appendix A.3).

Our definition of a zombie borrower is derived from the literature on zombie firms (eg, Acharya et al. 2019;Acharya et al. 2024; Banerjee and Hofmann 2022; Favara et al. 2024). Existing studies have used many criteria to detect zombie firms (see Acharya et al. 2022 for a recent review). For example, Adalet McGowan et al. (2018) and Acharya et al. (2019) define zombie firms as those in financial distress (e.g., leverage or stock concept), those unable to generate sufficient revenues to meet payments on outstanding loans (e.g., income vs debt payment or flow concept) and those which have subsidized credit. It is generally accepted that zombie firms are highly levered, non-viable entities that stay afloat through borrowing more.

Similarly, we define zombie household borrowers as risky borrowers who survive with borrowing from banks or other NBFIs and thus avoid delinquency or default. In our baseline regressions, a household is

[9]https://www.reb.or.kr/r-one/main.do

[10]Previous papers show the importance of DSR as the early warning indicators of financial stability (Drehmann et al. 2024; Drehmann and Juselius 2014).

defined as in the zombie status if its debt service burden is high with the DSR greater than 50%, 70% or 90%.[11] As an alternative and more strict definition of zombie household borrowers, we can consider only the borrowers who maintain the zombie status for at least two consecutive years. The empirical results using this alternative definition of zombie borrowers are similar to those from the baseline definition.[12] Delinquent borrowers who have not formally defaulted are determined by whether borrowers are more than 30 days late in repaying their debt, similar to the financial distress (FD) measure in Mustre-del Río et al. (2025).[13] Data on delinquency can be easily obtained from the CCP dataset at the individual borrower level.

Among the 12.1 million total number of observations in the sample reported in Table 1, around 10.3 million observations (85%) are on normal households and around 1.8 million observations (15%) on vulnerable households consisting of 14% on zombie households whose DSR is above 50% and 1% on delinquent households (Figure 1).[14] This means that the share of vulnerable households in total households with loans is economically significant. Among the observations on vulnerable households, 34% have the DSR between 50 and 70%, 18% between 70 and 90% and 42% greater than 90%, while the remaining 6% are observations on delinquent households.

[11]The latter two thresholds are derived from the DSR guideline titled "Debt service ratio (DSR) to be introduced as household debt management standard", released on October 18, 2018 by the Financial Services Commission (FSC). The FSC defines a borrower with the DSR greater than 70% and 90% as a "risky" and "highly risky" borrower, respectively.

[12]The total DSR and interest-only DSR requirements have a rational that households do not have enough income to cover all interest payments or interest plus principal payments. In the household debt literature, the DSR has often been used to identify households with borrowing restrictions or determine the likelihood of default (eg Johnson and Li 2010). Especially, the interest-only DSR is in line with the standard zombie literature which assesses debt repayment as a flow concept related to the interest coverage ratio (ICR). We can use the interest-only DSR as a proxy for the ICR since the two variables have an inverse relationship. If the discretionary income of zombie household borrowers is around 50-70% of total income after deducting the minimum or subsistence level of consumption and various tax payments, zombie borrowers' debt service amount is larger than their discretionary income, which is similar to the ICR less than 1 for zombie firms. For low-income household borrowers who pay no tax, their discretionary income is around 70-80% of total income, which justifies the DSR thresholds of 70% and 90%. Finally, we can combine these DSR metrics with the number of loan accounts or poor credit score following the zombie firm literature (e.g., McGowan et al. 2018, Acharya et al. 2019, and Acharya et al. 2020).

[13]This paper explains why household FD is a useful and timely measure of financial vulnerability.

[14]The actual number of observations used in regression analyses reported in Tables 4 to 8 differ depending on the availability of data for specific variables used in each regression, ranging from 9.6 million to 18.7 million.

3.2 Characteristics of vulnerable household borrowers

Panel A of Table 1 presents summary statistics for vulnerable and normal household borrowers. Vulnerable borrowers appear to have lower income and credit scores, higher consumption and loan amounts, and are older, more self-employed and more likely to hold mortgages (columns (1)−(3)) than normal borrowers. In particular, the average quarterly income, consumption, and debt service amount of normal borrowers are KRW 9.87 million, KRW 6.76 million, and KRW 1.45 million, respectively, with an average loan amount of KRW 60.2 million. In contrast, vulnerable borrowers have an average quarterly income, consumption, and debt service amount of KRW 8.81 million, KRW 7.91 million, and KRW 8.78 million, respectively, with an average loan amount of KRW 201.6 million. Therefore, the ratio of average consumption to average income (a proxy for average propensity to consume) for normal borrowers (68.4%) is lower than that for vulnerable borrowers (89.7%). Also, the average debt-to-average annual income ratio for normal borrowers (1.5) is much lower than that for vulnerable borrowers (5.7).

Within vulnerable borrowers, zombie and delinquent borrowers show distinct characteristics (columns (4) − (7)). First, zombie borrowers with the DSR above 50, 70, and 90% exhibit significantly higher consumption (around KRW 8 million per quarter) than delinquent borrowers (about KRW 3.6 million per quarter). Second, zombie borrowers have a significantly larger amount of outstanding loans (KRW 211−252 million) than delinquent borrowers (KRW 53 million). Third, the average credit score of zombie borrowers (860-868) is much higher than that of delinquent borrowers (329). Finally, the share of self-employed borrowers in zombie borrowers (0.2−0.22) is smaller than that in delinquent borrowers (0.31). Notably, the average credit score of normal borrowers (845) and the share of self-employed borrowers in normal borrowers (0.1) are lower than the average credit score of zombie borrowers (860) and the share of self-employed borrowers in zombie borrowers (0.2), respectively. These may partly explain the greater average loan amount of zombie borrowers than that of normal borrowers because household borrowers with higher credit scores can borrow more and self-employed borrowers tend to borrow more to run their businesses (often in the form of non-mortgage secured loans as shown in Panel B of Table 1) than non-self-employed borrowers.

Within the zombie group, the characteristics vary by DSR level (Appendix Table A.3). As the DSR increases from 50−70% to 70−90% and then to +90%, zombie borrowers tend to have lower average income and consumption, higher loan amounts and credit scores and a greater share of self-employed individuals

and the owners of mortgage loans and non-mortgage secured loans. Therefore, as the DSR increases from 50−70% to 70−90% and then to +90%, the ratio of average consumption to average income for zombie borrowers increases marginally from 90% to 93% and then 96%, respectively. In contrast, the ratio for delinquent borrowers is only 40%. This implies that once household borrowers face delinquency, they tend to substantially reduce consumption to return to the normal status. Also, as the DSR increases, the average debt-to-average annual income ratio for zombie borrowers increases substantially from 4.5 to 5.3 and then to 7.6. In contrast, the ratio for delinquent borrowers is low at 1.5, which is about the same level as that for normal borrowers.

Panel B of Table 1 presents the composition of household loans by loan and lender type. Vulnerable borrowers hold a higher share of mortgages and non-mortgage secured loans and a lower share of other types of loan than normal borrowers. They also rely less on banks and more on non-bank lenders than normal borrowers (columns (1) and (2)).

Again, zombie and delinquent borrowers show distinct characteristics in terms of loan and lender types (Table 1, Panel B, columns (4)−(7)). Zombie households predominantly (72−79%) borrow in the form of mortgages and non-mortgage secured loans. So, they are more likely to be asset-rich. By contrast, delinquent households rely predominantly (86%) on other types of loans which are mostly consumer loans. This means that, despite low levels of the debt-to-income ratio, delinquency is likely to be mainly for consumer loans, and that zombie borrowers rarely transition to the delinquency status (as shown later in Table 3).

Figure 2 illustrates similar trends by lender and loan type over time. Panel A shows that banks account for about 60% of loans to normal borrowers, 40% to zombie borrowers, and 20% to delinquent borrowers, indicating greater reliance on non-banks among vulnerable borrower groups. Specifically, zombie borrowers depend more on non-bank depository institutions (NBDs) (e.g., savings and mutual finance banks), which account for 40−50% of their loans. In addition, deeply zombie borrowers with the DSR above 90% rely on more borrowing from NBDs than zombie borrowers with the DSR above 50%. In contrast, delinquent borrowers rely more on non-bank other institutions —such as business entities and credit card companies —at around 40%, likely reflecting limited access to traditional credit due to low income and credit scores. Panel B reveals that zombie borrowers hold notably larger amounts of mortgage and non-mortgage secured loans than normal or delinquent borrowers. In addition, deeply zombie borrowers with the DSR above

90% rely more on non-mortgage secured loans than zombie borrowers with the DSR above 50%.

The distinct characteristics of zombie and delinquent borrowers in terms of consumption, loan amounts and types, and lender types imply that we will need to keep these distinctions in mind when we conduct empirical analyses on the behavior of vulnerable households.

3.3 Factors explaining the probability of being vulnerable borrowers

This section more formally examines the factors associated with becoming a vulnerable borrower using logit regression models. The dependent variables are dummies indicating whether a borrower i in quarter t is classified as a vulnerable borrower (VULNERABLE): either a zombie (Z(50+), Z(70+), Z(90+)) or delinquent borrowers (DEQ). Borrower characteristic variables are included to identify factors linked to household vulnerability.

Columns (1) to (5) in Table 2 present the results including the DSR. Consistent with the definition of vulnerable borrowers, when a household borrower's DSR increases by 10 percentage points, after controlling for borrower characteristics such as income, credit score, and age, the probability of the borrower becoming a vulnerable borrower increases by 6 percentage points (column (1)). Notably, we find different impacts of a higher DSR on the probability of being a zombie versus a delinquent borrower. When a borrower's DSR increases by 10 percentage points, the probability of the borrower becoming a zombie borrower increases by 5-6 percentage points (columns (2)-(4)), but the probability of the borrower becoming a delinquent borrower increases by less than 0.5 percentage points (column (5)). The low sensitivity of the delinquency probability to the DSR is consistent with the stylized fact on the low debt-to-income ratio of delinquent borrowers reported in the previous section.

We further run the similar logit regression models after replacing the DSR with dummies for mortgage and non-mortgage secured loans, as well as a dummy for self-employment. Columns (6) to (10) in Table 2 present the results. After controlling for borrower characteristics such as income, credit score, and age, we find that a household borrower holding mortgage loans or non-mortgage secured loans has a higher probability of being vulnerable than one who does not hold such loans, and that a self-employed borrower is more likely to become vulnerable than one who is not self-employed (column (6)). In particular, the probability of a borrower being vulnerable is 2.3 times higher when the borrower has a positive amount of non-mortgage secured loans (0.463) than when it has a positive amount of mortgage loans (0.208).

Again, we find different impacts of higher shares of borrowers with mortgage loans or non-mortgage secured loans on the probability of being a zombie versus a delinquent borrower. A household borrower holding mortgage loans or non-mortgage secured loans has a higher and economically significant probability of being a zombie than the probability that a borrower who does not hold such loans is a zombie (columns (7)-(9)). In particular, the coefficient on the dummy variable for a borrower holding a positive amount of non-mortgage secured loans (0.46, 0.35, and 0.27 for Z(50+), Z(70+), and Z(90+), respectively) is greater by 2.3-2.7 times than the coefficient on the dummy variable for a household holding a positive amount of mortgage loans (0.20, 0.14, and 0.1 for Z(50+), Z(70+), and Z(90+), respectively). Also, a self-employed borrower is economically significantly more likely to become a zombie than a borrower who is not self-employed (columns (7)-(9)).

By contrast, a borrower holding mortgage loans or non-mortgage secured loans has a higher but economically insignificant probability of being delinquent than the probability that a borrower who does not hold such loans is delinquent (column (10)). In particular, the coefficient on the dummy variable for a borrower holding a positive amount of mortgage loans (0.008) is greater by 2.7 times than the coefficient on the dummy variable for one holding a positive amount of non-mortgage secured loans (0.003). Also, a self-employed borrower is more likely to become a zombie than one who is not self-employed (column (10)), but the coefficient on the self-employment dummy for the probability of being a delinquent borrower is 4-7 times smaller than that for the probability of being a zombie borrower. The low sensitivity of the delinquency probability to the dummy for a household borrower holding mortgage loans or non-mortgage secured loans is consistent with the stylized fact on the very large share of other loans in total loans for delinquent households reported in the previous section.

Overall, we find that the DSR is less important in explaining the probability of being a delinquent borrower than that of being a zombie borrower. Between mortgage loans and non-mortgage secured loans, non-mortgage secured loans are associated with a higher probability of a household borrower being a zombie than mortgage loans, but the opposite is true for the probability of a household borrower being delinquent. Finally, self employment is associated with a higher probability of a household borrower being vulnerable, while higher income and credit scores a lower probability.

3.4 Transition probability: normal, zombie and delinquent borrowers

This subsection examines how vulnerable household borrowers —including zombie and delinquent borrowers —maintain or change their status over time by computing transition probabilities. For each initial status in period t, the sum of probabilities of transitioning to the normal, zombie and delinquent status in period $t+k$ (for k=1 to 12) equals 1; that is, values in each row sum to 1.

Table 3 shows that zombie borrowers are more likely to remain in that status, especially in the near term and at lower DSR threshold levels. For instance, borrowers with the DSR above 50% in a given quarter q have a 0.876 probability of remaining zombies in the next quarter $q+1$ as shown in the left-hand section of Panel A. This probability declines to 0.489 over a three-year horizon as shown in the left-hand section of Panel F. The persistence is also weaker as the DSR threshold becomes higher. For instance, Panel D shows that after one year, the retention rate is 72.6% for the 50%+ DSR group and 66.2% for the 90%+ DSR group.

In contrast, delinquent borrowers in period t have a relatively high probability of returning to the normal status —ranging from 0.274 in one quarter to 0.852 in three years. Similarly, the recovery of zombie borrowers to the normal status becomes more likely at higher DSR levels and over longer horizons. For instance, borrowers with the DSR above 90% have a 60.6% probability of returning to the normal status after three years, while those with the DSR above 50% have a 12.0% probability of returning to the normal status after one year (Table 3, Panel F, right-hand section).

Overall, normal borrowers become vulnerable borrowers over three years with a very small probability ranging from 0.3% to 8.2%. And delinquent borrowers have a higher likelihood of returning to the normal status than zombie borrowers have. This may reflect greater access to government support programs available to delinquent borrowers. Finally, zombie borrowers are more likely to remain in the zombie status than to switch to the normal status over the next two years. Despite lower income levels, they tend to be asset-rich and avoid default, holding both mortgage and non-mortgage secured loans.[15] These findings suggest the need to investigate potential evergreening of loans to vulnerable household borrowers by financial institutions in Korea and its macroeconomic implications, particularly for consumption growth.

[15]See Park (2017) for the characteristics of wealthy hand-to-mouth households in Korea whose wealth is highly concentrated on illiquid assets such as housing and real estate. For the definition of wealthy hand-to-mouth households, see Kaplan et al. (2014).

4 Evergreening loans to vulnerable household borrowers

4.1 Lending to vulnerable borrowers by all financial institutions

We begin our empirical analysis by examining financial institutions' lending to vulnerable households. This analysis aims to understand whether and how financial institutions may engage in evergreening loans to vulnerable households to avoid their default. Before conducting regression analysis, we examine how key borrower characteristics changed around the event quarter, defined as the time when borrowers become classified as zombie (i.e., with the DSR exceeding 50%, 70%, or 90%) or as delinquent. To figure out the evergreening behavior of financial institutions toward vulnerable borrowers, we restrict the sample to borrowers with a credit history including loan amounts covering at least two quarters before and four quarters after the event quarter.[16]

Figure 3 illustrates fluctuations in the DSR, loan amounts, borrower income, and credit score around the event quarter. Panel A displays the evolution of these variables before and after household borrowers become vulnerable at time 0. Panel B presents a similar analysis but restricts the sample to zombie borrowers that were normal before transitioning to the zombie status at time 0. Both panels show similar trends that zombie borrowers experience sudden increases in loan amounts, possibly to purchase housing or other non-housing assets shown in Table 1. In other words, the DSR level tends to rise sharply due to large increases in loans for asset purchases, rather than through gradual loan growth.

Notably, zombie and delinquent borrowers exhibit distinct patterns. First, Panels A and B show that zombie household borrowers experience a sharp increase in the loan amount during the event quarter ($t = 0$), followed by gradual increases in the loan amount over the subsequent four quarters. This may indicate evergreening —a tendency more pronounced among the zombie borrowers with higher DSRs and credit scores. Panel B shows that the increase in the loan amount after the event quarter is most pronounced when a borrower's DSR increases from a level below 50% to a level between 70% and 90%, and that the decrease in borrower income during the event quarter is most pronounced when a borrower's DSR increases from a level below 50% to a level above 90%. In contrast, delinquent borroweers tend to exhibit a declining trend in loan amounts over time, possibly due to financial institutions'reluctance to extend further loans

[16]After we apply the restriction, the sample size decreases from 194,094 to 86,259 for zombie borrowers and from 38,354 to 16,721 for delinquent borrowers.

as borrowers' credit score deteriorates and their income decreases.

Second, zombie borrowers experience a temporary decline in income from KRW 39-40 million to KRW 36 million during the event quarter, but income recovers within a year to near the pre-event level. The decline in income during the event quarter contributes to sharp increases in the DSR of zombie borrowers during the quarter. In contrast, delinquent borrowers undergo a gradual and sustained drop in income over the same period, from around KRW 34 million to KRW 32 million. Note that such reductions in income contribute to increasing the DSR, but the loan amount falls faster, so the DSR falls during and after the event quarter.

Third, the credit score of zombie borrowers only slightly decreases during the event quarter but stays at more or less the same level after becoming zombie. In contrast, the credit score of delinquent borrowers starts to fall already a quarter before it becomes delinquent, and sharply falls during the event quarter and one quarter after. This implies that a fall in the credit score may have triggered declines in the loan amount to a borrower and the classification of the borrower as delinquent may have led to further declines in the credit score, which prompted financial institutions to further reduce the loan amount.

Taken together, the DSR level of zombie borrowers tends to remain elevated or even increases —especially for those with higher initial DSRs —primarily due to rising loan amounts after the event quarter despite income recovery. In contrast, the DSR level of delinquent borrowers decline over time, suggesting that the reduction in loan amounts has exceeded the reduction in income, possibly reflecting stringent debt repayment requirements imposed by financial institutions. This result provides evidence of evergreening loans extended to zombie borrowers by financial institutions.

Referring to Acharya et al. (2019) and to further test the evidence of evergreening of loans to vulnerable borrowers after controlling for other variables that are associated with household loans, we run the following regression model on loan growth (1) with data aggregated at the lender-borrower-city-quarter level:

$$\mathrm{Y}_{b,i,c,q} = \beta_0 + \beta_1 \text{Zombie or DEQ}_{i,q-k} + \beta_2 \mathrm{X}_{i,q} + \alpha_i + \gamma_{c,q} + \delta_{b,q} + \epsilon_{b,i,c,q}, \tag{1}$$

where Y denotes the outcome variable of interest in the lending relationship between lending institution b and borrower i (in city c) in quarter q. The three outcomes capture the intensive and extensive margins of lending: log(LMT), NEW_LOAN, and dlog(LMT). log(LMT) is the log of the total loan amount.

NEW_LOAN is a dummy equal to 1 if the borrower experiences positive loan growth. dlog(LMT) is the log difference of the total loan amount.

Our main variables of interest are dummies for vulnerable borrowers, including zombie and delinquent borrowers: $Z(50+)$, $Z(70+)$, and $Z(90+)$ are dummies for highly indebted household borrowers whose DSR exceeds 50%, 70%, and 90%, respectively. DEQ is the delinquent borrower dummy which is equal to 1 if debt payments are overdue by more than 30 days.

X_{iq} is a vector of borrower-specific controls, consisting of age group dummies for middle-aged ($40s-50s$) and elderly (60 and above) individuals, log income (log(INCOME)), a dummy for the self-employment status (SELF_EMP), a dummy for mortgage loan holders (MLOAN), and log credit score (log(C_SCORE)). Our baseline specification includes an array of fixed effects, such as borrower fixed effects (α_i) to capture unobserved time-invariant individual borrower-level heterogeneity, CITY x YQ fixed effects ($\gamma_{c,q}$) to control for time-varying unobserved demand shocks related to house prices that are specific to a city and common across all financial institutions lending to borrowers in the same city. With the inclusion of FI x YQ fixed effects ($\delta_{b,q}$), we also capture unobserved quarter-by-quarter shocks to financial institutions' balance sheet and capital adequacy ratios.

Table 4 examines how vulnerable household borrowers —despite being financially troubled —secure loans that may facilitate evergreening. Panel A presents the results for the short-term horizon (q-1), while Panel B covers the longer-term horizon (q-4). If the coefficients of interest (β_1) are positive, this implies a higher level of the loan amount outstanding, a higher share of borrowers with increases in loan amounts, and a higher loan growth rate for a specific type of vulnerable borrowers than the other borrowers.

The results reported in the left-hand section of Panels A and B (columns (1) to (4)) show that vulnerable borrowers hold significantly larger loan amounts than normal households ($\beta_1>0$) in both the short-term and longer-term horizons. These results are consistent with Table 1.

The center section of Panel A (columns (5) to (8)) shows that existing lenders are more likely to extend new loans (i.e., increase the loan amount) to zombie borrowers with the DSR above 70% and those with the DSR above 90% than to the other types of borrower in the short term. This result is consistent with what Figure 3 shows. In contrast, we obtain the opposite results for zombie borrowers with the DSR above 50% and delinquent borrowers. Similarly, the center section of Panel B (columns (5) to (8)) indicates that in the longer term (i.e. after one year), vulnerable borrowers are more likely to face difficulties with obtaining

new loans than the other borrowers.

The right-hand section of Panels A and B shows that the loan growth rate for vulnerable borrowers is lower than that for the other types of borrower in both the short and longer terms. Notably, delinquent borrowers face much lower loan growth than the other borrower groups in the short term as shown in column (12) of Panel A (i.e., around 14 percentage points lower) but almost the same loan growth rate in the longer term as shown in column (12) of Panel B. This implies that delinquent borrowers can get out of the delinquency status and start borrowing again after some years either by repaying debt by themselves or with the help of government support programs.

The results reported in Figure 3 indicate that financial institutions increase the amount of loans to household borrowers within a year after they become zombie. The results in Table 4 show that over a longer-term (beyond one year) horizon, zombie borrowers are less likely to increase loan amounts and more likely to face slower loan growth than the other types of borrowers. Overall, these findings can be interpreted that Korean financial institutions apply prudent lending standards to zombie households, by increasing the absolute loan amounts to zombie borrowers in the short run but increasing loans to them at a slower pace than to the normal borrowers in the longer term in order to limit the vulnerable borrowers' ability to take on additional debt as their vulnerable status persists over time.

4.2 Lending to vulnerable households by type of financial institutions

The analysis in the previous subsection uses the total amount of loans extended by all types of financial institution. In this subsection, we consider if the share of loans extended by banks or non-bank financial institutions is different for vulnerable borrowers from that for normal borrowers. Given borrowing costs and lenders' risk preferences, households may want to borrow in the following order of lenders: banks, non-bank depository institutions, and other non-bank institutions. To confirm this conjecture, we first test if the share of loans extended to vulnerable households by banks, non-bank depository institutions or other non-bank institutions or its change is larger for vulnerable borrowers than the other borrowers. In particular, we estimate the following borrower-level specifications:

$$\text{Share of FI}_{iq} = \beta_0 + \beta_1 \text{Zombie or DEQ}_{i,q-k} + \beta_2 \text{X}_{iq} + \alpha_i + \gamma_c + \delta_q + \epsilon_{iq}, \tag{2}$$

$$\Delta\text{Share of FI}_{iq} = \beta_0 + \beta_1 \text{Zombie or DEQ}_{i,q-k} + \beta_2 \text{X}_{iq} + \alpha_i + \gamma_c + \delta_q + \epsilon_{iq}, \quad (3)$$

where FI includes banks (BANK), non-bank depository institutions (NBD), and other non-bank institutions (NBO). The dependent variables are the share of banks, NBD, and NBO and its change. The main variables of interest are lagged dummies for zombie and delinquent borrowers (q-1 or q-4). Control variables include age group dummies, log income, dummies for the self-employment status and the mortgage loan status, and log credit score. Borrower, city, and quarter fixed effects are included.

Panel A of Table 5 shows results on the share of banks. In particular, the left-hand section of Panel A shows that zombie household borrowers tend to have a lower share of bank loans one year later ($\beta_1<0$) than that of the other types of borrowers (columns (1) to (3)), indicating that zombie borrowers have greater reliance on non-bank institutions. When we look at the change in the bank loan share (the right-hand section of Panel A), we find that zombie borrowers with the DSR above 70% or 90% face a smaller increase in the share than the other borrowers (columns (5) to (7)). In contrast, the coefficients on delinquent borrowers are positive (columns (4) and (8)), indicating that banks tend to provide more loans to delinquent households than to the other borrowers and that delinquent borrowers face a larger increase in the bank loan share than the other borrowers.

Panel B presents results on the share of NBDs. Zombie household borrowers tend to have a higher share of NBDs than the other borrowers after one year (columns (1) to (3)). When we look at the change in the NBD loan share, we find that zombie borrowers face a smaller increase in the share than the other borrowers (columns (5) to (7)). Similarly, the coefficients for delinquent households are negative (columns (4) and (8)), indicating that NBDs tend to provide less loans to delinquent households than to the other borrowers and that delinquent borrowers face a smaller increase in the NBD loan share than the other borrowers.

Panel C shows results on the share of NBOs as a flip side of what we show in Panels A and B altogether. Zombie household borrowers tend to have a lower share of NBOs than the other borrowers after one year (columns (1) to (3)). When we look at the change in the NBO loan share, we find that zombie borrowers face a greater increase in the share than the other borrowers (columns (5) to (7)). In contrast, the coefficient for delinquent households is significantly negative (column (8)), indicating that delinquent borrowers face a smaller increase in the NBO loan share than the other borrowers.

The results reported in columns (5) to (7) of Panels A, B, and C of Table 5 suggest that NBOs may act as a last resort for the evergreening of loans to zombie borrowers when their access to banks and NBDs is limited, while the opposite holds for delinquent borrowers. Overall, these results support the hypothesis that zombie households prefer to borrow in the following order: banks, NBDs, and then NBOs. Non-bank financial institutions, especially NBOs, drove evergreening of loans to zombie households in Korea.

5 Vulnerable borrowers and consumption growth

5.1 Stylized facts

Utilizing the borrower-level data, we first describe how consumption patterns vary across normal, zombie, and delinquent borrowers over time. Figure 4 presents the quarterly consumption growth rate over a 12-quarter period, dividing household borrowers into nine groups: delinquent, normal (five groups with DSRs below 50%, in 10 percentage-point intervals), and zombie households (three groups with DSRs between 50–70%, 70–90%, and above 90%) over 2017 and 2023. Cumulative consumption growth over horizon h is defined as the difference between the log of consumption in quarter q and quarter $q+h$.

Figure 4 confirms that all three groups experience increases in cumulative consumption growth over time, but that each group shows a distinctive pattern. First, normal borrowers experience larger consumption growth than zombie or delinquent borrowers. Among normal borrowers, those with the DSR below 10% experience the largest increase in future consumption growth, ranging from 2% to 20% over the next three years. As the DSR range increases from 10-20% to 40-50%, future consumption growth becomes slower. Second, zombie households with the DSR exceeding 50% show even slower consumption growth compared to normal households, with the peak cumulative consumption growth rate remaining below 10% over three years. This possibly reflects the 'wealthy hand-to-mouth' behavior highlighted by Kaplan et al. (2014).[17] Notably, zombie borrowers with the DSR exceeding 90% exhibit smaller declines in future consumption growth than the other zombie groups, suggesting that they may be less likely to be constrained by illiquid assets and able to maintain good credit score despite having relatively lower income than the

[17] 'Wealthy hand-to mouth' households hold little liquid wealth while owning a large amount illiquid assets, thus having positive net illiquid asset. 'Poor hand-to-mouth' households hold little liquid wealth but have negative net illiquid asset. Although the former are relatively wealthy, they behave similarly to the latter in terms of consumption decisions, as both groups are liquidity constrained.

other zombie groups (see Table 1).[18] Third, delinquent borrowers substantially reduce their consumption, particularly in the short run, but recover their consumption after two years. Their consumption growth ranges from -27% to 13%, while the other types of borrowers exhibit smaller and consistently positive variations over time.

5.2 Baseline regression

We first test the effects of vulnerable borrowers on future consumption growth at the individual borrower level. Prior cross-country studies show that rising household debt burdens tend to predict slower consumption or economic growth (Mian et al. (2017), Lombardi et al. (2022)). In particular, Lombardi et al. (2022) analyze data from 54 economies between 1990 and 2015 and find that household debt stimulates consumption growth in the short run —mainly within one year —but its adverse effects persist over the long run. To empirically validate these cross-country findings with individual borrower-level data, we estimate the following baseline regression equations (4):

$$\Delta C_{i,q+h} = \beta_0^h + \beta_1^h \,\text{Zombie or DEQ}_{i,q} + \gamma^h X_{i,q} + \epsilon_{i,q+h} \tag{4}$$

where $\Delta C_{i,q+h}$ denotes the cumulative log change in consumption between quarter q and quarter $q+h$, with $h = \{1, 2, \ldots, 12\}$ for borrower i and quarter q. Our main explanatory variables are dummies for vulnerable borrowers including both zombie and delinquent borrowers: $Z(50+)$, $Z(70+)$, and $Z(90+)$ are the dummies for highly indebted household borrowers whose DSR exceeds 50%, 70%, and 90%, respectively; and DEQ is the delinquent borrower dummy which is equal to 1 if debt payments are overdue by more than 30 days. The vector $X_{i,q}$ includes control variables that are likely to be associated with consumption growth such as age group dummies, log income, dummies for the self-employment status and the mortgage loan status, and log credit score. Borrower, city, and quarter fixed effects are included. We conjecture that highly indebted households with higher DSRs reduce their consumption, especially when facing liquidity constraints, and therefore we expect $\beta_1 < 0$.

Table 6 shows our main regression results. We focus on the relationship of vulnerable borrowers and cumulative consumption growth over both the short (less than one year) and the medium (one to

[18] We cannot test this hypothesis empirically due to lack of balance sheet data on liquid assets.

three years) run. Panel A shows the results for the short-term horizon, whereas panel B those for the medium-term horizon. In Panel A, Columns (1)-(4), (5)-(8), and (9)-(12) correspond to cumulative future consumption growth over the next one, two, and three quarters – q+1, q+2, and q+3 – respectively. In Panel B, Columns (1)-(4), (5)-(8), and (9)-(12) correspond to cumulative future consumption growth over the next one, two, and three years – y+1, y+2, and y+3 – respectively.

Panel A shows that the coefficients on $Z(50+)$ are negative over the short-term horizon. In particular, zombie borrowers in this group experienced lower consumption growth than the other reference groups by 0.192 percentage points after one quarter (column (1)) and 3.929 percentage points after three quarters (column (9)). In contrast, the coefficients on $Z(70+)$ and $Z(90+)$ are positive after one quarter. However, the coefficient on $Z(70+)$ turns negative after two quarters. From the third quarter, the coefficients on all definitions of zombie borrowers are negative.

Panel B shows that in the longer horizons (i.e., between one year and three years), the coefficients on all zombie dummies are negative and statistically significant. In particular, highly indebted borrowers with the DSR above 50% experienced slower consumption growth than the other borrower groups by 5.194 percentage points after one year (column (1)) and by 7.592 percentage points after three years (column (9)). This result suggests that, on average the deceleration in consumption growth is more pronounced among borrowers with the DSR exceeding 50% than those with the DSR above 70% or 90%. That is, the largest reductions in consumption growth occur once the DSR crosses the 50% threshold and persist as the threshold moves further into the right tail of the DSR distribution. Overall, these results indicate that zombie borrowers exhibit significantly lower consumption growth than the other reference groups, supporting the evidence of Lombardi et al. (2022).

In contrast, columns (4), (8) and (12) of Panel A and columns (4) and (8) of Panel B report negative coefficients on the delinquent borrower dummy (DEQ). Specifically, after the first quarter, delinquent borrowers exhibit on average 33.3 percentage points lower consumption growth than the other borrower groups. This negative effect continues and becomes smaller through the two-year horizon. However, after three years the coefficient on DEQ turns positive to 3.74, suggesting a higher consumption growth for delinquent borrowers than that for the other borrower groups.

Estimating regression equation (4) for an increasing value of h traces out Jordà (2005) local projection impulse response function $\{\beta_1^h\}$ for the dummies for vulnerable borrowers on subsequent consumption

growth, with $h = \{1, 2, \ldots, 12\}$. Figure 5 shows that the negative effects for zombie borrowers become stronger over time and its peak impact is observed after 10 quarters (Panels (A) to (C)). Also, the coefficient on the dummy for delinquent borrowers is negative after 1-9 quarters, but turns positive after 10 quarters: it starts from -33 percentage points after one quarter but increases to 4 percentage points after three years (Panel (D)).

The results reported in this section confirm that vulnerable borrowers overall appear to exhibit slower consumption growth than normal borrowers (Panel (E) of Figure 5). However, zombie and delinquent borrowers show distinctive consumption dynamics over the subsequent three-year horizon: zombie borrowers experience more pronounced and persistently lower consumption growth than the other borrower groups, whereas delinquent borrowers show much lower consumption growth than the other borrower groups initially but the gap becomes smaller gradually. In sum, our results provide evidence of borrowing constraints which limit future consumption growth for highly indebted households, especially for the medium term (e.g., Johnson and Li 2010; Mian et al. 2017; Lombardi et al. 2022).

5.3 Heterogeneity in vulnerable borrowers and consumptions growth

In this section, we look at how the lower consumption growth rate of vulnerable borrowers varies with individual borrowers' characteristics such as their income level and age. Previous studies (e.g., Jappelli et al. 1998; Johnson and Li 2010) suggest that the DSR can be a more informative measure of borrowing constraints when combined with other household borrower characteristics such as liquid assets and income, as it is otherwise unclear what level of the DSR signifies borrowing constraints. For instance, a very low DSR of a borrower may potentially reflect either an inability to borrow or a preference not to borrow. Moreover, it is possible that a precautionary saving motive is associated with liquidity constraints linked to household indebtedness (e.g., Mian et al. 2013, Baker 2018). In addition, a large literature documents empirical evidence on life-cycle consumption expenditure (e.g., Gourinchas and Parker 2002; Campbell and Cocco 2007; Fernández-Villaverde and Krueger 2007).

In this regard, this paper employs demographic variables such as income and age to find out further links between vulnerable household borrowers and consumption growth. In particular, we perform the regression analyses by including an interaction term between demographic variables and vulnerable borrower dummies in the baseline regression model (4). The demographic variables we use are a dummy for the high-income

group (H_income) and a dummy of the elderly (AGE(60+)). Individual borrowers are divided into three income groups based on their income levels (low-income (bottom 30%), middle-income (middle 40%), and high-income (top 30%)) and three age cohorts (young (20s-30s), middle-aged (40s-50s) and elderly (60+)).

Panel A of Table 7 presents the results on the interaction between the vulnerable borrower dummy and the high-income group (top 30%) dummy in relation to consumption growth over the medium term. We find that the coefficients on all Z variables are negative and significant, while the coefficients on the interaction term Z x $H_$income are positive and statistically significant for zombie borrowers. This result suggests that highly indebted borrowers with the DSR exceeding 50% and in the high-income group are likely to experience smaller reductions in consumption growth, possibly indicating that income can be a proxy for liquidity. In contrast, the coefficient on DEQ x $H_$income is negative and significant for the next year's consumption growth, but it becomes smaller in magnitude and statistically insignificant for consumption growth after two or three years. This result indicates that slower consumption growth for delinquent borrowers than for the other borrower groups is more pronounced for the high-income group within the first year, but that this effect fades over time.

Panel B presents the results on the interaction between the vulnerable borrower dummy and the elderly borrower (above age 60) dummy. The coefficients on the interaction term Z x AGE(60+) are positive and significant for the next three years, indicating that the negative effects on consumption for zombie borrowers are weaker for the elderly group than for the other age groups. This may be because the elderly have larger accumulated wealth than the younger cohorts despite lower regular income and thus their consumption is less affected by becoming zombie borrowers, and because their consumption profile is more concentrated on necessities than the other age groups, which are less elastic and less sensitive to debt repayment pressures.

Figure 6 presents the results from the local projection model specified in equation (4). In particular, it shows the sum of the coefficient on the vulnerable borrower dummies and that on the interaction term between the vulnerable borrower dummies and either the three income group dummies or the three age group dummies over the subsequent 12 quarters.

Panel A shows that lower consumption growth for zombie borrowers than for the other borrowers is most pronounced for the low-income group (blue dots) and least pronounced for the high-income group (red dots). This is consistent with the findings from the literature that highly indebted, low-income households face tighter liquidity constraints.

Panel B shows that lower consumption growth for zombie borrowers than for the other borrowers holds for all age groups, but that it is most pronounced for the young cohort (blue dots) and least pronounced for the elderly cohort (green dots). This is consistent with the fact that the young cohort tends to have lower income and smaller accumulated wealth than the other age cohorts, and thus their consumption growth is more heavily affected when they become zombie borrowers.

5.4 Macroeconomic shocks, vulnerable borrowers and consumption

This section examines how vulnerable borrowers' consumption is affected by macroeconomic shocks such as changes in the policy rate and house prices. With regard to monetary policy, prior research shows that policy rate hikes can dampen consumption growth, particularly among indebted households who face high borrowing costs through the interest rate channel (e.g., Taylor 1995; Mishkin 1996) or face increased debt service burden through the cash-flow channel (e.g., Flodén et al. 2021; Cloyne et al. 2020). In particular, Flodén et al. (2021) use administrative data on Swedish households and document that indebted households cut consumption more sharply than debt-free households in response to policy rate increases, because the former are more likely to hold adjustable-rate mortgages. Given the similarly high prevalence of adjustable-rate mortgages in Korea as well,[19] vulnerable household borrowers in Korea are likewise expected to cut consumption when policy rates increase.

Turning to house prices, changes in house prices are directly linked to wealth effects and looser financial constraints (e.g., Campbell and Cocco 2007), implying that homeowners tend to increase consumption when house prices rise. However, if these households are liquidity-constrained, akin to "wealthy hand-to-mouth" households (e.g., Kaplan et al. 2014), their consumption response may be muted unless they can borrow against that wealth or access liquidity. That is, even as house prices rise, heavily indebted homeowners may be unable to increase consumption because housing wealth cannot be easily converted into liquid assets.

To test the hypotheses regarding the possibility of vulnerable borrowers affected by macroeconomic conditions, we add an interaction term between vulnerable borrower dummies and the change in the policy

[19]The share of adjustable-rate loans among household debt and housing mortgages in Korea declined from 66.8% to 61.1% and from 54.8% to 40.8%, respectively, between 2017 and 2023.

rate or house price growth in regression (4). The specific regression equation is as follows:

$$\Delta C_{i,c,q+h} = \beta_0^h + \beta_1^h \,\text{VULNERABLE}_{i,q} + \beta_2^h \,\text{VULNERABLE}_{i,q} * \text{MACRO} + \gamma^h X_{i,q} + \epsilon_{i,c,q+h} \qquad (5)$$

where VULNERABLE denotes dummies for zombie or delinquent borrowers, and MACRO refers to either policy rate changes (ΔPR_q) or house price growth ($\Delta \log(HPI)_{c,q}$). The primary focus of this analysis is the coefficient β_2, which captures the marginal effects of vulnerable borrowers under changing macroeconomic conditions. Borrower fixed effects and city-time fixed effects are included, which absorb monetary policy shocks and house price growth.

Figure 7 illustrates the response of vulnerable borrowers' consumption to policy rate changes and house price growth. Panel A shows that the adverse effects of zombie households on consumption growth in response to policy rate increases (β_2) continue to increase for about 9 quarters before gradually weakening (three panels from the left). In contrast, delinquent households experience an even more pronounced and accumulating decline in consumption growth, lasting over three years, as the policy rate rises. This result indicates that delinquent borrowers are very sensitive to increasing borrowing costs proxied by rising policy rates.

Panel B presents the coefficients on the interaction term between vulnerable borrower dummies and house price growth (β_2). The three panels from the left for zombie borrowers indicate that they behave like 'wealthy hand-to-mouth'households —exhibiting limited responsiveness to wealth gains from house price increases over the next year or so, possibly due to liquidity constraints. While the coefficients turn positive after five to eight quarters for zombie borrowers, they subsequently revert to negative values. In contrast, the marginal effects of house price growth for delinquent borrowers remain positive and increase over time.

More formally, Panels A and B of Table 8 show that the negative impacts of rising policy rates on zombie borrowers' consumption growth (β_2) are more persistent and pronounced over the three-year horizon than over the one-year horizon. Specifically, for zombie households with the DSR exceeding 50%, the 5.1 percentage point decline in one-year ahead consumption growth is further amplified by an additional 0.469 percentage point reduction when the policy rate increases by 1 percentage point (Column (1) of Panel B), and the 7.7 percentage point decline in three-year ahead consumption growth is further amplified by an additional 4.3 percentage point reduction when the policy rate rises by 1 percentage point (Column (9) of

Panel B). For delinquent households, the decline in consumption growth due to increases in the policy rate becomes more pronounced over the longer term, particularly after three years (column (12) of Panel B).

Panels C and D of Table 8 show that the coefficients on the interaction term between the zombie dummy and house price growth are either insignificant or negative for the first four quarters and after three years, implying that zombie borrowers generally behave like "wealthy hand-to-mouth" households. In contrast, delinquent borrowers tend to exhibit higher consumption growth over time as house prices rise than the other borrowers. This may reflect the fact that, since delinquent borrowers are generally less likely to be substantial asset holders, they respond more strongly to buoyant macroeconomic conditions than to the wealth effects associated with higher house prices.

In sum, vulnerable borrowers exhibit significantly lower consumption growth in response to policy rate increases, which is consistent with the hypotheses of the interest rate or cash-flow channel of monetary policy. By contrast, zombie borrowers show only limited consumption responses to house price increases, which does not supports the wealth-effect channel but the wealthy hand-to-mouth household channel.

5.5 An alternative measure of vulnerable household borrowers

The previous sections examine how vulnerable borrowers, combining zombie and delinquent borrowers, are associated with lower future consumption growth than that of the other borrowers. In this section, we introduce an alternative measure of household vulnerability. In particular, we use principal component analysis (PCA) for six standard indicators of household vulnerability: the negative value of log of credit score; the negative value of income; the number of financial institution accounts[20]; the DSR; the interest-only DSR and the debt-to-income (DTI) ratio. Instead of relying on the tails of the DSR distribution, we use the DSR itself in constructing a household vulnerability measure using PCA. By construction, a higher value of the first principal component (PC1) indicates greater financial vulnerability of household borrowers.

Table 9 compares the effects of two household borrower vulnerability measures on consumption growth over the short and medium run. Columns (1) to (6) report the coefficient on the dummy variable for all vulnerable borrowers. Consistent with the results in the previous section, we find that consumption growth

[20]We use the number of accounts as a proxy of financial distress because we cannnot construct household leverage data due to the lack of asset data at the borrower level.

is significantly lower for vulnerable borrowers than for the normal borrowers, with the difference ranging from 3.6 to 10.7 percentage points over three years.

Columns (7) to (12) present the results using the PCA-based measure of household borrower vulnerability. These results show that as household borrowers' overall vulnerability increases, their future consumption growth rate becomes smaller. The decline in consumption growth associated with a unit increase in PC1 ranges from 1.6 to 9.6 percentage points over three years.

In sum, the results suggest that both the dummy-based measure targeting the tails of the DSR distribution and the PCA-based measure from the level of five standard indicators point to the negative impact of household borrowers' financial vulnerability on future consumption growth which increases over time.

5.6 Share of vulnerable household borrowers and consumption: city-level analysis

The previous sections examine how vulnerable household borrowers and their heterogeneous characteristics are associated with future consumption growth at the individual borrower level, and find that these borrowers tend to have lower consumption growth than normal borrowers over the short and medium term. To explore the macro-level implications of vulnerable household borrowers on consumption, this section investigates how the prevalence of vulnerable borrowers affects city-level consumption in Korea over 2017-2023. Vulnerable borrowers —defined as those with the DSR exceeding 50% or classified as delinquent — account for approximately 15% of the indebted population (see Figure 1).[21] Despite this relatively small share, their aggregate impact on regional consumption growth may be significant. To test this conjecture, we empirically examine whether the share of vulnerable households exerts significant impacts on regional economic outcomes.

Using borrower-level data linked to the city-level consumption variables with city-level characteristics such as housing and demographics, we construct a synthetic panel from repeated cross-sectional data (Campbell and Cocco 2007; Aladangady 2017). We then test our hypotheses on how the overall level of household borrower vulnerability affects city-level consumption, by employing the share of vulnerable households as derived from individual borrower-level data.

[21]The indebted population comprises about 40% of the total population.

Given the availability of regional consumption and income data at the annual frequency, we focus our regression models on annual changes in consumption growth. The specific regression models are as follows:

$$\Delta C_{c,y+h} = \beta_0^h + \beta_1^h \, \text{rVULNERABLE}_{c,y} + \beta_2^h X_{c,y} + \alpha_c + \gamma_y + \epsilon_{c,y} \tag{6}$$

where $\Delta C_{c,y+h}$ is the log change in city-level per capita private consumption expenditure after one and two years.[22] The main independent variable is the ratio of vulnerable borrowers, which is defined in several ways: $rVULNERABLE$ denotes the city-level share of zombie borrowers with the DSR above 50% or delinquent borrowers (i.e., payments are overdue at least 30 days); and rDSR(50+), rDSR(70+), rDSR(90+) and rDEQ indicate the share of borrowers with the DSR exceeding 50%, 70%, 90% and delinquent borrowers, respectively. X are control variables that are associated with city-level consumption growth: log(INC) which is the log of city-level per capita personal income; log(GRDP) which is the log of gross regional domestic product (GRDP); and dlog(HPI) which is the log change in city-level house prices. City and year fixed effects are included, and standard errors are clustered at the city x year level.

Panel A of Table 10 shows how the share of vulnerable borrowers in a city is associated with future consumption growth in the city. Columns (1) to (5) report results for one-year ahead consumption growth, while columns (6) to (10) present results for two-year ahead growth. Column (1) shows that the coefficient on rVULNERABLE is negative and statistically significant, indicating that a one percentage point increase in the share of vulnerable household borrowers within a city is associated with a reduction in consumption growth of approximately 0.4 percentage points. Columns (2) to (4) show that the coefficients on the share of borrowers with the DSR (rDSR) exceeding 50%, 70%, and 90% are negative and statistically significant, and that higher DSR thresholds are associated with larger declines in consumption growth. In contrast, column (5) shows that the coefficient on rDEQ are statistically insignificant for one-year ahead consumption growth, indicating that the share of delinquent households does not have significant effects on consumption growth at the city level, possibly due to their very low level - accounting for only about 1% within a city.

Columns (6) to (10) of Panel A show that the results for two-year ahead consumption growth are consistent with those for one-year-ahead growth, showing statistically significant negative coefficients on the share of all vulnerable borrowers and on all three measures of the zombie borrower share at the city

[22]Results for vulnerable borrowers on three-year ahead consumption growth are not included in this section, as all coefficients are statistically insignificant due to the short time-series dimension of the dataset.

level. Notably, the impact of the city-level share of vulnerable borrowers and zombie borrowers on two-year ahead consumption growth is more pronounced, further supporting the evidence from Table 6 that the adverse effects of vulnerable households on consumption growth intensify at the individual borrower level over longer time horizons. Moreover, we find that the coefficients on income-related variables, such as log(GRDP) and log(INC), are either insignificant or negative, while the coefficients on house price growth are positive and significant for one-year ahead consumption growth but negative and significant for two-year ahead consumption growth. This result suggests that housing wealth effects are short-lived and income effects are negligible at the city level.

Panels B through E of Table 10 further examine how the city-level share of zombie borrowers differentiated by income and age affects future consumption growth. That is, in regression equation (6), we consider the share of zombie borrowers defined as the DSR exceeding 50%, 70%, or 90% whose are in a specific income or age group.[23]

Columns (1) to (3) in Panels B and C report the coefficients on the share of zombie borrowers with the DSR exceeding 50% and belong to an income group. Specifically, r(50+,L), r(50+,M), and r(50+,H) denote the shares of zombie borrowers with the DSR exceeding 50% and in the low-, middle-, and high-income groups, respectively, at the city level. r(70+,L), r(70+,M), and r(70+,H) in columns (4), (5), and (6), respectively, of Panels B and C report the coefficients on the share of zombie borrowers with the DSR exceeding 70% and belong to the low-, middle- or high-income group. Finally, r(90+,L), r(90+,M), and r(90+,H) in columns (7), (8), and (9), respectively, of Panels B and C report the coefficients on the share of zombie borrowers with the DSR exceeding 90% and belong to the low-, middle- or high-income group.

Panel B shows that within a given DSR threshold level (columns (1)−(3) vs. (4)−(6) vs. (7)−(9)), a city with a 1 percentage point higher share of low-income zombies experiences a greater decline in one-year ahead consumption growth (columns (1), (4), or (7)) than the city with a 1 percentage point higher share of middle-income (columns (2), (5), or (8), respectively) or high-income zombies (columns (3), (6), or (9), respectively). Likewise, within a given income group (columns (1), (4), (7) vs. (2), (5), (8) vs. (3), (6), (9)), a 1 percentage point increase in the share of zombie borrowers with the highest DSR threshold (90%) leads to the largest reduction in one-year ahead consumption growth (columns (7), (8), and (9)). Combining the

[23]Since the coefficients on the share of delinquent borrowers at the city level are insignificant, we do not conduct further analyses on the share of delinquent borrowers under each demographic group.

two aspects, a 1 percentage point increase in the share of low-income zombies with the DSR above 90% in a city leads to the largest reduction in city-level one-year ahead consumption growth (by -1.310 percentage points), whereas the same increase in the share of high-income zombies with the DSR above 50% results in the smallest reduction (by -0.777 percentage points). This result is consistent with the earlier findings in Table 7.

Panel C presents the results from a similar analysis for two-year ahead consumption growth. The reduction in two-year ahead consumption growth (Panel C) for an increase in each share is more pronounced than that in one-year ahead consumption growth at the city level (Panel B). The extent of reductions in consumption growth differs by the zombie borrowers' income level: the negative effects on consumption growth are more pronounced in cities with a higher share of low-income zombies than in cities with a higher share of middle- or high-income zombies, which is consistent with evidence on liquidity-constrained indebted households.

Columns (1) to (3) of Panels D and E present city-level results when we consider the share of zombie borrowers with the DSR exceeding 50% by age group. Specifically, r(50+,Y), r(50+,M), and r(50+,O) denote the shares of zombie households with the DSR exceeding 50% in the young, middle-aged, and old groups, respectively. r(70+,Y), r(70+,M), and r(70+,O) in columns (4), (5), and (6), respectively, of Panels D and E report the coefficients on the share of zombie borrowers with the DSR exceeding 70% and in the young, middle-aged and old group, respectively. Finally, r(90+,Y), r(90+,M), and r(90+,O) in columns (7), (8), and (9), respectively, of Panels D and E report the coefficients on the share of zombie borrowers with the DSR exceeding 90% and in the young, middle-aged and old group, respectively.

Overall, the effects of the share of the elderly zombie borrowers at the city level are mixed. The city-level one-year ahead consumption growth is generally insignificantly or marginally significantly affected by the share of elderly zombie borrowers (columns (3) and (9) of Panel D and columns (3), (6), and (9) of Panel E), whereas a higher share of young or middle-aged zombie borrowers leads to a significant decline in consumption growth in one or two years (columns (1), (4), and (7) or columns (2), (5) and (8), respectively, of Panels D and E). Also, within the young group in columns (1), (4), and (7) of Panels D and E, a 1 percentage point increase in the share of zombie borrowers with the highest DSR threshold (90%) leads to the largest reduction in one- and two-year ahead consumption growth (column (7) of Panels D and E), while the same increase with the lowest DSR threshold (50%) leads to the smallest reduction (column (1)

of Panels D and E). Finally, within the middle-aged group in columns (2), (5), and (8) of Panel E, a 1 percentage point increase in the share of zombie borrowers with the highest DSR threshold (90%) leads to the largest reduction in two-year ahead consumption growth (column (8) of Panel E), while the same increase with the lowest DSR threshold (50%) leads to the smallest reduction (column (2) of Panel E).

In sum, the results reported in Table 10 suggest that, at the city level, the share of zombie borrowers and the share decomposed by demographic characteristics significantly explain lower future consumption growth. For example, a 1 percentage point higher share of zombie borrowers with the DSR exceeding 50% means a 0.43 percentage point lower consumption growth rate at the city level two years later. This means that, even though zombie borrowers are around 15% total indebted household borrowers, they have significant impacts on aggregate consumption at both the regional and national levels in Korea.

6 Conclusion

We examine the characteristics of vulnerable household borrowers in Korea consisting of zombie and delinquent borrowers. We find that zombie borrowers tend to persist over time and rarely switch to the delinquency state. Delinquent borrowers exhibit different characteristics from zombie households. In particular, delinquent borrowers have a large amount of consumer loans, while zombie households hold a large share of mortgage and other secured loans.

Focusing on lending to vulnerable borrowers, we first show that when normal borrowers turn into zombies, their loan amount slowly increases over the next year indicating the existence of evergreening by financial institutions. When we compare loan growth of normal and vulnerable borrowers, we find that zombie or delinquent borrowers receive less new loans than normal borrowers and the total loan growth rate for zombie borrowers is slower than that for normal borrowers. Regarding which types of financial institution lend to vulnerable households, we find that the share of lending to zombie borrowers by banks and non-bank depository institutions (NBDs) decreases and that by other non-bank institutions (NBOs) increases, while banks are more likely to increase loans to delinquent households.

Regarding vulnerable households' consumption, we find that zombie borrowers experience slower consumption growth after one to three years than normal borrowers, and the gap becomes larger over time and when the policy rate increases. By contrast, delinquent borrowers exhibit slower consumption growth

in one or two years, but recover in three years. In addition, when the share of zombie borrowers increases in a city, the city's consumption growth rate significantly declines in one or two years, and the decline is larger for low-income and young borrowers, providing evidence of wealthy hand-to-mouth households.

This paper's findings provide a few policy implications. First, it highlights the need for policymakers to pay attention to zombie households in addition to delinquent households. In particular, it is important to consider the impact of zombie households on consumption dynamics at the regional and national levels.

Second, this paper stresses the importance of having in place stringent regulatory limits on the debt service ratio including amortization. Such limits will reduce the probability of a normal household borrower turning into a zombie borrower. Further, given that zombie borrowers tend to rely on NBFIs, especially on NBOs, to survive, more stringent and comprehensive debt service limits at the household borrower level are warranted, with as few exceptions (eg first-time home-buyers) as possible, on household borrowing from all types of financial institution.

Finally, debt relief programs on delinquent or deeply zombie, young and low-income borrowers may increase household income and revive consumption. However, debt relief can also increase moral hazard by household borrowers. Therefore, it is crucial to assure consistency between ex-ante regulation on household borrowing and ex-post debt relief and maintain a balance between mitigating an ex-post slowdown in consumption growth and mitigating ex-ante moral hazard.

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Figure 1. Share of vulnerable borrowers

This figure shows the share of zombie borrowers by DSR level. Panel A presents the share of households categorized by DSR and adjusted DSR levels. Bars indicate the proportion of zombie households with DSR—defined as the ratio of debt repayment to total income—exceeding 50%, 70%, and 90%. Red dots represent the corresponding shares based on adjusted DSR, which is calculated as $DSR/(1-0.18)$ to account for disposable income under the assumption of the 18% income tax rate. Panels B and C show the decomposition of zombie household shares by household income distribution and age cohort, respectively. In Panel B, low-income households are at the bottom 30% of the income distribution, middle-income households at 30—70%, and high-income households at the top 30%. In Panel C, the age groups are categorized into three cohorts: youth (aged 20s–30s), middle-aged (40s–50s), and elderly (over 60).

A. Share of individual borrowers based on DSR and adjusted DSR levels

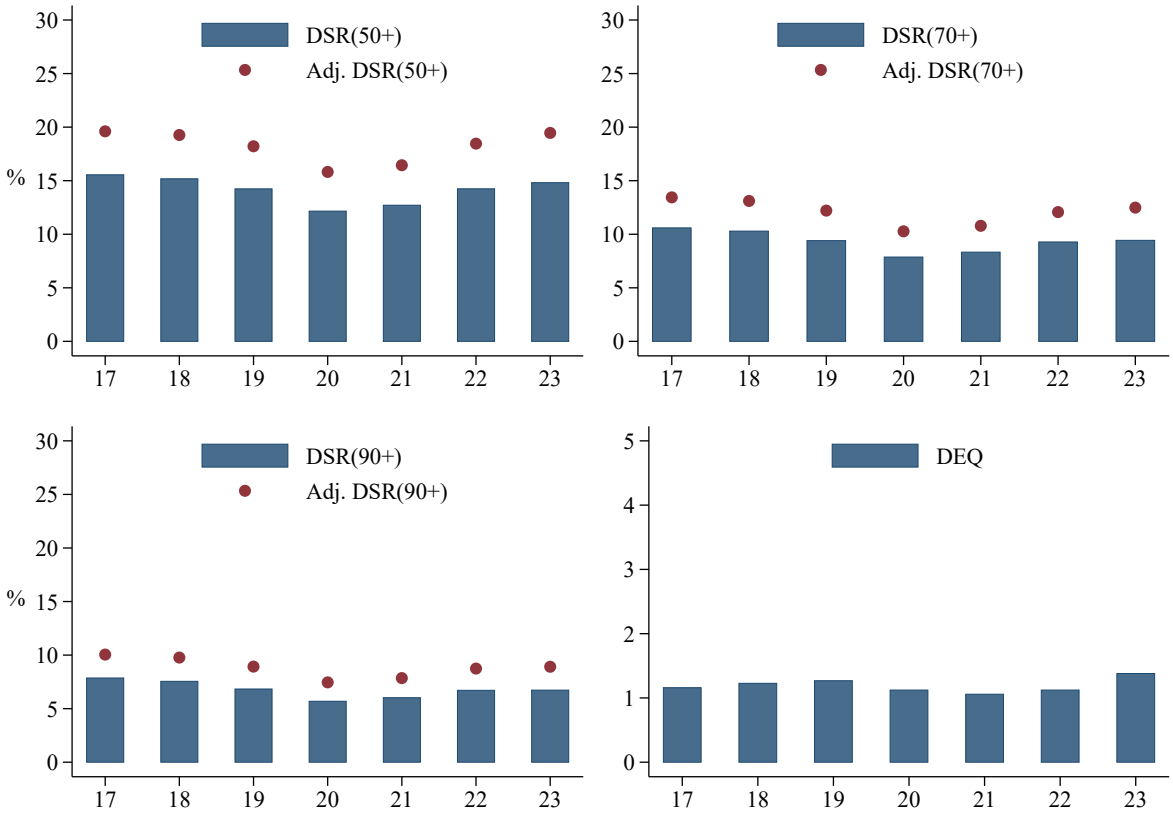
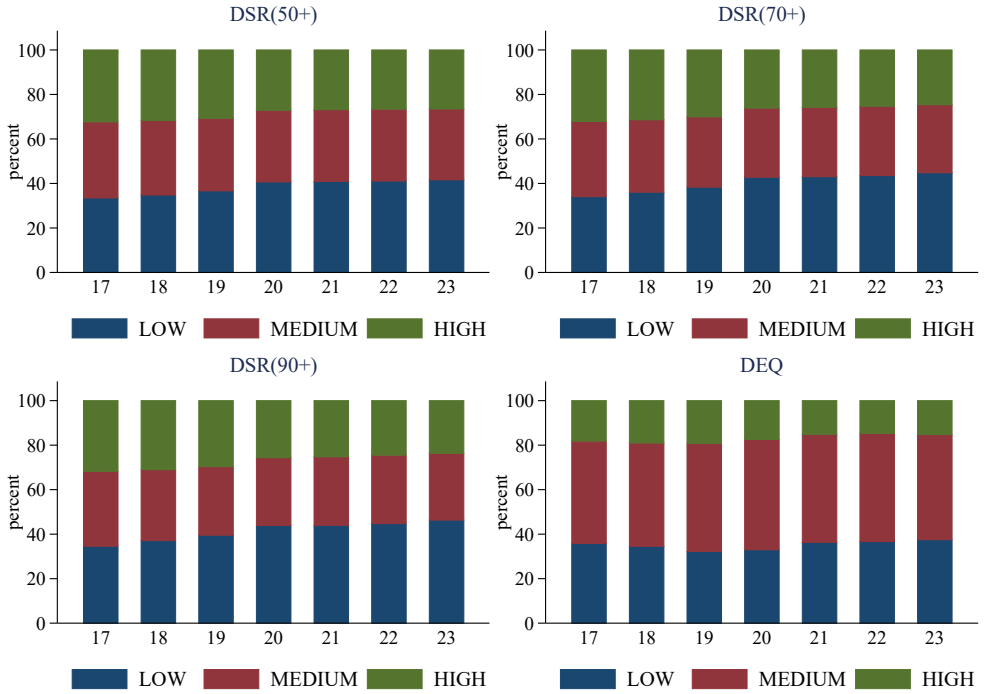


Figure 1. Continued

B. Composition of individual borrowers based on DSR levels and income distribution



C. Composition of individual borrowers based on DSR levels and age cohort

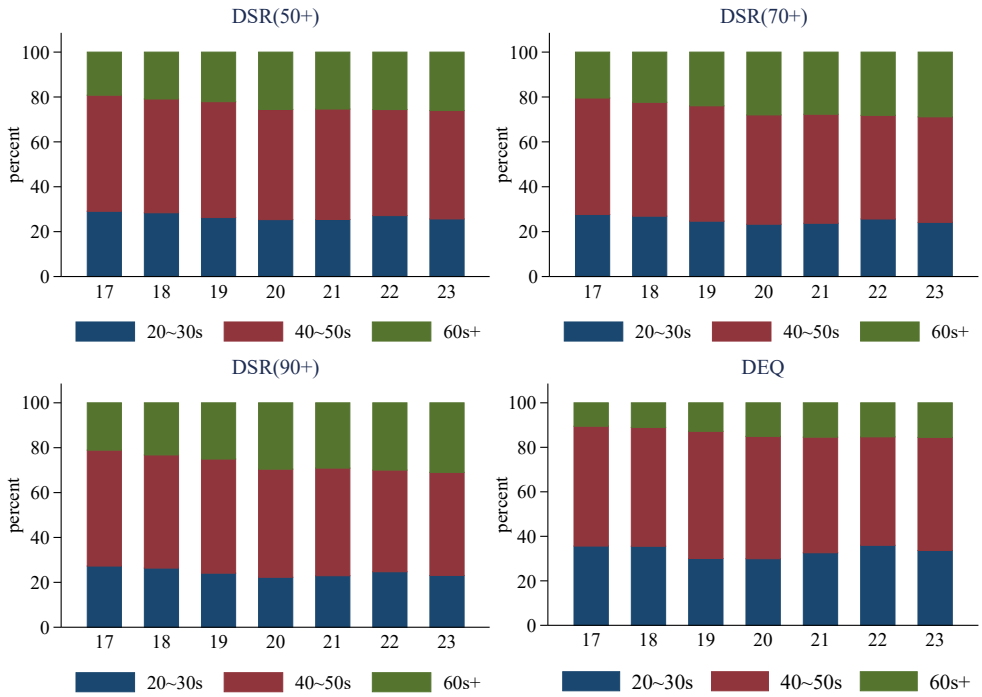
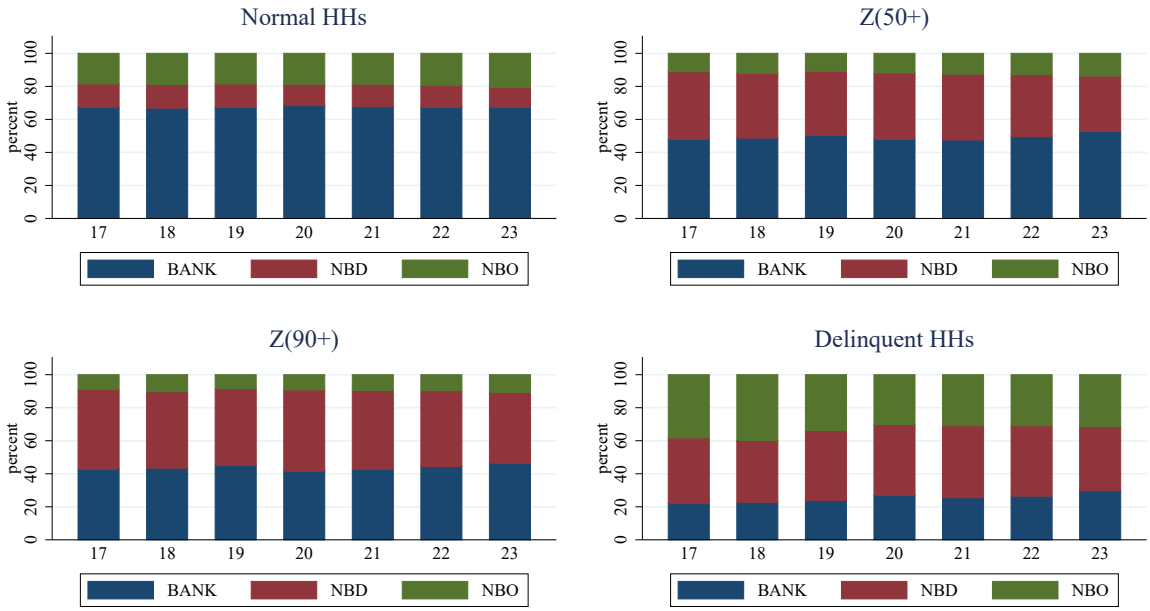


Figure 2. Composition of household loans by lender and loan types.

Households are classified as normal (DSR below 50%), zombie (DSR above 50% or 90%), and delinquent (debt overdue by more than 30 days) ones. Panel A shows the composition of household loans by lender type—banks (BANK), non-bank depository institutions (NBD), and other non-bank institutions (NBO). Panel B presents the composition by loan type —mortgage, non-mortgage secured, and other loans.

A. Lender types



B. Loan types

Figure 3. Quarterly dynamics of loan, income, and credit scores

This figure presents event study plots illustrating the dynamics of the DSR, loan amounts, individual income, and credit score around the quarter when a borrower's status changes from normal to zombie or delinquent. Panel A shows the evolution of the loan amount for borrowers who transition from the normal status (i.e., the DSR below 50%, 70%, or 90%) to the zombie status (i.e., the DSR above 50%, 70%, or 90%, respectively) and for borrower who transition from the normal status to the delinquent status. Panel B shows the evolution of the loan amount for borrowers who transition from the strict normal status (i.e., the DSR below 50%) to the different levels of the zombie status (i.e., the DSR between 50% and 70%, between 70% and 90%, or above 90%, respectively). Three panels, from left to right, depict the evolution of the DSR alongside outstanding loan amounts, individual income, and credit scores, respectively, over the period of two quarters preceding and the four quarters following the quarter in which a household transitions from the normal to vulnerable status. The sample includes borrowers that have remained vulnerable for at least one year, with observations starting two quarters prior to the transition.

A. From normal to zombie or delinquent borrowers

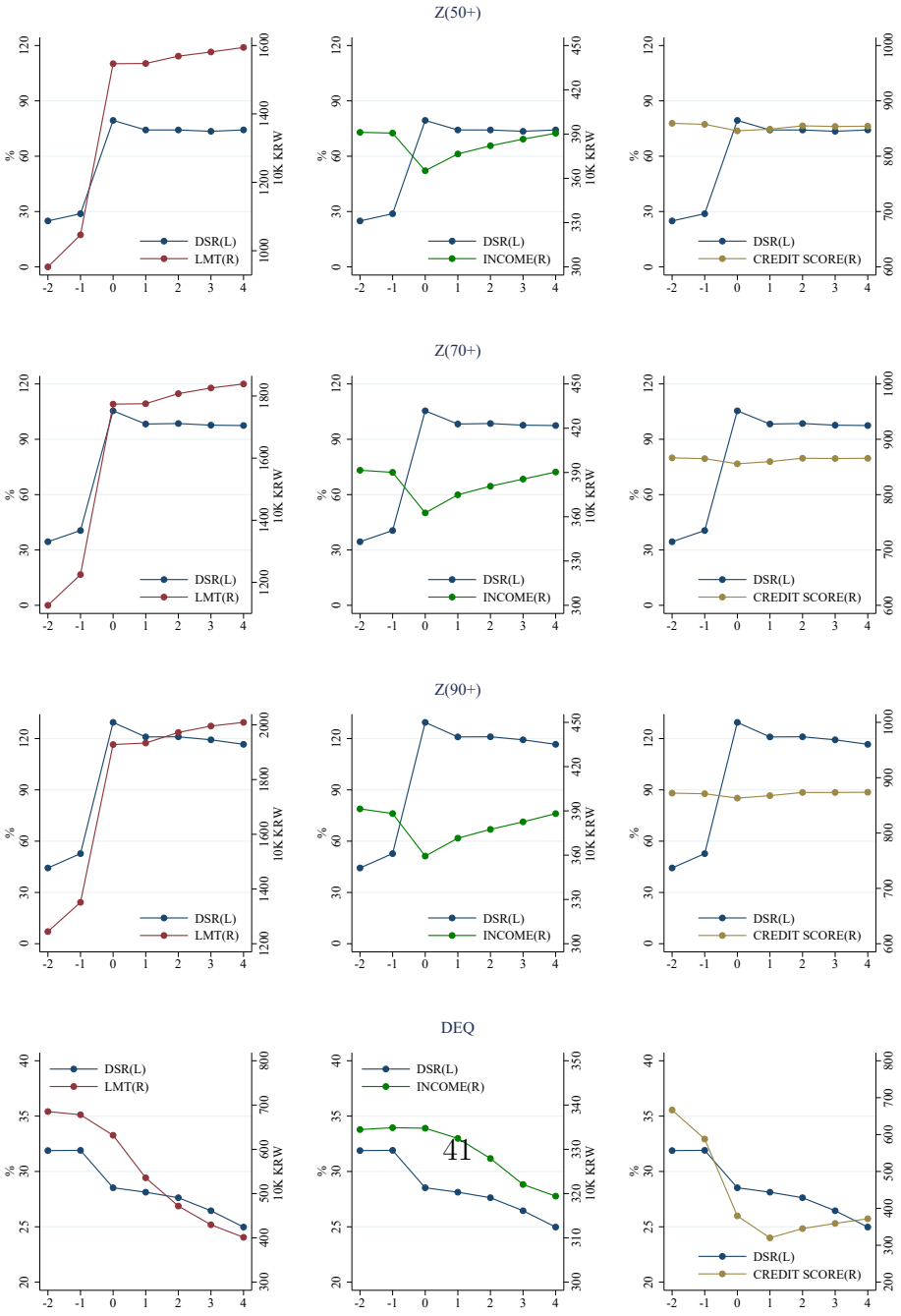


Figure 3. Continued

B. From strict normal to zombie borrowers

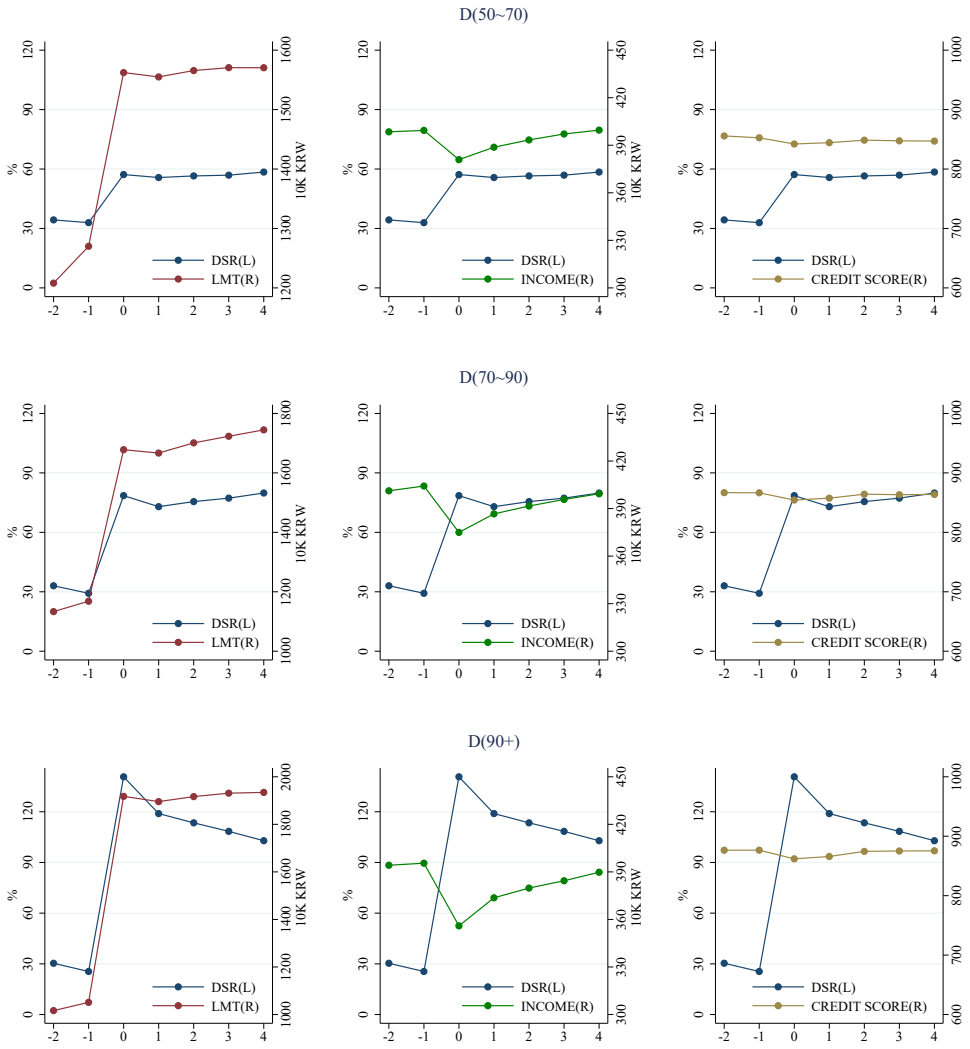


Figure 4. DSR levels and future consumption growth

This figure illustrates the quarterly dynamics of future consumption growth for different household borrower groups over h quarters from t to $t+h$, where $h = 1, 2, \ldots, 12$. The groups (X-axis) are classified into nine categories: delinquent households, normal households (five groups with DSRs below 50%, in 10 percentage-point intervals), and zombie households (three groups with DSRs of 50−70%, 70−90%, and above 90%). Cumulative consumption growth over horizon h (Y-axis) is defined as the difference between the log of consumption in quarter t and in quarter $t+h$, averaged across the respective groups.

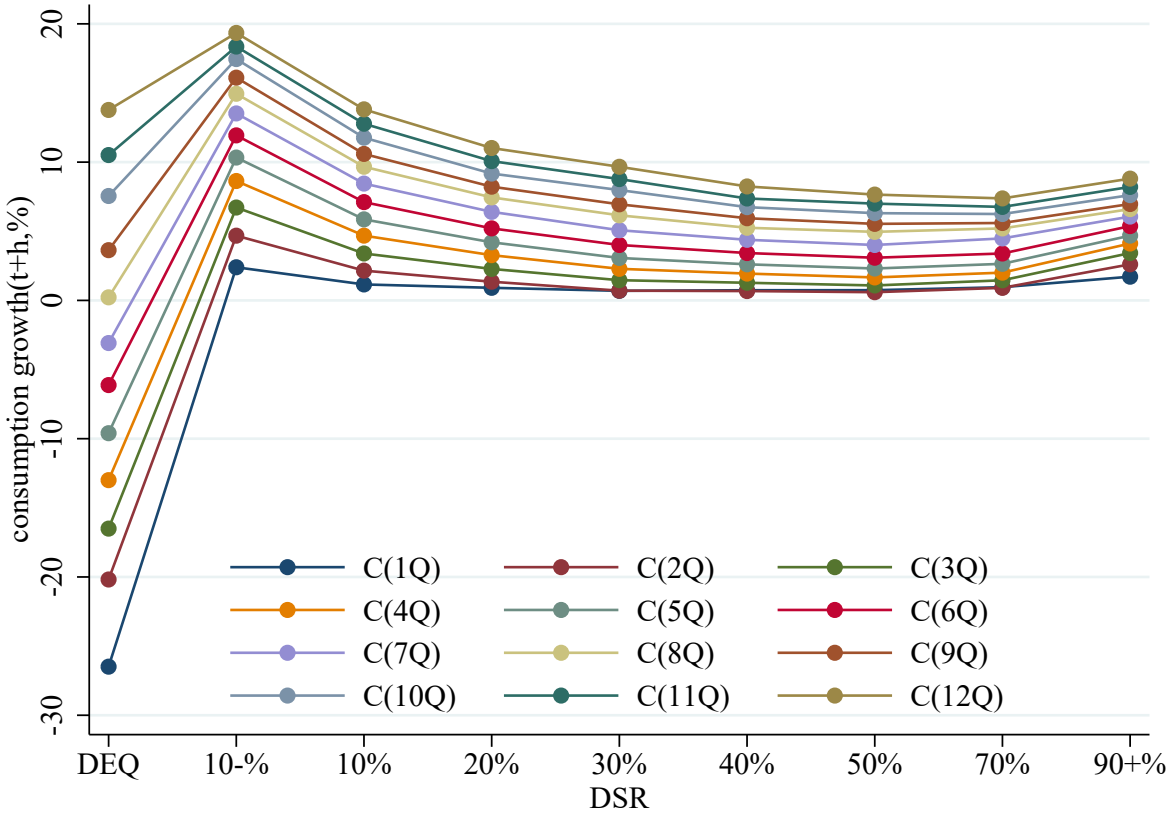


Figure 5. Vulnerable borrowers and future consumption

This figure presents the estimated average future quarterly consumption growth of vulnerable household borrowers over 1 to 12 quarters for the sample period from Q1 2017 to Q4 2023. Panels A, B, and C show results for the coefficients on the dummies for highly indebted borrowers with DSRs exceeding 50%, 70%, and 90%, respectively. Panel D presents the coefficient on the dummy for delinquent borrowers. Panel E shows the coefficients on dummy for vulnerable borrowers who are either zombie borrowers (with DSR greater than 50%) or delinquent borrowers. Panel F shows the coefficient on the first principal component (PC1) of the five standardized indicators measuring borrowers' vulnerabilities (e.g., the negative log credit score, negative net income, the number of accounts, the DSR, and the debt-to-income ratio). A higher value of PC1 indicates greater vulnerability.

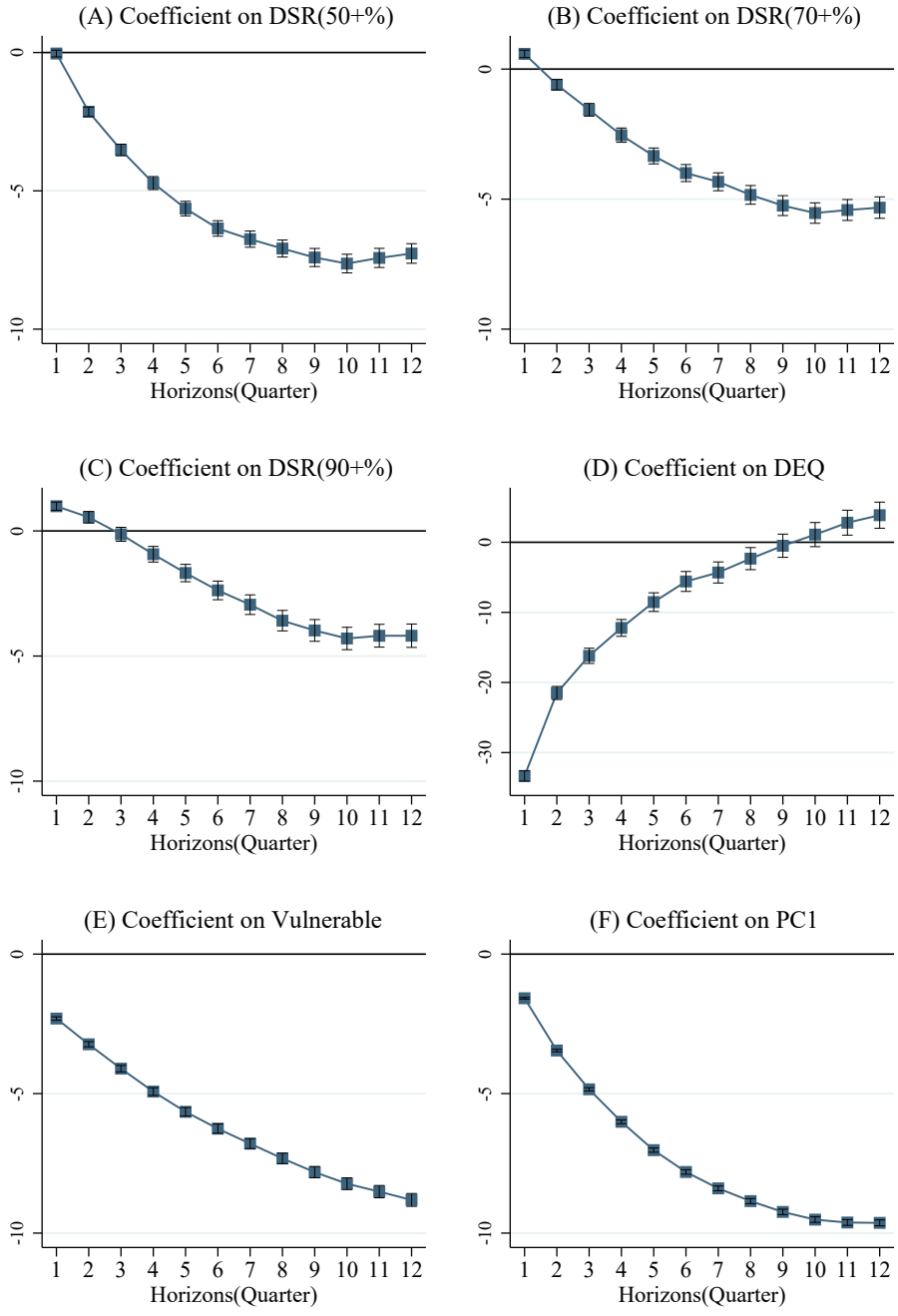
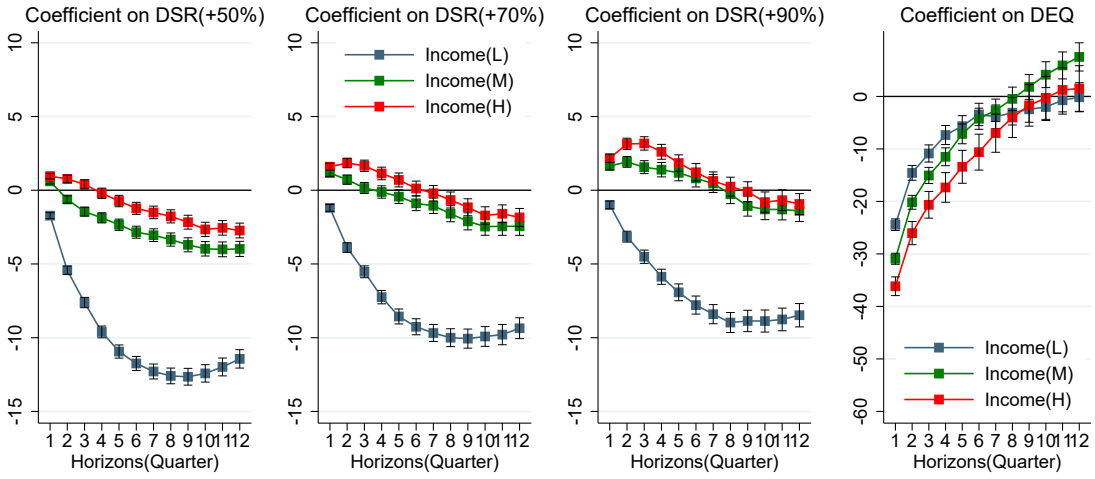


Figure 6. Impact of heterogeneity in borrower income and age on the future consumption growth of vulnerable borrowers.

This figure shows the estimated effects of dummy variables for vulnerable borrowers on quarterly consumption growth from q+1 to q+12 over the period from Q1 2017 to Q4 2023. Panel A presents the sum of the coefficient on a vulnerable borrower dummy and the coefficient on the interaction term between a vulnerable borrower dummy and an income-group dummy (i.e., low-income (bottom 30%), middle-income (30−70%), and high-income (top 30%) groups). Panel B the sum of the coefficient on a vulnerable borrower dummy and the coefficient on the interaction term between a vulnerable borrower dummy and an age-cohort dummy (i.e., young (20s–30s), middle-aged (40s–50s), and elderly (60+)).

A. Income distribution



B. Age cohort

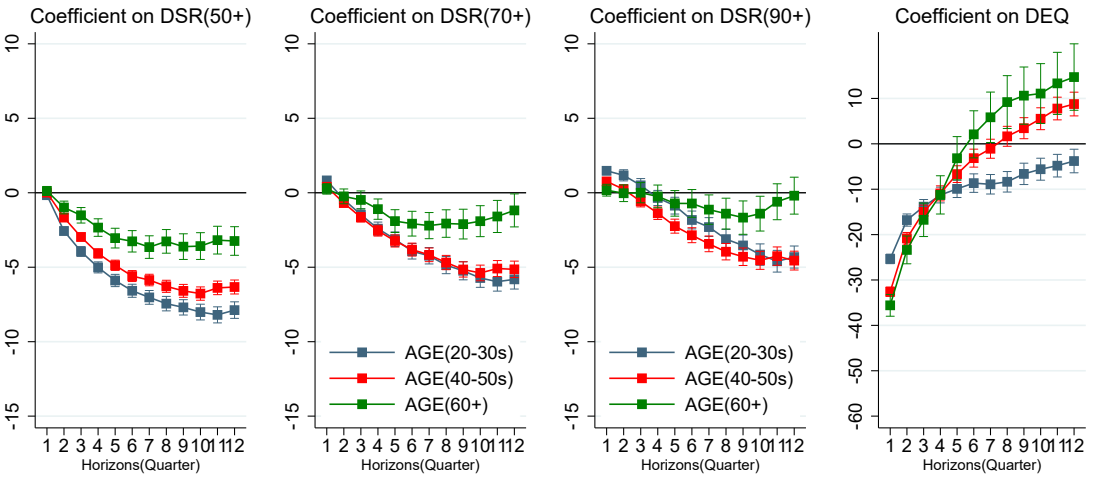
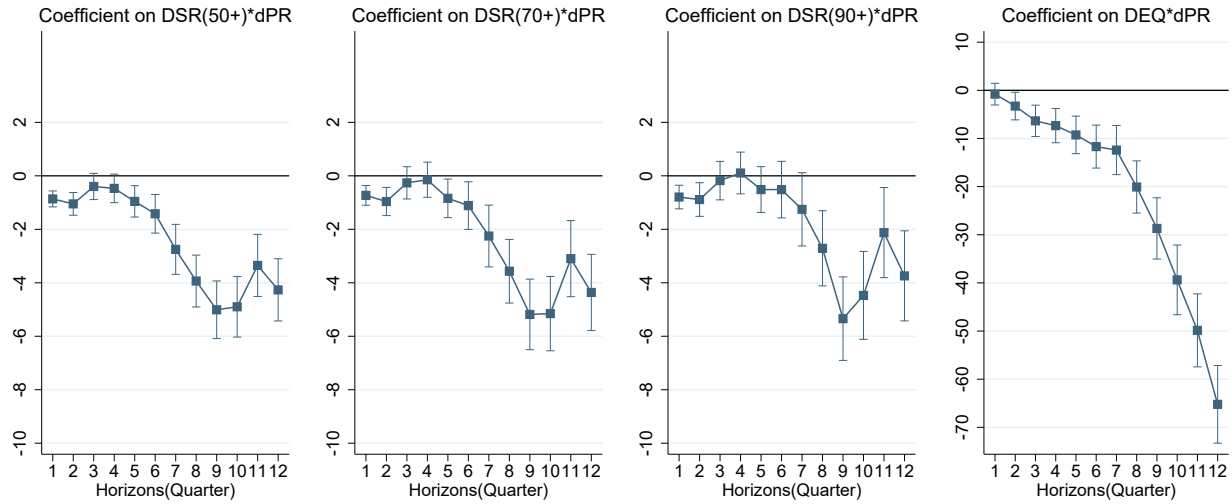


Figure 7. The impact of policy rate changes and house price growth on future consumption of vulnerable borrowers.

This figure shows the estimated effects of the interaction term between a vulnerable borrower dummy and policy rate increases or house price growth on quarterly consumption growth from q+1 to q+12 over the period from Q1 2017 to Q4 2023. Panel A reports the coefficients of the interaction term between vulnerable borrower dummies and policy rate increases, estimated after adding the interaction term to regression equation (4). Panel B shows the the coefficients on the interaction term between vulnerable borrower dummies and house price growth.

A. Marginal effect of monetary policy tightening on future consumption growth by vulnerable borrowers (β_2^h)



B. Marginal effect of house pice growth on future consumption growth by vulnerable borrowers (β_2^h)

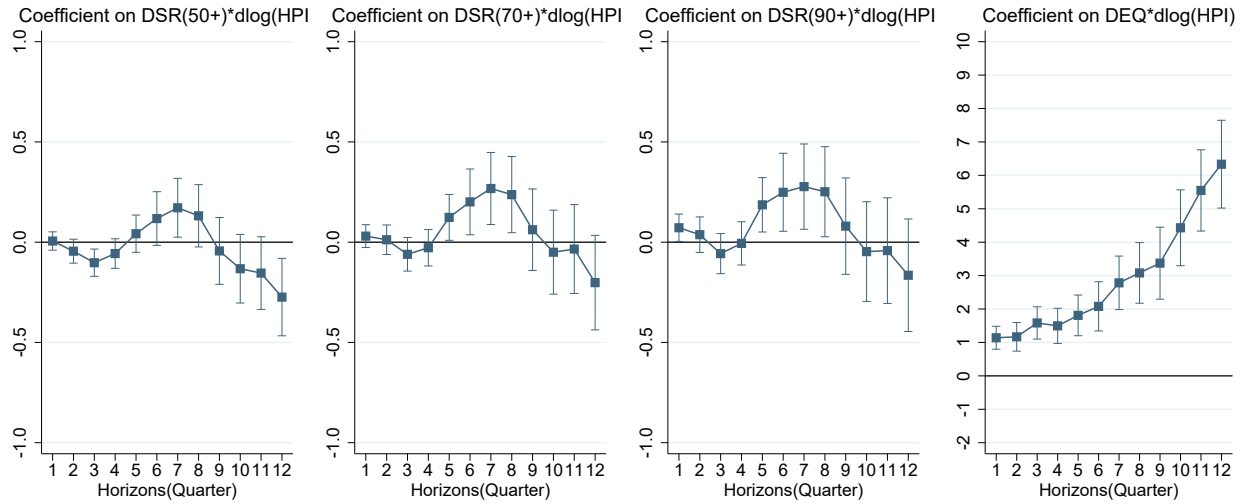


Table 1. Descriptive statistics

This table shows descriptive statistics of the quarterly variables on indebted households from 2017 to 2023. *Normal* households are defined as those with a DSR below 50%. *Vulnerable* households include those with a DSR exceeding 50% and those classified as delinquent, with payments overdue more than 30 days. Zombie households are those with a DSR exceeding 50% (Z(50+)), 70% (Z(70+)), or 90% (Z(90+)). *Difference* represents the mean difference in each variable between the vulnerable and normal households. *INCOME*, *CONSUMPTION*, *DEBT SERVICE* and *LOAN AMOUNT* are measured in units of KRW 100,000. *r_MORTGAGE*, *r_JEONSEI*, *r_SECURED*, *r_OTHER*, *r_BANK*, *r_NBD*, and *r_NBO* are expressed as percentages. Specifically, r_MORTGAGE (%) is the proportion of mortgage loans, r_JEONSEI (%) is the proportion of loans for Jeonsei, r_SECURED is the proportion of non-mortgage secured loans, r_BANK is the ratio of loans from banks, r_OTHER is the proportion of remaining loan types excluding mortgage, Jeonsei, and non-mortgage secured loans, r_NBD is the ratio of loans from non-bank depositories (e.g., savings banks and mutual financial companies), and r_NBO is the ratio of loans from NBOs (e.g., credit card companies and specialized loan business.)

Panel A. Borrower characteristics

	(1) Normal		(2) Vulnerable		(3) Difference	(4) Z(50+)		(5) Z(70+)		(6) Z(90+)		(7) Delinquent	
	mean	sd	mean	sd	b	mean	sd	mean	sd	mean	sd	mean	sd
INCOME	98.74	45.71	88.13	44.93	-10.61***	88.26	45.17	85.12	44.06	82.72	42.94	86.06	40.98
CONSUMPTION	67.55	68.45	79.06	79.79	11.51***	81.79	80.35	80.55	80.20	79.04	79.50	35.99	54.57
LOAN AMOUNT	602.30	761.77	2015.94	1330.58	1413.64***	2110.33	1304.05	2343.93	1325.50	2518.64	1343.22	525.45	715.63
DEBT SERVICE	14.51	15.19	87.77	67.43	73.26***	91.91	66.94	112.88	73.32	130.24	77.83	22.40	32.23
AGE	44.99	13.18	47.60	12.77	2.61***	47.87	12.78	48.52	12.89	48.82	13.01	43.39	11.90
CREDIT SCORE	844.60	132.01	828.23	166.44	-16.37***	859.82	110.50	864.82	105.09	868.08	101.76	329.38	87.77
SELF_EMP=1	0.10	0.30	0.21	0.41	0.11***	0.20	0.40	0.22	0.41	0.22	0.42	0.31	0.46
MORTGAGE=1	0.36	0.48	0.67	0.47	0.31***	0.70	0.46	0.72	0.45	0.73	0.44	0.15	0.35
Observations	10332350		1773428		12105778	1667810		1063058		747407		105618	

Panel B. Compositions of household loans

	(1) Normal		(2) Vulnerable		(3) Difference	(4) Z(50+)		(5) Z(70+)		(6) Z(90+)		(7) Delinquent	
	mean	sd	mean	sd	b	mean	sd	mean	sd	mean	sd	mean	sd
r_MORTGAGE	30.48	42.49	52.55	41.67	22.07***	55.27	41.01	56.30	40.91	57.37	40.90	9.65	25.39
r_JEONSEI	7.08	24.03	2.69	12.85	-4.39***	2.72	12.87	2.41	11.67	2.26	10.92	2.25	12.54
r_SECURED	2.29	13.72	16.30	32.90	14.01***	17.20	33.58	20.25	35.71	21.79	36.67	2.05	12.66
r_OTHER	60.14	57.02	28.46	40.09	-31.69***	24.81	37.53	21.03	34.40	18.58	32.30	86.04	34.91
r_BANK	55.49	46.07	48.01	44.29	-7.48***	49.59	44.47	48.64	44.69	48.63	44.93	23.03	32.38
r_NBD	15.73	33.08	32.80	42.04	17.07***	33.13	42.40	36.73	43.67	38.65	44.30	27.67	35.49
r_NBO	28.78	40.96	19.18	32.59	-9.60***	17.28	31.18	14.63	28.97	12.72	27.16	49.30	38.97
Observations	10332350		1773428		12105778	1667810		1063058		747407		105618	

Table 2. Factors associated with the probability of being vulnerable households.

This table reports the results from logit regressions using various vulnerable household borrower indicators —Vulnerable, Z(50+), Z(70+), Z(90+), and DEQ —as dependent variables. The dummy for a vulnerable household is equal to 1 when the household is either zombie or delinquent. The zombie household dummies (Z(50+), Z(70+), Z(90+)) are equal to 1 if a household borrower's DSR exceeds 50%, 70% and 90%, respectively. The delinquent household borrower dummy (DEQ) is equal to 1 if debt payments are overdue by more than 30 days. Explanatory variables include a dummy variable for the self-employment status (SELF_EMP), a dummy variable for non-mortgage secured loan holders (SECU_LOAN), and a dummy variable for mortgage loan holders (MLOAN). Control variables include the log of household income (log(INCOME)), the log of credit score (log(C_SCORE)), and age group dummies for middle-aged (40s−50s) and elderly (60 and above) individuals. City-quarter fixed effects are included. Standard errors are clustered at the city-year level. t-statistics are in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	VULNERABLE	Z(50+)	Z(70+)	Z(90+)	DEQ	VULNERABLE	Z(50+)	Z(70+)	Z(90+)	DEQ
DSR	0.006***	0.006***	0.005***	0.005***	0.000***					
	(548.805)	(542.493)	(674.744)	(793.648)	(46.991)					
MLOAN=1						0.208***	0.200***	0.136***	0.100***	0.008***
						(292.681)	(281.819)	(225.805)	(192.377)	(82.059)
SELF_EMP=1						0.093***	0.082***	0.060***	0.045***	0.012***
						(87.010)	(77.948)	(64.935)	(54.706)	(41.494)
SECU_LOAN=1						0.463***	0.460***	0.353***	0.269***	0.003***
						(214.799)	(213.530)	(165.082)	(134.627)	(17.800)
log(INCOME)	-0.002***	-0.012***	-0.007***	-0.002***	0.010***	-0.117***	-0.125***	-0.100***	-0.080***	0.008***
	(-3.790)	(-23.319)	(-17.375)	(-6.006)	(72.232)	(-141.177)	(-152.810)	(-134.500)	(-119.308)	(60.954)
log(C_SCORE)	-0.139***	0.033***	0.021***	0.013***	-0.172***	-0.177***	-0.002**	0.010***	0.013***	-0.174***
	(-123.694)	(46.447)	(39.940)	(27.810)	(-163.405)	(-129.478)	(-2.383)	(13.375)	(20.060)	(-164.707)
AGE(40s-50s)=1	0.011***	0.012***	0.006***	0.001**	-0.001***	0.016***	0.018***	0.017***	0.013***	-0.002***
	(23.780)	(27.778)	(18.648)	(2.372)	(-10.070)	(22.966)	(26.914)	(29.063)	(26.815)	(-18.509)
AGE(60+)=1	0.017***	0.016***	0.012***	0.006***	0.002***	0.000	-0.000	0.006***	0.007***	0.001***
	(28.552)	(26.212)	(27.167)	(17.569)	(11.850)	(0.471)	(-0.201)	(7.593)	(9.516)	(4.203)
Observations	12,104,075	12,104,075	12,104,075	12,104,075	12,104,075	12,104,075	12,104,075	12,104,075	12,104,075	12,104,075
R-squared	0.561	0.582	0.643	0.663	0.164	0.190	0.193	0.159	0.127	0.167
BORROW FE	N	N	N	N	N	N	N	N	N	N
CITY*YQ FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Table 3. Transition probability: normal, zombie and delinquent households

Panel A. 1 Quarter

	State(Q+1)			State(Q+1)			State(Q+1)		
State(t)	Normal	Z1(50)	DEQ	Normal	Z2(70)	DEQ	Normal	Z3(90)	DEQ
Normal	0.977	0.020	0.003	0.984	0.013	0.003	0.987	0.009	0.003
Zombie	0.120	0.876	0.004	0.130	0.866	0.003	0.140	0.857	0.003
DEQ	0.274	0.036	0.690	0.290	0.020	0.690	0.298	0.013	0.690

Panel B. 2 Quarter

	State(Q+2)			State(Q+2)			State(Q+2)		
State(t)	Normal	Z1(50)	DEQ	Normal	Z2(70)	DEQ	Normal	Z3(90)	DEQ
Normal	0.965	0.030	0.005	0.976	0.019	0.005	0.981	0.014	0.005
Zombie	0.180	0.814	0.006	0.200	0.795	0.005	0.218	0.777	0.005
DEQ	0.420	0.050	0.530	0.442	0.028	0.530	0.453	0.017	0.530

Panel C. 3 Quarter

	State(Q+3)			State(Q+3)			State(Q+3))		
State(t)	Normal	Z1(50)	DEQ	Normal	Z2(70)	DEQ	Normal	Z3(90)	DEQ
Normal	0.956	0.038	0.006	0.970	0.025	0.006	0.976	0.018	0.006
Zombie	0.229	0.764	0.007	0.256	0.738	0.006	0.282	0.712	0.006
DEQ	0.507	0.055	0.438	0.531	0.030	0.438	0.543	0.019	0.438

Panel D. 1 Year

	State(Y+1)			State(Y+1)			State(Y+1)		
State(t)	Normal	Z1(50)	DEQ	Normal	Z2(70)	DEQ	Normal	Z3(90)	DEQ
Normal	0.948	0.046	0.006	0.965	0.029	0.006	0.973	0.021	0.006
Zombie	0.267	0.726	0.007	0.300	0.694	0.007	0.332	0.662	0.006
DEQ	0.566	0.059	0.376	0.592	0.032	0.376	0.605	0.019	0.376

Panel E .2 Year

	State(Y+2)			State(Y+2)			State(Y+2)		
State(t)	Normal	Z1(50)	DEQ	Normal	Z2(70)	DEQ	Normal	Z3(90)	DEQ
Normal	0.920	0.073	0.007	0.947	0.046	0.007	0.960	0.033	0.007
Zombie	0.351	0.641	0.008	0.394	0.598	0.007	0.433	0.560	0.007
DEQ	0.716	0.062	0.222	0.744	0.033	0.222	0.758	0.020	0.222

Panel F. 3 Year

	State(Y+3)			State(Y+3)			State(Y+3)		
State(t)	Normal	Z1(50)	DEQ	Normal	Z2(70)	DEQ	Normal	Z3(90)	DEQ
Normal	0.910	0.082	0.008	0.940	0.052	0.008	0.955	0.037	0.008
Zombie	0.503	0.489	0.008	0.562	0.430	0.008	0.606	0.539	0.007
DEQ	0.819	0.005	0.128	0.842	0.003	0.128	0.852	0.012	0.128

Table 4. Lending to vulnerable households: Total loan regression.

This table presents estimation results from regression equation (1). The dependent variables are the log of total loan amount log(LMT); a dummy variable for new loans NEW_LOAN, which is equal to 1 if the change in the loan amount is greater than zero; and the change in the log of total loan amount dlog(LMT). $Z(50+)$, $Z(70+)$, and $Z(90+)$ are the dummy variables for highly indebted households whose DSR exceeds 50%, 70%, and 90%, respectively. DEQ is the delinquent household dummy, which is equal to 1 if debt payments are overdue by more than 30 days. Control variables include age group dummies for middle-aged ($40s - 50s$) and elderly (60 and above) individuals, the log of household income (log(INCOME)), a dummy variable for self-employment status (SELF_EMP), a dummy variable for mortgage loan holders (MLOAN) and the log of credit score (log(C_SCORE)). Borrower, City x year-quarter (CITY x YQ), lender type x quarter (FI x YQ) fixed effects are included. Standard errors are clustered at the city x year level. t-statistics are shown in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively.

Panel A. Shorter-term horizon

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
DEP. VAR.	$log(LMT)$				NEW_LOAN				NEW_FI			
$Z(50+)_{q-1} = 1$	0.348***				-0.010***				-0.030***			
	(379.072)				(-29.347)				(-88.131)			
$Z(70+)_{q-1} = 1$		0.352***				0.007***				-0.021***		
		(319.148)				(16.024)				(-52.238)		
$Z(90+)_{q-1} = 1$			0.357***				0.019***				-0.014***	
			(279.941)				(37.555)				(-29.529)	
$DEQ_{q-1} = 1$				0.080***				-0.046***				-0.028***
				(29.212)				(-67.931)				(-37.862)
$AGE(40s - 50s) = 1$	0.003**	0.004***	0.004***	0.004***	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(2.025)	(2.839)	(3.176)	(3.204)	(-0.312)	(-0.417)	(-0.394)	(-0.541)	(-0.182)	(-0.393)	(-0.448)	(-0.529)
$AGE(60+) = 1$	-0.057***	-0.059***	-0.059***	-0.063***	-0.005***	-0.004***	-0.004***	-0.004***	-0.006***	-0.006***	-0.005***	-0.005***
	(-28.701)	(-29.277)	(-29.710)	(-31.121)	(-6.495)	(-6.158)	(-6.036)	(-6.268)	(-7.965)	(-7.655)	(-7.482)	(-7.311)
log(INCOME)	0.392***	0.379***	0.370***	0.331***	-0.014***	-0.012***	-0.011***	-0.012***	-0.007***	-0.004***	-0.003***	-0.001***
	(301.247)	(291.240)	(284.172)	(253.763)	(-29.870)	(-24.311)	(-22.034)	(-26.024)	(-13.935)	(-9.128)	(-6.329)	(-3.044)
SELF_EMP=1	0.014***	0.015***	0.016***	0.018***	-0.014***	-0.014***	-0.014***	-0.014***	-0.016***	-0.016***	-0.016***	-0.016***
	(11.304)	(12.022)	(12.884)	(14.743)	(-32.962)	(-33.487)	(-33.675)	(-32.370)	(-36.103)	(-36.519)	(-36.809)	(-36.508)
MLOAN=1	0.955***	0.973***	0.984***	1.020***	0.064***	0.061***	0.060***	0.062***	0.033***	0.030***	0.029***	0.028***
	(798.951)	(813.769)	(822.953)	(851.366)	(158.565)	(152.178)	(150.027)	(156.063)	(80.314)	(73.942)	(70.671)	(68.138)
log(C_SCORE)	0.191***	0.189***	0.190***	0.213***	0.066***	0.066***	0.066***	0.054***	0.057***	0.057***	0.057***	0.050***
	(100.853)	(99.739)	(99.765)	(103.408)	(119.410)	(119.172)	(119.009)	(90.673)	(101.292)	(101.346)	(101.189)	(82.406)
Observations	16,220,105	16,220,105	16,220,105	16,220,105	16,243,711	16,243,711	16,243,711	16,243,711	16,243,711	16,243,711	16,243,711	16,243,711
R-squared	0.650	0.649	0.648	0.647	0.127	0.127	0.127	0.127	0.157	0.157	0.156	0.156
BORROWER FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CITY*YQ FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
FI*YQ FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Table 4. continued

Panel B. Longer-term horizon

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
DEP. VAR.	$log(LMT)$				NEW_LOAN				$dlog(LMT)$			
$Z50_{q-4}=1$	0.175***				-0.015***				-6.030***			
	(173.934)				(-41.407)				(-105.690)			
$Z70_{q-4}=1$		0.189***				-0.012***				-6.035***		
		(155.016)				(-26.206)				(-88.367)		
$Z90_{q-4}=1$			0.195***				-0.011***				-6.114***	
			(138.019)				(-21.108)				(-76.844)	
$DEQ_{q-4}=1$				-0.114***				-0.031***				-0.131
				(-38.396)				(-46.854)				(-0.892)
$AGE(40s-50s)=1$	0.013***	0.014***	0.014***	0.013***	0.000	0.000	0.000	0.000	0.542***	0.533***	0.532***	0.546***
	(8.909)	(9.085)	(9.109)	(8.736)	(0.565)	(0.540)	(0.539)	(0.539)	(6.358)	(6.256)	(6.242)	(6.399)
$AGE(60+)=1$	-0.048***	-0.049***	-0.049***	-0.050***	-0.004***	-0.004***	-0.004***	-0.004***	-0.089	-0.061	-0.047	-0.011
	(-21.312)	(-21.613)	(-21.778)	(-22.311)	(-4.660)	(-4.535)	(-4.495)	(-4.451)	(-0.696)	(-0.476)	(-0.370)	(-0.084)
log(INCOME)	0.327***	0.325***	0.323***	0.314***	-0.014***	-0.014***	-0.013***	-0.013***	-4.237***	-4.140***	-4.072***	-3.793***
	(216.865)	(215.427)	(214.104)	(207.449)	(-24.931)	(-24.128)	(-23.826)	(-23.179)	(-44.835)	(-43.821)	(-43.108)	(-40.202)
SELF_EMP=1	0.010***	0.011***	0.012***	0.014***	-0.015***	-0.015***	-0.015***	-0.015***	-1.340***	-1.375***	-1.406***	-1.489***
	(7.380)	(7.927)	(8.585)	(10.078)	(-30.219)	(-30.535)	(-30.681)	(-31.278)	(-16.724)	(-17.154)	(-17.539)	(-18.564)
MLOAN=1	1.010***	1.014***	1.017***	1.026***	0.067***	0.067***	0.066***	0.066***	15.411***	15.230***	15.116***	14.824***
	(712.158)	(715.466)	(717.819)	(722.997)	(141.592)	(140.272)	(139.822)	(138.695)	(162.782)	(161.244)	(160.283)	(157.713)
log(C_SCORE)	0.152***	0.148***	0.146***	0.134***	0.053***	0.053***	0.054***	0.050***	5.970***	6.111***	6.164***	6.184***
	(68.301)	(66.479)	(65.718)	(59.433)	(81.084)	(81.705)	(81.864)	(76.590)	(49.833)	(50.976)	(51.399)	(50.691)
Observations	12,939,302	12,939,302	12,939,302	12,939,302	12,958,791	12,958,791	12,958,791	12,958,791	12,937,664	12,937,664	12,937,664	12,937,664
R-squared	0.668	0.668	0.668	0.668	0.136	0.136	0.136	0.136	0.047	0.047	0.047	0.046
BORROWER FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CITY*YQ FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
FI*YQ FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Table 5. Lending to vulnerable households: banks vs. non-banks

This table presents estimation results linking the share of bank and non-bank financial institution (NBFI) lending to vulnerable households. Panel A reports results with the share of bank lending (R_BANK) and the change in the share as the dependent variable. Panel B focuses on the share of non-bank depository institution (R_NBD) lending and its change. Panel C shows results for the share of other non-bank institution (R_NBO) lending and its change. Key explanatory variables include $Z(50+)$, $Z(70+)$, and $Z(90+)$ —dummies for highly indebted households with DSRs exceeding 50%, 70%, and 90%, respectively. DEQ is a dummy equal to 1 if debt payments are overdue by more than 30 days. Control variables include age group dummies (middle-aged: 40s−50s; elderly: 60+), the log of household income (log(INCOME)), self-employment status (SELF_EMP), mortgage loan status (M_LOAN), and the log of credit score (log(C_SCORE)). Borrower, city, and year-quarter fixed effects are included.

Panel A. The share of loans from banks (R_BANK) and its change

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DEP. VAR.	R_BANK				ΔR_BANK			
$Z(50+)_{q-4}=1$	-2.181***				0.070***			
	(-34.239)				(3.510)			
$Z(70+)_{q-4}=1$		-1.738***				-0.125***		
		(-22.830)				(-5.112)		
$Z(90+)_{q-4}=1$			-1.199***				-0.298***	
			(-13.870)				(-10.242)	
$DEQ_{q-4}=1$				3.111***				1.002***
				(24.751)				(19.449)
$AGE(40s-50s)=1$	0.549***	0.549***	0.551***	0.557***	0.072***	0.071***	0.071***	0.072***
	(4.615)	(4.614)	(4.631)	(4.683)	(2.701)	(2.674)	(2.648)	(2.708)
$AGE(60+)=1$	0.231	0.246	0.253	0.264	0.042	0.040	0.039	0.042
	(1.395)	(1.480)	(1.526)	(1.590)	(1.096)	(1.040)	(1.015)	(1.090)
log(INCOME)	-0.374***	-0.322***	-0.284***	-0.230**	-0.785***	-0.795***	-0.801***	-0.787***
	(-3.411)	(-2.934)	(-2.586)	(-2.092)	(-26.659)	(-27.024)	(-27.214)	(-26.773)
SELF_EMP=1	-0.220**	-0.241**	-0.256**	-0.262**	0.143***	0.147***	0.148***	0.147***
	(-2.169)	(-2.369)	(-2.516)	(-2.574)	(5.730)	(5.880)	(5.943)	(5.911)
MLOAN=1	14.208***	14.124***	14.072***	14.028***	1.994***	2.007***	2.012***	2.002***
	(100.340)	(99.647)	(99.219)	(98.821)	(65.111)	(65.740)	(66.028)	(65.962)
log(C_SCORE)	13.730***	13.786***	13.802***	14.123***	2.111***	2.107***	2.107***	2.210***
	(87.663)	(87.977)	(88.065)	(90.183)	(52.366)	(52.275)	(52.280)	(54.093)
Observations	9,594,937	9,594,937	9,594,937	9,594,937	9,594,937	9,594,937	9,594,937	9,594,937
R-squared	0.849	0.849	0.849	0.849	0.041	0.041	0.041	0.041
BORROW FE	Y	Y	Y	Y	Y	Y	Y	Y
CITY FE	Y	Y	Y	Y	Y	Y	Y	Y
YQ FE	Y	Y	Y	Y	Y	Y	Y	Y

Table 5. Continued

Panel B. The share of loans from non-bank depository institutions (R_NBD) and its change

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DEP. VAR.		R_NBD				ΔR_NBD		
$Z(50+)_{q-4}=1$	2.611***				-0.475***			
	(49.098)				(-30.409)			
$Z(70+)_{q-4}=1$		2.830***				-0.524***		
		(43.417)				(-26.948)		
$Z(90+)_{q-4}=1$			2.787***				-0.550***	
			(37.089)				(-23.665)	
$DEQ_{q-4}=1$				-3.167***				-0.480***
				(-22.869)				(-8.530)
Observations	9,594,937	9,594,937	9,594,937	9,594,937	9,594,937	9,594,937	9,594,937	9,594,937
R-squared	0.849	0.849	0.849	0.849	0.041	0.041	0.041	0.041
CONTROL	Y	Y	Y	Y	Y	Y	Y	Y
BORROW FE	Y	Y	Y	Y	Y	Y	Y	Y
CITY FE	Y	Y	Y	Y	Y	Y	Y	Y
YQ FE	Y	Y	Y	Y	Y	Y	Y	Y

Panel C. The share of loans from other non-bank institutions (R_NBO) and its change

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DEP. VAR.		R_NBO				ΔR_NBO		
$Z(50+)_{q-4}=1$	-0.430***				0.406***			
	(-7.251)				(22.403)			
$Z(70+)_{q-4}=1$		-1.091***				0.649***		
		(-15.716)				(30.327)		
$Z(90+)_{q-4}=1$			-1.588***				0.847***	
			(-20.628)				(34.263)	
$DEQ_{q-4}=1$				0.056				-0.521***
				(0.360)				(-8.159)
Observations	9,594,937	9,594,937	9,594,937	9,594,937	9,594,937	9,594,937	9,594,937	9,594,937
R-squared	0.849	0.849	0.849	0.849	0.041	0.041	0.041	0.041
CONTROL	Y	Y	Y	Y	Y	Y	Y	Y
BORROW FE	Y	Y	Y	Y	Y	Y	Y	Y
CITY FE	Y	Y	Y	Y	Y	Y	Y	Y
YQ FE	Y	Y	Y	Y	Y	Y	Y	Y

Table 6. Vulnerable households and future consumption growth.

This table presents the coefficients on several variables identifying vulnerable households in regressions on future consumption growth, ΔC_{q+h}, for horizons $h = 1, 2, 3, 4, 8, 12$ quarters over the period from Q1 2017 to Q4 2023. In Panels A and B, zombie borrower dummies (Z(50+), Z(70+), and Z(90+) are equal to 1 if an individual's DSR exceeds 50%, 70% and 90%, respectively. The delinquent borrower dummy (DEQ) is equal to 1 if the individual has debt payments overdue by more than 30 days. Control variables include age group dummies (middle-aged: 40s−50s; elderly: 60+), the log of income (log(INCOME)), self-employment status (SELF_EMP), mortgage loan status (M_LOAN), and the log of credit score (log(C_SCORE)). Individual borrower fixed effects and city x year-quarter fixed effects are included. Standard errors are clustered at the city x year level. t-statistics are shown in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively.

Panel A. Short-term horizon (less than one year): zombie and delinquent households

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
DEP. VAR.	$\Delta(C_{q+1})$				$\Delta(C_{q+2})$				$\Delta(C_{q+3})$			
$Z(50+) = 1$	-0.192***				-2.445***				-3.929***			
	(-3.047)				(-27.664)				(-36.601)			
$Z(70+) = 1$		0.447***				-0.859***				-1.911***		
		(6.056)				(-8.285)				(-15.243)		
$Z(90+) = 1$			0.854***				0.311***				-0.450***	
			(10.145)				(2.622)				(-3.144)	
$DEQ = 1$				-33.369***				-21.567***				-16.297***
				(-88.853)				(-45.382)				(-29.433)
$AGE(40s - 50s) = 1$	0.638***	0.636***	0.638***	0.591***	0.839***	0.840***	0.844***	0.815***	1.178***	1.180***	1.185***	1.166***
	(8.861)	(8.830)	(8.854)	(8.231)	(7.265)	(7.272)	(7.304)	(7.071)	(7.847)	(7.857)	(7.889)	(7.771)
$AGE(60+) = 1$	-0.069	-0.058	-0.054	-0.087	-0.132	-0.094	-0.077	-0.094	0.264	0.318	0.341	0.336
	(-0.572)	(-0.474)	(-0.446)	(-0.719)	(-0.690)	(-0.491)	(-0.403)	(-0.495)	(1.082)	(1.303)	(1.398)	(1.380)
log(INCOME)	-4.188***	-4.093***	-4.062***	-3.958***	-6.908***	-6.586***	-6.434***	-6.344***	-9.282***	-8.831***	-8.615***	-8.474***
	(-55.821)	(-54.642)	(-54.331)	(-53.611)	(-60.792)	(-58.050)	(-56.809)	(-56.590)	(-64.838)	(-61.788)	(-60.365)	(-59.892)
log(C_SCORE)	7.339***	7.350***	7.349***	-0.466***	0.389	0.419*	0.421*	-4.480***	-9.658***	-9.609***	-9.602***	-13.221***
	(45.944)	(46.016)	(46.009)	(-2.752)	(1.633)	(1.755)	(1.766)	(-17.619)	(-31.646)	(-31.475)	(-31.449)	(-40.869)
SELF_EMP=1 = 1	-3.175***	-3.174***	-3.175***	-2.723***	-5.909***	-5.923***	-5.931***	-5.643***	-8.335***	-8.355***	-8.366***	-8.153***
	(-41.235)	(-41.185)	(-41.198)	(-35.423)	(-49.395)	(-49.511)	(-49.568)	(-47.267)	(-54.502)	(-54.621)	(-54.685)	(-53.356)
MLOAN=1 = 1	-0.179***	-0.332***	-0.377***	-0.163**	-0.211**	-0.746***	-0.981***	-0.884***	-0.096	-0.840***	-1.174***	-1.212***
	(-2.706)	(-5.069)	(-5.800)	(-2.566)	(-2.114)	(-7.540)	(-9.965)	(-9.148)	(-0.769)	(-6.771)	(-9.503)	(-9.977)
Observations	11,880,515	11,878,976	11,878,976	11,878,976	11,262,105	11,262,105	11,262,105	11,262,105	10,658,015	10,658,015	10,658,015	10,658,015
R-squared	0.021	0.021	0.021	0.023	0.041	0.041	0.041	0.042	0.065	0.065	0.065	0.066
BORROW FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CITY*YQ FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6. Continued

Panel B. Longer-term horizon (more than one year): zombie and delinquent households

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
DEP. VAR.	$\Delta(C_{y+1})$				$\Delta(C_{y+2})$				$\Delta(C_{y+3})$			
$Z(50+)=1$	-5.194***				-7.603***				-7.592***			
	(-42.838)				(-47.947)				(-41.644)			
$Z(70+)=1$		-2.943***				-5.274***				-5.586***		
		(-20.843)				(-28.555)				(-26.414)		
$Z(90+)=1$			-1.298***				-3.988***				-4.417***	
			(-8.077)				(-18.998)				(-18.439)	
$DEQ=1$				-12.331***				-2.469***				3.739***
				(-20.102)				(-3.069)				(3.936)
$AGE(40s-50s)=1$	1.446***	1.451***	1.457***	1.447***	2.265***	2.284***	2.293***	2.311***	3.029***	3.042***	3.050***	3.076***
	(8.106)	(8.130)	(8.164)	(8.111)	(8.698)	(8.765)	(8.797)	(8.866)	(9.092)	(9.124)	(9.148)	(9.222)
$AGE(60+)=1$	1.026***	1.093***	1.122***	1.130***	3.524***	3.606***	3.634***	3.681***	4.921***	4.980***	5.004***	5.051***
	(3.585)	(3.819)	(3.919)	(3.948)	(8.557)	(8.754)	(8.822)	(8.936)	(9.330)	(9.439)	(9.482)	(9.570)
log(INCOME)	-11.315***	-10.768***	-10.500***	-10.288***	-15.767***	-15.068***	-14.755***	-14.280***	-15.464***	-14.782***	-14.449***	-13.905***
	(-67.992)	(-64.804)	(-63.267)	(-62.466)	(-67.861)	(-64.930)	(-63.645)	(-62.016)	(-54.464)	(-52.132)	(-51.016)	(-49.427)
log(C_SCORE)	-20.212***	-20.145***	-20.133***	-22.823***	-60.524***	-60.417***	-60.391***	-60.901***	-82.977***	-82.876***	-82.853***	-82.009***
	(-56.331)	(-56.119)	(-56.076)	(-60.382)	(-116.405)	(-116.118)	(-116.040)	(-112.279)	(-130.501)	(-130.245)	(-130.168)	(-122.620)
SELF_EMP=1 = 1	-10.423***	-10.447***	-10.460***	-10.302***	-14.854***	-14.881***	-14.895***	-14.869***	-14.662***	-14.669***	-14.674***	-14.706***
	(-58.228)	(-58.344)	(-58.410)	(-57.576)	(-57.365)	(-57.444)	(-57.491)	(-57.402)	(-44.123)	(-44.130)	(-44.142)	(-44.240)
MLOAN=1 = 1	-0.028	-0.919***	-1.331***	-1.515***	-0.387*	-1.463***	-1.918***	-2.532***	-2.158***	-3.163***	-3.614***	-4.307***
	(-0.195)	(-6.409)	(-9.320)	(-10.767)	(-1.951)	(-7.421)	(-9.767)	(-13.039)	(-8.706)	(-12.834)	(-14.712)	(-17.708)
Observations	10,069,955	10,069,955	10,069,955	10,069,955	7,814,977	7,814,977	7,814,977	7,814,977	5,797,201	5,797,201	5,797,201	5,797,201
R-squared	0.096	0.095	0.095	0.095	0.229	0.228	0.228	0.228	0.376	0.376	0.376	0.376
BORROW FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CITY*YQ FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7. Heterogeneity among vulnerable borrowers and consumption growth: interaction with demographic variables

This table shows future consumption growth of vulnerable borrowers compared to the other groups of household borrowers, accounting for borrowers' income and age distributions. Future consumption growth is measured as the log change in consumption, ΔC_{y+h}, over the horizons of one to three years from Q1 2017 to Q4 2023. The zombie borrower dummies (Z(50+), Z(70+), and Z(90+)) are equal to 1 if an individual's DSR exceeds 50%, 70% and 90%, respectively. The delinquent borrower dummy (DEQ) is equal to 1 if the individual has debt payments overdue by more than 30 days. Panel A presents the results on the associations between vulnerable households and high-income groups (top 30%). Panel B presents those on the associations between vulnerable borrowers and elderly borrowers (above age 60). Control variables include age group dummies for middle-aged (40s−50s) and elderly (60 and above) individuals, the log of income, a dummy for the self-employment status and a dummy for mortgage loan holders. Individual borrower fixed effects and city x year-quarter fixed effects are included. Standard errors are clustered at the city x year level. t-statistics are shown in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively.

Panel A. Longer-term horizon: income distribution

DEP. VAR.	$\Delta(C_{y+1})$				$\Delta(C_{y+2})$				$\Delta(C_{y+3})$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$Z(50+)=1$	-6.500***				-9.109***				-8.922***			
	(-44.900)				(-47.565)				(-40.167)			
Z(50+) x H_income	5.627***				6.234***				4.933***			
	(25.757)				(22.066)				(15.304)			
$Z(70+)=1$		-4.052***				-6.486***				-6.649***		
		(-24.184)				(-29.243)				(-25.926)		
Z(70+) x H_income		4.994***				5.289***				4.080***		
		(18.915)				(15.581)				(10.625)		
$Z(90+)=1$			-2.378***				-5.079***				-5.437***	
			(-12.531)				(-20.240)				(-18.768)	
Z(90+) x H_income			4.994***				4.982***				3.988***	
			(16.193)				(12.601)				(8.987)	
$DEQ=1$				-11.033***				-2.054**				4.240***
				(-16.703)				(-2.377)				(4.139)
DEQ x H_income				-7.369***				-1.696				-2.272
				(-4.763)				(-0.813)				(-0.948)
H_income = 1	-1.917***	-1.608***	-1.491***	-1.190***	-2.205***	-1.839***	-1.696***	-1.423***	-1.363***	-1.049***	-0.938***	-0.697***
	(-14.165)	(-11.988)	(-11.161)	(-8.980)	(-12.287)	(-10.336)	(-9.568)	(-8.086)	(-6.397)	(-4.969)	(-4.461)	(-3.341)
Observations	10,069,955	10,069,955	10,069,955	10,069,955	7,814,977	7,814,977	7,814,977	7,814,977	5,797,201	5,797,201	5,797,201	5,797,201
R-squared	0.096	0.096	0.095	0.096	0.229	0.228	0.228	0.228	0.376	0.376	0.376	0.376
BORROW FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CITY*YQ FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CONTROL	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Table 7. Continued

Panel B. Longer-term horizon: age cohort

DEP. VAR.	$\Delta(C_{y+1})$				$\Delta(C_{y+2})$				$\Delta(C_{y+3})$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Z(50+) = 1	-4.951***				-7.449***				-7.629***			
	(-39.267)				(-45.090)				(-40.305)			
Z(50+) x AGE(60+)	1.632***				2.737***				2.951***			
	(5.155)				(6.420)				(5.743)			
Z(70+) = 1		-2.714***				-5.149***				-5.804***		
		(-18.332)				(-26.576)				(-26.267)		
Z(70+) x AGE(60+)		1.145***				2.206***				3.651***		
		(3.109)				(4.432)				(6.136)		
Z(90+) = 1			-1.031***				-3.863***				-4.705***	
			(-6.063)				(-17.423)				(-18.696)	
Z(90+) x AGE(60+)			0.628				1.879***				3.816***	
			(1.512)				(3.344)				(5.707)	
DEQ = 1				-12.141***				-3.149***				3.154***
				(-19.189)				(-3.800)				(3.240)
DEQ x AGE(60+)				-0.976				11.897***				11.999***
				(-0.440)				(3.890)				(3.134)
Elderly = 1	0.689**	0.879***	0.972***	1.024***	2.994***	3.270***	3.386***	3.495***	4.347***	4.495***	4.625***	4.888***
	(2.369)	(3.044)	(3.376)	(3.580)	(7.168)	(7.874)	(8.179)	(8.489)	(8.127)	(8.454)	(8.723)	(9.266)
Observations	10,069,955	10,069,955	10,069,955	10,069,955	7,814,977	7,814,977	7,814,977	7,814,977	5,797,201	5,797,201	5,797,201	5,797,201
R-squared	0.096	0.095	0.095	0.096	0.229	0.228	0.228	0.228	0.376	0.376	0.376	0.376
CONTROL	Y	Y	Y	Y	Y	Y	Y	Y				
BORROW FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CITY*YQ FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Table 8. Macroeconomic conditions, vulnerable households, and consumption growth

This table presents future consumption growth of vulnerable households, accounting for changes in macroeconomic conditions. Future consumption growth is measured as the log change in consumption, ΔC_{q+k}, over the horizons of one to three quarters from Q1 2017 to Q4 2023. The zombie household indicators (Z(50+), Z(70+), and Z(90+) are equal to 1 if an individual's DSR exceeds 50%, 70% and 90%, respectively. The delinquent household dummy (DEQ) is equal to 1 if the individual has debt payments overdue by more than 30 days. Panel A presents the results on the associations between vulnerable households and quarterly policy rate changes (ΔPR). Panel B shows those on the associations between vulnerable households and quarterly house price growth (dlog(HPI)). Control variables include age group dummies for middle-aged (40–50) and elderly (60 and above) individuals, the log of income, a dummy for self-employment status and a dummy for mortgage loan holders. Borrower and city x year-quarter fixed effects are included. Standard errors are clustered at the city x year level. t-statistics are shown in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively.

Panel A. Shorter-term horizon: the change in policy rates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables	$\Delta(C_{q+1})$				$\Delta(C_{q+2})$				$\Delta(C_{q+3})$			
Z(50+) = 1	-0.108*				-2.349***				-3.890***			
	(-1.674)				(-25.829)				(-35.163)			
Z(50+) x ΔPR	-0.898***				-1.048***				-0.397			
	(-5.895)				(-4.824)				(-1.590)			
Z(70+) = 1		0.514***				-0.771***				-1.885***		
		(6.785)				(-7.207)				(-14.552)		
Z(70+) x ΔPR		-0.765***				-0.960***				-0.262		
		(-4.052)				(-3.578)				(-0.848)		
Z(90+) = 1			0.927***				0.392***				-0.433***	
			(10.700)				(3.188)				(-2.918)	
Z(90+) x ΔPR			-0.832***				-0.886***				-0.178	
			(-3.696)				(-2.764)				(-0.486)	
DEQ = 1				-33.304***				-21.300***				-15.779***
				(-85.729)				(-43.300)				(-27.550)
DEQ x ΔPR				-0.791				-3.273**				-6.343***
				(-0.689)				(-2.238)				(-3.815)
Observations	11,878,976	11,878,976	11,878,976	11,878,976	11,262,105	11,262,105	11,262,105	11,262,105	10,658,015	10,658,015	10,658,015	10,658,015
R-squared	0.021	0.021	0.021	0.023	0.041	0.041	0.041	0.042	0.065	0.065	0.065	0.066
BORROW FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CITY*YQ FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8. Continued

Panel B. Longer-term horizon: the change in policy rates

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	$\Delta(C_{y+1})$				$\Delta(C_{y+2})$				$\Delta(C_{y+3})$			
Z(50+) = 1	-5.149***				-7.562***				-7.739***			
	(-41.356)				(-47.707)				(-42.165)			
Z(50+) x ΔPR	-0.469*				-3.934***				-4.265***			
	(-1.721)				(-7.955)				(-7.189)			
Z(70+) = 1		-2.929***				-5.235***				-5.720***		
		(-20.153)				(-28.340)				(-26.903)		
Z(70+) x ΔPR		-0.146				-3.568***				-4.361***		
		(-0.435)				(-5.875)				(-5.997)		
Z(90+) = 1			-1.308***				-3.958***				-4.524***	
			(-7.885)				(-18.851)				(-18.793)	
Z(90+) x ΔPR			0.107				-2.711***				-3.741***	
			(0.269)				(-3.780)				(-4.352)	
DEQ = 1				-11.766***				-2.080***				1.653*
				(-18.604)				(-2.580)				(1.729)
DEQ x ΔPR				-7.336***				-20.076***				-65.222***
				(-4.046)				(-7.264)				(-15.839)
Observations	10,069,955	10,069,955	10,069,955	10,069,955	7,814,977	7,814,977	7,814,977	7,814,977	5,797,201	5,797,201	5,797,201	5,797,201
R-squared	0.096	0.095	0.095	0.095	0.229	0.228	0.228	0.228	0.376	0.376	0.376	0.376
CONTOL	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
BORROW FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CITY*YQ FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8. Continued

Panel C. Shorter-term horizon: House price growth (dlog(HPI))

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	$\Delta(C_{q+1})$				$\Delta(C_{q+2})$				$\Delta(C_{q+3})$			
Z(50+) = 1	-0.189***				-2.436***				-3.910***			
	(-2.987)				(-27.526)				(-36.412)			
Z(50+) x $\Delta log(HPI)$	0.009				-0.045				-0.102***			
	(0.399)				(-1.473)				(-2.950)			
Z(70+) = 1		0.440***				-0.861***				-1.900***		
		(5.947)				(-8.299)				(-15.154)		
Z(70+) x $\Delta log(HPI)$		0.035				0.012				-0.060		
		(1.194)				(0.324)				(-1.408)		
Z(90+) = 1			0.840***				0.304**				-0.441***	
			(9.945)				(2.560)				(-3.077)	
Z(90+) x $\Delta log(HPI)$			0.077**				0.037				-0.057	
			(2.215)				(0.828)				(-1.119)	
DEQ = 1				-33.638***				-21.852***				-16.688***
				(-88.985)				(-45.714)				(-30.022)
DEQ x $\Delta log(HPI)$				1.150***				1.168***				1.584***
				(6.569)				(5.353)				(6.426)
Observations	11,878,976	11,878,976	11,878,976	11,878,976	11,262,105	11,262,105	11,262,105	11,262,105	10,658,015	10,658,015	10,658,015	10,658,015
R-squared	0.021	0.021	0.021	0.023	0.041	0.041	0.041	0.042	0.065	0.065	0.065	0.066
CONTROL	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
BORROW FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CITY*YQ FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8. Continued

Panel D. Longer-term horizon: House price growth (dlog(HPI))

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	$\Delta(C_{y+1})$				$\Delta(C_{y+2})$				$\Delta(C_{y+3})$			
Z(50+) = 1	-5.182***				-7.705***				-7.425***			
	(-42.699)				(-45.123)				(-38.878)			
Z(50+) x $\Delta log(HPI)$	-0.057				0.132*				-0.274***			
	(-1.504)				(1.660)				(-2.780)			
Z(70+) = 1		-2.938***				-5.453***				-5.469***		
		(-20.784)				(-27.357)				(-24.633)		
Z(70+) x $\Delta log(HPI)$		-0.028				0.237**				-0.202*		
		(-0.597)				(2.448)				(-1.677)		
Z(90+) = 1			-1.297***				-4.173***				-4.325***	
			(-8.062)				(-18.377)				(-17.176)	
Z(90+) x $\Delta log(HPI)$			-0.006				0.252**				-0.165	
			(-0.109)				(2.197)				(-1.151)	
DEQ = 1				-12.764***				-4.447***				-0.062
				(-20.707)				(-5.204)				(-0.061)
DEQ x $\Delta log(HPI)$				1.496***				3.080***				6.334***
				(5.578)				(6.653)				(9.454)
Observations	10,069,955	10,069,955	10,069,955	10,069,955	7,814,977	7,814,977	7,814,977	7,814,977	5,797,201	5,797,201	5,797,201	5,797,201
R-squared	0.096	0.095	0.095	0.095	0.229	0.228	0.228	0.228	0.376	0.376	0.376	0.376
CONTROL	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
BORROW FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CITY*YQ FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9. Alternative measure of vulnerable household borrowers

This table presents the coefficients on the dummy for vulnerable households and on the first principal component (PC1) of six standard indicators on household vulnerabilities (e.g., the negative value of log credit score, the negative value of income, the number of accounts, the DSR, the interest-only DSR and the DTI ratio). Here, a higher value of PC1 indicates greater vulnerability. Control variables include age group dummies for middle-aged (40–50) and elderly (60 and above) individuals, the log of income, a dummy for self-employment status and a dummy for mortgage loan holders. Borrower and city x year-quarter fixed effects are included. Standard errors are clustered at the city x year level. t-statistics are shown in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	$\Delta(C_{q+1})$	$\Delta(C_{q+2})$	$\Delta(C_{q+3})$	$\Delta(C_{y+1})$	$\Delta(C_{y+2})$	$\Delta(C_{y+3})$	$\Delta(C_{q+1})$	$\Delta(C_{q+2})$	$\Delta(C_{q+3})$	$\Delta(C_{y+1})$	$\Delta(C_{y+2})$	$\Delta(C_{y+3})$
VULNERABLE	-3.600***	-4.981***	-6.182***	-7.272***	-9.966***	-10.738***						
	(-74.996)	(-74.929)	(-76.681)	(-79.616)	(-84.301)	(-79.330)						
PC1							-1.582***	-3.456***	-4.846***	-6.010***	-8.852***	-9.632***
							(-107.168)	(-150.066)	(-164.837)	(-175.463)	(-191.291)	(-176.796)
$AGE(40-50s)=1$	1.196***	1.785***	2.458***	2.970***	4.456***	5.302***	1.276***	1.955***	2.687***	3.241***	4.783***	5.597***
	(23.609)	(22.120)	(23.417)	(23.811)	(25.569)	(24.998)	(25.204)	(24.250)	(25.653)	(26.065)	(27.594)	(26.539)
$AGE(60+)=1$	1.204***	2.194***	3.563***	4.891***	8.969***	11.514***	1.057***	1.789***	2.975***	4.151***	7.885***	10.391***
	(13.731)	(15.976)	(20.187)	(23.502)	(30.963)	(32.221)	(12.062)	(13.042)	(16.878)	(19.988)	(27.319)	(29.195)
log(INCOME)	-4.812***	-7.645***	-10.153***	-12.383***	-18.342***	-20.993***	-6.136***	-11.109***	-15.199***	-18.767***	-28.174***	-32.048***
	(-96.939)	(-100.804)	(-105.280)	(-109.774)	(-119.087)	(-113.894)	(-116.805)	(-137.376)	(-147.596)	(-155.798)	(-171.332)	(-162.617)
log(C_SCORE)	7.945***	1.799***	-6.687***	-15.957***	-55.182***	-88.385***	7.547***	0.234	-9.116***	-19.115***	-60.214***	-94.094***
	(67.334)	(10.197)	(-29.761)	(-60.289)	(-146.775)	(-195.422)	(63.496)	(1.321)	(-40.484)	(-72.120)	(-160.368)	(-208.554)
SELF_EMP=1	-3.166***	-5.997***	-8.622***	-10.939***	-17.791***	-20.786***	-3.058***	-5.652***	-8.107***	-10.283***	-16.792***	-19.707***
	(-55.131)	(-66.663)	(-74.322)	(-79.810)	(-91.629)	(-86.934)	(-53.251)	(-62.889)	(-70.035)	(-75.261)	(-86.916)	(-82.872)
MLOAN=1	-0.359***	-1.158***	-1.606***	-1.936***	-2.466***	-2.774***	0.790***	2.004***	2.990***	3.827***	6.021***	6.299***
	(-8.962)	(-18.965)	(-20.822)	(-21.562)	(-20.360)	(-19.142)	(18.588)	(30.802)	(36.303)	(39.896)	(46.667)	(41.001)
Observations	18,711,860	18,010,817	17,324,757	16,657,223	14,130,475	11,827,166	18,711,860	18,010,817	17,324,757	16,657,223	14,130,475	11,827,166
R-squared	0.015	0.029	0.045	0.065	0.150	0.240	0.015	0.030	0.047	0.068	0.154	0.244
BORROW FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CITY*YQ FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Table 10. Future consumption growth of vulnerable households: city-level analysis

This table reports regression results linking the share of vulnerable household borrowers to future annual consumption growth at the city level. The dependent variable is the log change in consumption, ΔC_{y+h}, over one- to two-year horizons from 2017 to 2023 (Panels A−E). In Panel A, rVULNERABLE denotes the share of household borrowers with the DSR above 50% or delinquent debt (overdue more than 30 days) in each city. rDSR(50+), rDSR(70+), rDSR(90+) and rDEQ indicate the share of household borrowers with the DSR exceeding 50%, 70%, and 90% and those delinquent, respectively, in each city. In panels B and C, r(DSR, INCOME) indicates the share of various measures of vulnerable borrowers by income group —low (L), middle (M) and high (H) —in each city. In panels D and E, r(DSR, AGE) reports the share of various measures of vulnerable borrowers by age cohort —young (Y: 20s−30s), middle-aged (M: 40s−50s) and old (O: 60+) —in each city. All models control for the log of city-level income (log(INC)), the log of gross regional domestic product (GRDP) (log(GRDP)), and housing price growth (dlog(HPI)), with city and year fixed effects. Standard errors are clustered at the city x year level. t-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Dependent variable: 1- and 2-year ahead consumption growth

DEP. VAR.	$\Delta(C_{y+1})$					$\Delta(C_{y+2})$				
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
rVULNERABLE	-0.393***					-0.418***				
	(-2.924)					(-5.362)				
rDSR(50+)		-0.405**					-0.430***			
		(-2.848)					(-5.143)			
rDSR(70+)			-0.443**					-0.550***		
			(-2.768)					(-7.285)		
rDSR(90+)				-0.458**					-0.614***	
				(-2.808)					(-6.726)	
rDEQ					0.126					-0.421
					(0.149)					(-0.266)
log(INC)	-0.066	-0.067	-0.057	-0.062	-0.162**	-0.018	-0.017	0.012	0.018	-0.116
	(-0.976)	(-0.969)	(-0.861)	(-1.014)	(-2.460)	(-0.132)	(-0.130)	(0.098)	(0.158)	(-0.786)
log(GRDP)	-0.102**	-0.097**	-0.088*	-0.092**	-0.137***	-0.042	-0.037	-0.022	-0.024	-0.085
	(-2.354)	(-2.282)	(-2.104)	(-2.205)	(-2.927)	(-0.692)	(-0.619)	(-0.381)	(-0.416)	(-1.236)
dlog(HPI)	0.005***	0.005***	0.005***	0.005***	0.005***	-0.003***	-0.003***	-0.003***	-0.004***	-0.003**
	(6.312)	(6.259)	(6.245)	(6.137)	(6.913)	(-3.204)	(-3.237)	(-3.232)	(-3.420)	(-2.787)
Observations	102	102	102	102	102	85	85	85	85	85
R-squared	0.951	0.951	0.951	0.950	0.946	0.948	0.949	0.950	0.951	0.944
CITY FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
YEAR FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table 10. Continued

Panel B. DSR and income distribution: 1-year ahead consumption growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	r(50+,L)	r(50+,M)	r(50+,H)	r(70+,L)	r(70+,M)	r(70+,H)	Z(90+,L)	r(90+,M)	r(90+,H)
r(DSR, INCOME)	-1.217*	-0.942***	-0.777*	-1.289*	-1.018***	-0.945**	-1.310**	-1.111**	-1.049*
	(-1.847)	(-3.317)	(-2.004)	(-1.940)	(-2.940)	(-2.156)	(-2.630)	(-2.859)	(-1.821)
Observations	102	102	102	102	102	102	102	102	102
R-squared	0.949	0.951	0.949	0.948	0.951	0.950	0.949	0.951	0.949

Panel C. DSR and income distribution: 2-year ahead consumption growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	r(50+,L)	r(50+,M)	r(50+,H)	r(70+,L)	r(70+,M)	r(70+,H)	r(90+,L)	r(90+,M)	r(90+,H)
r(DSR, INCOME)	-1.646**	-1.191***	-0.559**	-2.323***	-1.236***	-0.953***	-2.032***	-1.385***	-1.515***
	(-2.498)	(-4.823)	(-2.545)	(-3.281)	(-6.668)	(-4.172)	(-4.231)	(-6.016)	(-5.324)
Observations	85	85	85	85	85	85	85	85	85
R-squared	0.948	0.951	0.945	0.951	0.951	0.947	0.950	0.951	0.949

Panel D. DSR and age cohort: 1-year ahead consumption growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	r(50+,Y)	r(50+,M)	r(50+,O)	r(70+,Y)	r(70+,M)	r(70+,O)	r(90+,Y)	r(90+,M)	r(90+,O)
r(DSR,AGE)	-1.017**	-0.583**	-1.304	-1.080**	-0.706*	-2.092**	-1.134***	-0.668	-2.640***
	(-2.734)	(-2.251)	(-1.585)	(-2.790)	(-2.069)	(-2.176)	(-3.278)	(-1.684)	(-3.082)
Observations	102	102	102	102	102	102	102	102	102
R-squared	0.952	0.949	0.948	0.952	0.949	0.949	0.952	0.948	0.950

Panel E. DSR and age cohort: 2-year ahead consumption growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	r(50+,Y)	r(50+,M)	r(50+,O)	r(70+,Y)	r(70+,M)	r(70+,O)	r(90+,Y)	r(90+,M)	r(90+,O)
r(DSR, AGE)	-0.574**	-0.975***	-1.216	-1.060***	-1.201***	-1.825*	-1.225***	-1.350***	-2.115*
	(-2.459)	(-3.719)	(-1.478)	(-5.028)	(-5.454)	(-1.825)	(-4.968)	(-5.247)	(-1.962)
Observations	85	85	85	85	85	85	85	85	85
R-squared	0.945	0.951	0.945	0.948	0.951	0.946	0.949	0.952	0.946

Appendix

Appendix A.1. Variable description

Table A.1 Description of variables

Variables	Comment	Data source
Panel A: Borrower characteristic variables		
Debt to service ratio (DSR)	The ratio of the total debt service to income	Authors' calculation
Delinquent borrower (DEQ)	Dummy for the delinquent borrowers who have 30 day past due of the household loans	CCP
Income (log(INCOME))	Logarithms of estimated income from credit rating agency	CCP
Credit score(C_SCORE)	Logarithms of credit score	CCP
Age & Age groups	Borrower's age and age groups (Young(20-30s), Middle(40-50s), Old(60+))	CCP
MLOAN	Dummy for the mortgage loan holders	CCP
SECU_LOAN	Dummy for the non-mortgage secured loan holders	CCP
SELF_EMP	Dummy for the self-employment status	CCP
Consumption growth (ΔC)	Log differences in credit & check card spending x 100	CCP
Panel B: Borrower-financial institution level variables		
log(LMT)	Log of total household loan commitments to a borrower	CCP
NEW_LOAN	Dummy variable flagged as new loan when the total amount of loans increases	CCP
NEW_FI	Dummy variable flagged as new loan from different types of financial institutions	CCP
Panel C: City level variables		
House price growth	log changes in house prices	Korea Real Estate Board
Panel D: Macroeconomic variables		
Policy rate (ΔPR) (%)	Changes in the call rate	Bank of Korea

Appendix A.2. Computing the debt service ratio (DSR)

We construct DSRs at the individual borrower level using the loan-level and account-level information. The loan-level data include the total loan amounts and the newly issued loan amounts. The account-level data comprise the actual principal and interest payments, original maturity, remaining maturity, total loan balance and repayment methods (e.g., equal installments of principal, equal installments of principal and interest, and lump-sum payment). The borrower-level data include borrower's annual income.

The DSR is generally computed as follows:

$$DSR_{it} = \frac{Debt\ service_{it}}{Income_{it}} = \frac{Principal_{it} + Interest_{it}}{Income_{it}}$$

where *Debt service* is the amount of principal and interest payments by borrower i and quarter t where the payments are related to the total amount of loans including mortgages, credit card loans, non-mortgage secured loans and other loans. *Income* is the quarterly income for borrower i and quarter t.

Table A.2 provides details on how we measure the DSR, which is the ratio of the sum of actual principal and interest payments for each type of loans to income. For the principal, we collect the maturity of each loan from account information and replace any missing variables with the value-weighted average maturity of the types of loans and financial institutions. The principal of mortgage loans is computed differently based on the repayment methods (equal installment of principal, equal installment of principal and interest, and lump-sum payment). The principal of the non-mortgage related loans is computed as the ratio of the total loan balance to maturity. The maximum maturities applied for the DSR computation can differ depending on loan types and the timing of DSR regulations. For interest payments, we estimate interest rates following Flodén et al. (2021), who use data on the interest payments and debt amounts for each borrower's loan account.[24] For any missing values of interest rates, we replace them with the interest rate provided by the Economic Statistics System (ECOS) of the Bank of Korea.

Since we use the DSR to assess borrowers' financial health and debt repayment capacity, we sum up the principal and interest payments for each loan at the borrower level and divided them into his or her quarterly income.

[24] $interest\ rate_{lt} = \frac{interest\ payment_{lt}}{0.5\ debt_{lt-1} + 0.5\ debt_{lt}}$ for loan account l and time t.

Table A.2 Computing the Debt Service Ratio (DSR)

Loan categories	Sub-categories	Repayment method	Principal	Interest
Mortgage loans	Individual mortgage loans / mortgage balance loans	Equal installments of principal	$\frac{Total\ loan\ amount}{Maturity}$	Actual interest payments
		Equal installments of principal and interest	$\frac{r}{(1-(1+r))^{-M}} * D - IRP$[1], where r is average interest rate per quarter; M is the remaining maturities in quarters; D is the quarterly total loan amount; IRP is the actual interest payment.	
		Lum-sum payment	$\frac{Total\ loan\ amount}{Maturity\ (Max\ 10\ year)}$	
Non-mortgage loans	Jeonsei/ Insurance loans	—	No consideration	
	Jeonsei secured loan	—	$\frac{Total\ loan\ amount}{4\ year}$	
	Credit loans	Lum sum payment/ Installment (before Jan. 2022)	(Oct. 2018) $\frac{Total\ loan\ amount}{10\ year}$ (Jul. 2021) $\frac{Total\ loan\ amount}{7\ year}$ (Jan. 2022) $\frac{Total\ loan\ amount}{5\ year}$ Since Jan. 2022, maturity for installment loans includes for the maturity between 3 and 10 year.	
	Non-mortgage secured loans	—	(Oct. 2018) $\frac{Total\ loan\ amount}{10\ year}$ (Jan. 2022) $\frac{Total\ loan\ amount}{8\ year}$	
	Other loans (Lease, short-term card loans)	—	Upcoming 1 year payment	
	Security secured loans	—	(Oct. 2018) $\frac{Total\ loan\ amount}{8\ year}$	
	Deposit secured loans	—	(Oct. 2018) $\frac{Total\ loan\ amount}{8\ year}$ (Jun. 2019) No considerations	
	Card loans	—	(Jan. 2022) $\frac{Total\ loan\ amount}{Stated\ Maturity}$ Installment : max 5 year Lum sum: max 3 year	

Note: [1] Following Dyan et al. (2003), each type of installment loan is computed.

Appendix A.3. Additional Figures and Tables

Figure A.3.1. Distributions of DSR

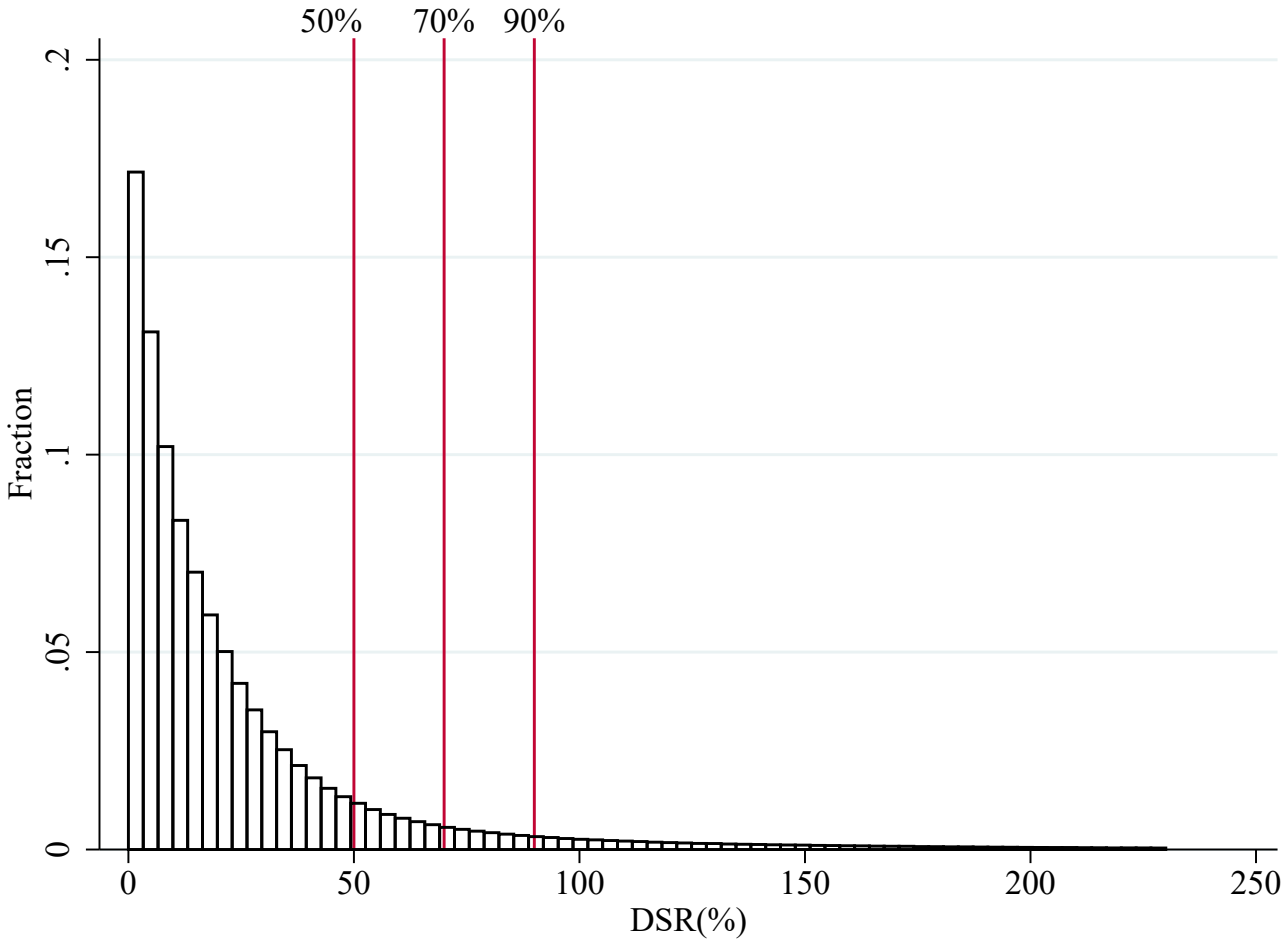


Figure A.3.2. Comparison between sample and official data: household loans and consumption growth

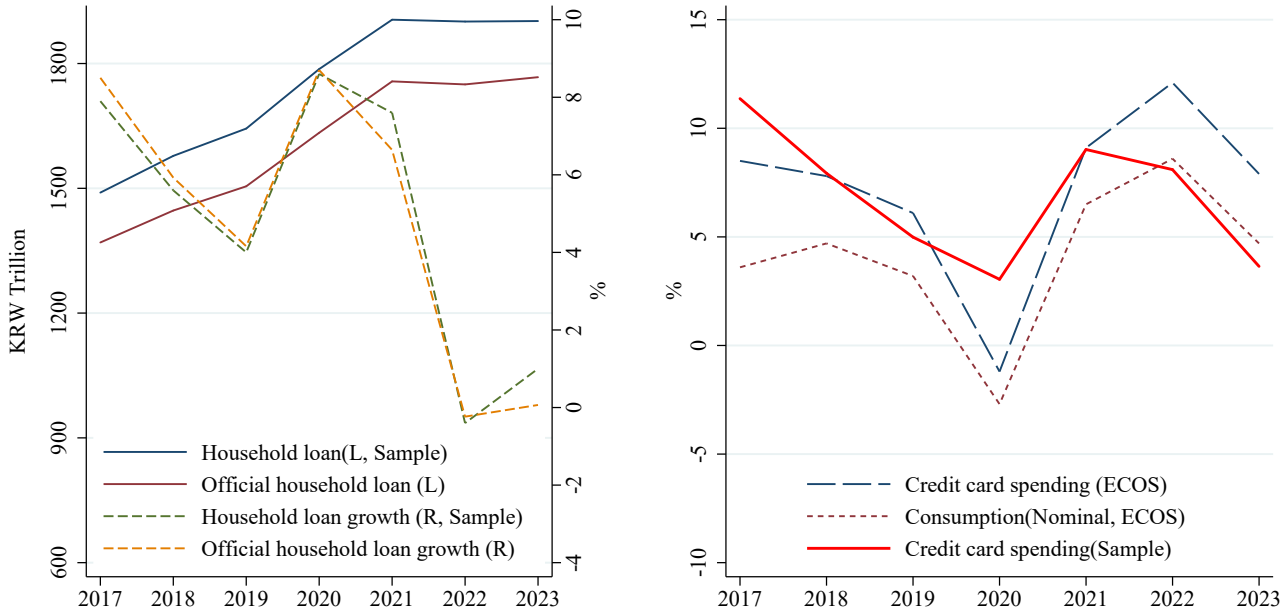


Table A.3 Characteristics of vulnerable borrowers

This table presents descriptive statistics for quarterly variables on indebted households from 2017 to 2023. Zombie borrowers are classified into three groups based on their DSR: 50–70%, 70–90%, and above 90%. INCOME, CONSUMPTION, DEBT SERVICE and LOAN AMOUNT are expressed in units of KRW 100,000, while SELF_EMP and MORTGAGE are dummy variables indicating self-employment and mortgage loan holders, respectively.

	(1) $Z(50-70)$		(2) $Z(70-90)$		(3) Z(90+)	
	mean	sd	mean	sd	mean	sd
INCOME	93.77	46.54	90.80	46.11	82.72	42.94
CONSUMPTION	83.96	80.56	84.14	81.73	79.04	79.50
LOAN AMOUNT	1699.67	1156.23	1930.59	1183.90	2518.64	1343.22
DEBT SERVICE	55.05	27.87	71.79	36.87	130.24	77.83
AGE	46.72	12.50	47.79	12.56	48.82	13.01
CREDIT SCORE	851.02	118.93	857.09	112.20	868.08	101.76
SELF_EMP=1	0.18	0.38	0.20	0.40	0.22	0.42
MORTGAGE=1	0.64	0.48	0.66	0.47	0.71	0.45
Observations	604,702		315,569		747,407	

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