

WORKING MORE TO PAY THE MORTGAGE: INTEREST RATES AND LABOR SUPPLY

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Abstract

Using income tax data for the universe of Polish population and exploiting variation in floating-rate mortgage payments driven by inter-bank interest rates fluctuations, I show that households work and earn more when their mortgage payments are higher. Higher income covers around 35% of the increase in the payment. The effect is stronger for households with higher payment-to-income ratio, in places with lower unemployment, and for more flexible income sources. The increase in labor supply is accompanied by a decrease in consumption and savings and is driven by several mechanisms, including spousal labor supply, change of job, and additional income from after-hours contracts. Interest rates, and hence monetary policy, can affect labor supply of indebted households, consistent with a model of labor decisions with consumption commitments.

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There is an extensive evidence that household borrowing significantly impacts the real economy and plays an important role in the transmission of monetary policy (Bernanke and Gertler, 1995; Mian *et al.*, 2013). The literature studies several mechanisms of that impact, yet virtually all of them are related to consumption behavior (Iacoviello, 2005; Calza *et al.*, 2013; Garriga *et al.*, 2017; Di Maggio *et al.*, 2017; Jappelli and Scognamiglio, 2018; Cloyne *et al.*, 2020). In the basic mechanism, increasing interest rates has contractionary impact on the aggregate demand, because it reduces consumption of households with debt, especially mortgage holders. The decline of consumption of households with mortgages is driving the overall consumption response (Cloyne *et al.*, 2020), and may be particularly pronounced for households with variable-rate mortgages (Di Maggio *et al.*, 2017). But the focus on consumption ignores another important economic decision of households: labor supply. If labor supply of indebted households also responds to changes in interest rates, ignoring it may provide an incomplete picture of how monetary policy and household debt interact.

Should we expect interest rates changes to have any impact on labor supply of indebted households? If borrowing gets more expensive, and households do not want or cannot borrow less, they may attempt to increase their income by working more. Such response would be optimal especially in a model of consumption commitments, where debt-financed consumption is costly to adjust (Chetty and Szeidl, 2007). In such a model, higher interest rates reduce other consumption, consistent with existing literature, but at the same time increase labor supply. However, is the increase in labor supply realistic? Even after the rise of flexible employment opportunities in the “gig economy”, a typical household continues to derive majority of its labor income from salaried positions with limited opportunities to benefit from higher labor supply. And if the household responds by reducing consumption, there may be no reason to work more.

This paper attempts to shed light on this question by studying the relationship between household debt, interest rate changes, and labor income. Using data from Poland, I show that when a monthly payment for pre-existing floating-rate mortgages increases due to fluctuations in the reference rate of the loan (WIBOR/LIBOR), households respond by working and earning more. The magnitude of this effect is substantial: around 35% of the increase in payment is covered with the increase in income. The effect is higher for households with higher payment-to-income ratio, more pronounced in places with low unemployment and for more flexible sources of income, and driven by several mechanisms, including spousal labor supply, change of job or additional income from after-hours work.

The findings capture an intuitive idea that people work harder when their obligations are higher¹ and is consistent with multiple stylized facts from various contexts. Basic analysis of the US Survey

¹The mechanism I am identifying can also be interpreted as a household finance analogy of Jensen (1986) free cash flows result. Jensen’s mechanism operates in corporate finance world through reduced agency problem, while the mechanism in this paper operates through the increase in effort, but both suggest that debt leads to higher income or profits.

of Consumer Finance shows that more indebted households work more hours per week; mortgage-holders in Health and Retirement Study are less likely to be retired at any given age, and individuals in Current Population Survey are less likely to report that they quitted a job and are faster to find a new job when unemployed if they have a mortgage (see Appendix Figures 7, 8 and 9). While all these relationships are only correlations, they are consistent with the results of my analysis and suggest that positive impact of debt on labor supply can be generalized to other settings. It is worth noting, however, that the relationship between level of debt and household labor supply may be non-linear. While I document the positive effect of debt on labor supply in the sample of borrowers with low bankruptcy rates and recourse loans, debt overhang effect may suppress labor supply for borrowers who are close to bankruptcy, have negative equity and non-recourse loans (Bernstein (2018) and Donaldson *et al.* (2019)).

I conduct the analysis in the context of mortgage market in Poland, where 99.8% of mortgages are floating-rate loans. While all the other features of these loans are standard, the key difference compared to fixed-rate mortgages is the determination of interest part of a monthly payment. Interests are determined by the sum of reference rate (typically 3-Month WIBOR or LIBOR - *Warsaw/London Inter-bank Offered Rate*) and a fixed markup. Every 3-6 months the mortgage rate is updated to reflect the current level of the reference rate. The variation in payments driven by changes in reference rate could be large: in my data interests payments change by up to 50% in the period of 2 years.

I analyze the evolution of mortgage payments and income between 2005 and 2015 using the income tax data for the universe of Polish population. Using the mortgage interests tax deduction, I identify a near-universe of mortgage holders with loans originated between 2002 and 2006² and thus largely preexisting in the time period I analyze. I study how changes in the size of mortgage payment affect households labor income and other related outcomes. I exploit within-household variation in mortgage payment, driven predominantly by changes in the reference rate.

I start by documenting the strong relationship between the level of the reference rate (which is an average of WIBOR and LIBOR) and the size of interests payments in my data. 1 percentage point change in the reference rate changes the typical yearly payment by around 700 PLN, which corresponds to 16% of the average interest payment. The time evolution of the average amount of interests paid closely follows the evolution of the reference rate, illustrating the strong relationship between reference rate and interest payments.

The main result of the paper is the positive effect of debt payments on labor income, which I interpret as the effect on labor supply. This effect is substantial – around 35% of the increase in mortgage payment is covered with the increased labor income. My basic specification regresses

²But I observe interests payments made by these households in the entire analyzed period, i.e. 2005-2015.

household's income on the size of the mortgage payment, controlling for household and year fixed effects as well as for fixed effects for the interaction of age and previous-year income bins, and age-income-specific time trends. Conceptually, the specification compares how households with large mortgage react to interest rate changes vis-a-vis those with smaller or no mortgage. The results are similar when using only intensive variation in the mortgage size and when using both intensive and extensive margin variation.

I complement the main findings by exploring the heterogeneity of the income effect. The theory predicts that the effect will be higher when adjustment costs for labor supply are low, while adjustments costs for other consumption are high. I document a clear pattern of heterogeneity with respect to payment-to-income ratio (PTI). The increase in income after the increase in mortgage payment is monotonic in PTI and varies from essentially zero for households with low PTI to over twice the size of average effect for those with large PTI. This heterogeneity pattern suggests that adjustment of labor supply is more important for relatively large mortgages, for which responding to higher payments through reduced consumption may be very costly or not feasible. The size of the effect varies also by income type. The relative increase of income from self-employment is 35% higher than the increase in wages, which likely reflects greater ability of the self-employed to benefit from adjusting labor supply. Nonetheless, the effect among wage-earners is also significant and sizable and I identify several mechanisms which shed light on the ways in which this adjustment takes place. The change in pension income is not significant, which can be thought of as a placebo check for the validity of the specification. Finally, I show that the labor supply reaction is significantly stronger in areas with lower unemployment rate, consistent with these areas having more opportunities and hence lower adjustment costs of increasing labor supply.

What mechanisms are responsible for the income increase? I construct several proxies for additional labor market activities and show that they contribute to the observed effect. First, exploiting the fact that my data allows me to observe couples who file taxes jointly, I document a significant effect of spousal labor supply channel: households are more likely to become dual-earner household after their mortgage payment increases. Second, higher interests increase the probability that households receive a supplementary income from additional income-bearing gigs, on top of their regular employment. Third, households whose mortgage payments increase are more likely to change jobs and their new position is more likely to be in a different town than where they live. This suggests that when individuals face higher mortgage payments, they are more likely to take a higher-paying job which they might have previously rejected because of negative compensating differentials (e.g. long commute). This set of mechanisms is not exhaustive. While I do not observe effort and hours worked, I expect that their increase also contributes to the observed income effect, in particular for households with more flexible sources of income (self-employment, piece rate compensation).

The analysis includes several attempts to address the endogeneity concerns which arise in my setup. Because variation in mortgage payment is partially endogenous, due to possible prepayment and refinancing, I instrument payment size with the reference rate level interacted with a measure of mortgage size. The IV specification shows an effect which is similar to OLS estimate, consistent with variation in payments being driven mostly by reference rate fluctuations. My identifying assumption is that, conditional on individual's age and previous year household income (I control for the interaction of fixed effects and trends specific to age- and previous income bins), the effect of interest rates on household income is not systematically related to mortgage size except through the size of the payment. The key threat to validity of this exclusion restriction is that mortgage holders may have incomes which are differently sensitive to macroeconomic fluctuations and merely happen to be higher in the years with high interest rates. But if that were the case, we would expect high interest rates also leading to higher consumption and savings for mortgage holders. I show that the opposite is true. Using information on tax deductions for selected types of consumption and savings (charitable donations, private pension contributions, expenses on broadband internet), I show that they decrease following the increase in mortgage payment. While these measures do not represent overall household consumption, the results alleviate endogeneity concerns and demonstrate that consumption and savings adjustment is another way in which households respond to higher debt payments.

This paper contributes to the literature on the economic effects of household debt. Several papers analyze the link between debt, interest rates, and consumption ([Gross and Souleles, 2002](#); [Agarwal *et al.*, 2017](#); [Kartashova and Zhou, 2020](#)) and consumption-driven externalities ([Verner and Gyöngyösi \(2020\)](#)). Among them, [Di Maggio *et al.* \(2017\)](#) analyzes the effect of the mortgage payment decline due to ARM mortgages reset and shows that it leads to increased consumption of cars and to voluntary deleveraging. Under several assumptions, their estimates suggest that around 80% of the decrease in payment may be consumed. I complement their findings by showing that changes in the size of debt payments can also affect labor supply, at the same time also providing evidence for the consumption response. In my setting, labor income changes by around 35% of the change in the mortgage payment.

Some existing studies show that household debt can depress labor supply through debt overhang effect ([Bernstein, 2018](#); [Donaldson *et al.*, 2019](#)). My findings suggest that debt can have the opposite effect and increasing the value of debt obligations may lead to higher labor supply. In reality, both positive and negative impact of debt on labor supply can coexist and their relative importance depends on the presence of negative equity, strength of recourse laws, labor market conditions and types of jobs under consideration.³ Several other papers show evidence consistent with my findings. [Fortin \(1995\)](#)

³In my setting the borrower remains liable for the portion of debt remaining after seizure and sale of the house. Throughout the analyzed period Polish economy was continuously growing and the labor market was healthy. [Brown and Matsa \(2016\)](#) show that indebted households apply for more local jobs, but fewer positions outside of their commuting

and [Del Boca and Lusardi \(2003\)](#) show that women are more likely to work when their household has a mortgage, while the study of [Bednarzik *et al.* \(2017\)](#) shows that indebted individuals return to work faster after job displacement. Recent paper by [Bernstein and Koudijs \(2020\)](#) analyzes the impact of mortgage amortization schedule on wealth accumulation and confirm the positive impact of debt on labor supply, even though in their setting debt obligations merely shift in time and do not increase. [Rothstein and Rouse \(2011\)](#) analyze student loans and show that higher debt leads students to choose higher-salary jobs, while [Fos *et al.* \(2017\)](#) show that student debt decreases probability of enrollment in graduate school.

Documenting that interest rates can affect labor supply of mortgage holders contributes to the literature on the transmission of monetary policy ([Bernanke and Gertler, 1995](#); [Kashyap and Stein, 2000](#)). The labor supply channel is novel and is likely to be quantitatively important especially in countries with high reliance on floating-rate or adjustable-rate mortgages. It counters the typical effects of monetary policy: when interest rates increase, the contractionary impulse transmitted through other channels is mitigated by the increase in labor supply. Furthermore, my findings have implications for designing programs aimed at helping distressed borrowers, suggesting that optimal policy could involve directing resources to households with limited ability to increase income or structuring programs in ways which provide incentives to increase labor supply. The labor supply incentives should also be taken into consideration when designing bankruptcy laws or rules regarding the recourse, not only for mortgages but also e.g. for student loans. In addition, my findings have implications for the methods of risk assessment which banks and other institutions use when issuing the loan. The fact that labor income reaction is an important method of adjustment to tightened budget constraint suggests that ability to adjust income should be an important factor determining credit-worthiness of a potential borrower.

This paper contributes also to the literature on the relationship between consumption and labor income, especially in the presence of consumption commitments. While it is generally recognized that the link between consumption and labor supply can go in both directions ([Heckman, 1974](#)), the existing literature focuses on analyzing how income shocks affect consumption adjustment ([Jappelli and Pistaferri, 2010](#)).⁴ I show the causal effect in the other direction: shocks to the consumption prices⁵ can affect labor supply and thus income. The income response is a mechanism through which households can smooth their consumption, contributing to widely documented “excess smoothness”

zone

⁴[Chetty and Szeidl \(2007\)](#) discuss how consumption commitments can explain the added worker effect, i.e. the labor supply response of the spouse to the loss of job by the primary earner.

⁵I simplify the exposition by referring to debt payments as consumption. While technically debt payments are not consumption, the debt-financed purchases are. We can therefore think about increases in mortgage payments as increases in the cost of housing.

(Blundell *et al.*, 2016). This effect is most relevant for categories of expenditures that are large and have high adjustment costs. While mortgage payment is a prime example of such category,⁶ many other expenditures can have these characteristics (e.g. child care, medical bills). The approach taken in this paper can also be interpreted as studying elasticity of labor supply with respect to consumption prices. If the consumption truly cannot be changed, this is similar to studying the elasticity of labor supply with respect to wealth or unearned income (Imbens *et al.*, 2001; Deshpande, 2016; Cesarini *et al.*, 2017), although household may perceive these shocks differently. Imbens *et al.* (2001) and Cesarini *et al.* (2017) show that 11-13% of an unearned income shock coming from lottery prizes is spent reducing after-tax labor income, while Deshpande (2016) shows that 70-140% of lost disability benefits for children is compensated with their parents' higher income. My estimate of 35% of higher payments being covered with higher income is therefore of the same order, but higher than lottery-based estimates. This is likely because the labor supply response is higher when it is needed to guarantee status-quo level of consumption. This explanation also helps to reconcile the findings of Deshpande (2016).

1 Data and Institutions

1.1 Institutions: Mortgage and Labor Markets in Poland

This section provides a brief characteristic of Polish mortgage, housing, and labor markets. The most important feature of the Polish mortgage market, from the perspective of this study, is that almost all mortgages – 99.8% as of 2016 – are floating-rate.⁷ In a typical mortgage contract in Poland, the interest rate is defined as a reference rate – usually 3-month Warsaw Inter-bank Offer Rate, WIBOR, or 3-month LIBOR – plus a fixed markup. There is no initial period during which the rate is fixed. While the reference rate changes every day, each mortgage contract specifies the frequency with which the interest rate is updated, usually once in 3-6 months. In addition, some banks may not change the rate if the reference rate changed only slightly. In general, however, the variability in reference rate leads to changes in monthly mortgage payments, and in the analyzed period the variation generated by these movements is fairly large.

The average length of a mortgage contract in Poland is 26 years. Typical contract length is 25-

⁶Debt-financed consumption is likely to involve commitment by the very nature of debt, i.e. the fact that it is a way to pay for consumption which already took place. In the most stark example, student loan is a way of paying for consumption which cannot be adjusted after the borrower graduates.

⁷Strong dominance of floating-rate mortgages is not unique for Poland. Other countries where floating-rate mortgages are strongly dominant include Spain, Australia or Ireland and most countries in Europe have a large share of floating-rate mortgages (e.g. about half in the United Kingdom).

30 years, although shorter contracts (15 or 20 years) are also present. Popularity of refinancing is limited because the main motivation to refinance – benefiting from a decrease in interest rates – is not relevant, as mortgage payments automatically incorporate changes in the overall level of interest rates. However, some borrowers still choose to refinance occasionally (around 3-4% of mortgages are refinanced), usually to benefit from the improvement in borrower's credit worthiness that allows for lowering the mark-up part of the interest rate. Before 2017 mortgage contract could and often did include a prepayment penalty, typically around 3% of the pre-paid amount. There is no exact data on prepayment of mortgages, but anecdotal evidence suggests that non-negligible share of borrowers repays the loan in as little as 10-15 years. Home equity lines of credit are generally limited to firm owners, but even among them are very rare.

All mortgages in Poland are recourse loans which means that borrower still has to pay back the rest of the debt when the house is foreclosed and revenue from its sale is not enough to cover the total liability. Hence, there are no strategic bankruptcies and consumer bankruptcy, while possible, is rare in general. Around 2% of mortgages have delays in payments of more than 30 days, substantially less than 3.7% delinquent loans in the US. Mortgage market is now regulated by guidelines of KNF (Komisja Nadzoru Finansowego, Financial Supervision Authority) that dictate e.g. the maximum level of payment to income ratio (currently 0.5). Before 2006, most of these recommendations were not yet in place, yet anecdotally banks maintained reasonably strict standards on their own, with payment-to-income ratios requirements of around 0.3-0.4. Unlike the United States, there are no signs of credit requirements in Poland being relaxed before the global financial crisis.

Another characteristic of Polish mortgage market is its currency composition. Large fraction (the exact data for the time period of the analysis is not available, extrapolation from later years suggests that the fraction is 25-50%) of mortgages are denominated in foreign currency, mostly Swiss Franc or Euro, and use LIBOR as their reference rate. I do not observe currency in my data and hence I will treat all mortgages in the same way and use synthetic reference rate (an average of 3M WIBOR and 3M LIBOR CHF) to isolate the effects of changing interest rates. As shown in the Appendix Figure 5, the evolution of WIBOR and LIBOR is closely related and hence using their average yields similar results as using any of them individually.

The time of origination of mortgages analyzed in this paper, 2002-2006, represents relatively early phase in the development of Polish mortgage markets. While mortgage contracts were issued to households since the beginning of 1990s, right after the fall of communism, their popularity initially remained low. Historically, the alternative way of acquiring real estate was membership in housing cooperatives, which remain important even today. Households interested in acquiring a property would become a member of the cooperative; the cooperative would then borrow money needed to complete the project, and the cooperative members will pay their dues over the years, effectively repaying that

loan. In 1991, 96% of housing-related loans were issued to legal entities, including such cooperatives. Yet, legal changes introduced in 1997 paved a way for development of individual-oriented mortgage markets and the number and value of outstanding mortgages began to steadily grow (see Figure 1). By 2002, when the mortgages analyzed in this paper were first issued, housing-related loans issued to legal entities constituted only 28% of total loans, while the remaining 72% were household mortgages.

Consistent with these developments, in 1997 the total value of outstanding mortgages was 2 bln PLN. It increased to 78 bln PLN in 2006, and reached 374 bln PLN in 2015. The growth in the value of outstanding mortgages is driven mostly by a generational change in the way of acquiring real estate: cohorts entering adulthood at the end 1990s and in 2000s were the first heavily relying on mortgages, and hence as they gradually started to purchase homes, the total number and outstanding balance of the loans began to rise. As documented in Figure 1, recently the pace of this growth have slowed down, which is to some extent driven by the fact that the first borrowers reach the end of their loans and entering cohorts are off-set by those finishing to repay their loans. That said, rising real estate prices and modest increase in the size of residential units also contributed to observed increase throughout the period.

Housing market in Poland is split between single family houses and multiple-units apartment buildings. According to the last census, conducted in 2011, 40% of all units were single family houses. 56% of units are occupied by the owner, while 17% are rented. The remaining units are owned by cooperatives and occupied by their members, are public housing units, or are owned by employers and occupied by employees.⁸ In 2015, 27% of owner-occupied units had an outstanding mortgage. Ownership without mortgage is typically the case for units acquired before 2000, and for units acquired through inheritance, which is relatively common. Housing prices in the period 2002-2006 were mostly flat. Prices increased significantly in years 2008-2009, and plateaued at the higher level afterwards (see Figure 1).

Labor market institutions in Poland are similar to other European countries. The dominant type of contract is permanent employment which usually features 40-hour work week. The personal income tax rates have been 18% and 32% throughout most of the analyzed period, on top of social security contributions. In total, employees typically take home around 70% of their gross salary and 60% of the total cost to the employer. Unemployment rate throughout most of the analyzed period was between 9% and 12%. The unemployment was to large extent driven by rural areas (where mortgages are significantly less popular) and hence unemployment faced by my treatment group was lower. Importantly, in the entire analyzed period Polish economy witnessed economic growth and relatively healthy labor market. Poland was the only member of European Union which did not experience

⁸It is worth noting that Eurostat data reports ~84% homeownership rate for Poland, effectively treating all non-renting as owning.

recession as an aftermath of the financial crisis. Due to healthy financial system, no construction boom in the previous years and large demand for infrastructural investments, every quarter in the analyzed period had positive GDP growth. While unemployment hit the lows in 2008 and it increased slightly afterwards, the change was small (from 9 to 10-11%) compared to other European countries (e.g. in Spain unemployment went up from around 10% to 20-25%). As a result, in the entire analyzed period both nominal and real incomes were growing, as illustrated in Figure 4 in the Appendix.

1.2 Data and Summary Statistics

I use a panel dataset with 2005-2015 income tax records for the universe of Polish population. For each individual that have filed a tax declaration in a given year, I observe their income from various sources (e.g. salary, pensions, self-employment); a set of characteristics such as sex, age or place of residence; and the value of claimed tax deductions. Filing the tax declaration is mandatory and the process is comparable to that in other countries. The data allows me to follow individuals over time and match married couples who are filing taxes jointly. The dataset was obtained from Polish Ministry of Entrepreneurship and Technology; according to my knowledge, this is the first paper which uses the entire population of this dataset.⁹ The data is confidential and has been anonymized so that it is impossible to identify any single person; the person identifiers are synthetic and monetary values were modified by adding a small random noise component to mask the exact values.

The data is based on the income tax declarations filled by individuals every year, usually in March-April of the following year. Employers send tax forms with income information – which I do not observe – to their employees and to the Tax Administration. Employees use the forms to fill tax declarations – which I observe – in which they include their total income, amount of taxes already withheld and deductions they would like to apply. These declarations are later send to the Tax Administration who processes them, making returns or requesting payments. Because the tax is normally withheld at source, a typical taxpayer receives a modest return. Even though taxpayers declare their incomes themselves, the Tax Administration has employer records to validate the declarations and hence the measure of income is highly reliable. The amount of tax evasion in Poland, as proxied by the size of shadow economy (see [Medina and Schneider, 2017](#)), is fairly similar to countries like Spain or Norway (share of shadow economy in GDP of around 20%) and slightly larger compared to Germany or France (15%).

My key variable of interest, which allows me to identify mortgage holders and observe their mortgage interest payments, is mortgage tax deduction. The deduction was introduced in 2002 and abol-

⁹[Kopczuk \(2012\)](#), who analyzes the effects of business tax reform on income and tax revenues, is another paper which uses micro data from the same source. However, he only analyzes a sub-sample of all taxpayers.

ished in 2007,¹⁰ but households who started deducting interests during that period keep the right to deduct them until the end of their mortgage contract (usually 25-30 years). Therefore, if a household originated a mortgage and started deducting interests e.g. in 2003, I am able to observe the amount deducted in the whole period of my data (and hence I identify them as mortgage holders). However, if a household originated a mortgage in 2007, they are not allowed to use the deduction and in my data I do not identify them as mortgage holders.

The group of mortgage holders which I analyze is, therefore, a near-universe of households who initiated a mortgage between 2002 and 2006 (while households did not have to use the deduction, there were no incentive not to do so); the remaining part of the universe of taxpayers is a control group. The control group contains households without a mortgage and those with a mortgage originated after 2006 or before 2002. In practice, the number of mortgages originated before 2002 is very limited. The majority of the control group are owners without mortgage, but a non-negligible part are households with mortgages originated after 2006. My estimates will be therefore biased towards zero because part of the control group consists of households who also have mortgages and are subject to the treatment I analyze. In practice, however, this problem should not be very severe since mortgage holders form less than 15% of the control group (see the statistics for the entire mortgage market in Poland in [AMRON \(2015\)](#) and housing market statistics discussed above). At the same time, focusing on the subset of mortgages originated between 2002 and 2006 is convenient because at the time of large interest rate changes – which are the shocks which I want to exploit – all the mortgages are preexisting. I can therefore abstract from the problem of mortgage origination endogenously responding to the level of interest rate.

The deduction allows households to deduct all interests paid on their mortgage, irrespective of the level of the interest rate, if their initial mortgage size is below a threshold stipulated by the tax code. If the mortgage size is above the threshold, the household can deduct amount of interests paid multiplied by the ratio of the threshold to their mortgage size. The threshold varies over time, depending on the time of the first deduction, but the majority of mortgages do not exceed it. My data contains only the amount of interests deducted (I do not observe the mortgage size) and hence I cannot exactly determine whether a given mortgage exceeds the threshold. Based on auxiliary sources, however, I estimate that on average interests observed in my data correspond to around 90% of the true interests paid. The details of this estimate are discussed later, when I take this differences into account when interpreting the magnitudes of the effects.

¹⁰The official reason for abolishing the deduction is related to the incompatibility of the law with the rules of European Union (which Poland joined in 2004). However, the fact that the law was abolished instead of being just slightly modified suggests that budgetary reasons were an important motivation. Interestingly, the abolishment received little coverage and did not provoke a significant public discussion.

For the mortgage tax deduction, the amount of interest deducted is declared by the household based on the documentation received from the bank. While this documentation is not sent to the Tax Office with the tax declaration, it should be archived for at least 5 years for the purposes of potential tax audit. Only the amount of interests deducted is entered into the tax declaration.

I limit the sample to individuals who are observed in the entire analyzed period. To better tailor the control to the treatment group, I drop all people born before 1946 or after 1986, who were either too old or too young to be a potential mortgage holder in 2002-2006. My final data set is strongly balanced panel with 9.9 million individuals and over 100 million observations. There are over 160 thousands of individuals identified as mortgage holders but I drop those whose interests deductions time series seems incomplete, i.e. interests bounce back and forth between zero and positive value. This has minor effect on the data: there are 156 thousands of mortgage holders in the final sample.

Summary statistics for the main variables are presented in Table 1. Mortgage holders have two times higher income and are on average 6 years younger than the control group. Related to the age difference, they are less likely to receive pensions and more likely to be self-employed. Average household with a mortgage deducts 4376 PLN of interests per year. Not knowing the amount of principal paid every month, I am unable to compute the size of the total payment, but a reasonable estimate would imply that on average mortgage payment constitutes around 10% of household income. This average is relatively low, partially due to the fact that while nominal and real incomes were constantly growing after 2006, interests rates were lower in the second half of my sample.

2 Research Design

My strategy exploits the within-household variation in the size of mortgage payment driven by interest rate fluctuations to analyze the impact of the size of payment on household's labor income and other outcomes. The main specification is as follows:

$$Y_{i,t} = \alpha \cdot (Interests_{i,t} = WIBOR/LIBOR_t X Exposure_i) + \sum_{t=2005}^{2015} Year_t + \mu_i + \beta X_{i,t} + \varepsilon_{i,t}$$

The main explanatory variable is the amount of interests paid by household i in year t . While interests are only one part of total mortgage payment, they capture the majority of non-deterministic variation in the payment (since capital payments are set in advance, except for foreign-currency denominated loans where principal payments are subject to exchange rate movements) and constitute often more than a half of the entire payment in the initial few years. In the basic panel regression, I

directly include interests which I observe in the data. The variation in the size of the mortgage payment is driven mostly by fluctuations in WIBOR or LIBOR, which are the reference rates for most mortgages. To isolate only that part of variation, and to disregard other more endogenous mechanisms such as prepayment, I instrument the size of interests paid with the level of reference rate – an average of WIBOR and LIBOR – multiplied by an estimate of the mortgage size. My specification is therefore an instrumental variable panel estimation with fixed effects, year fixed effects, and additional time-varying controls. Conceptually, it studies how households with large mortgages react to changes in the interest rate, compared to household with smaller or no mortgage.

The basic specification controls for year fixed effects $Year_t$ and individual fixed effects. Preferred specification adds fixed effects for previous-year income bin, age, and the interaction of these two factors, as well as time trend specific to age-income group. Main outcome variable $Y_{i,t}$ is a measure of household income: the default is gross income but I also use additional measures such as wages, pension or business income. The economic mechanism I am trying to analyze suggest that appropriate specification involves variables in levels, not logarithms: I expect absolute income increase to be proportional to interest increase (because the extra income is supposed to cover an increase in interests) as opposed to relative change in income being proportional to change in interests. Income and interests payments are measured at family level since couples file taxes jointly and they claim only one tax deduction. The sample contains individual-level observations and my main results are obtained with weights of 0.5 for 2-person household observations. Standard errors are clustered on the household level.

I am trying to capture the following mechanism: in years in which household is paying high interests, I expect their income to be higher because household increases labor supply to cover additional expenses. In a perfectly flexible world we would expect that one additional unit of interests increases income by a fraction of unit. In practice, however, it is possible that due to labor market inflexibility, households must increase income by more than the increase in interests payments (e.g. to meet mortgage payments individual needs to work in a second job that does not have flexible hours). The effect may therefore be larger than the increase in the payment. On the other hand, it is entirely possible that households cover the entire increase in the mortgage payment via reduction of consumption or savings (or by additional borrowing), which means that the effect on income is zero.

2.1 Impact of Interest Rates on Mortgage Payments

Because all regressions include individual fixed effects, the entire identifying variation comes from time-variation in interests paid by the household. Conditional on paying interests in a given year, this variation reflects mostly fluctuations in the reference rate, usually WIBOR 3M (Warsaw Inter-

bank Offer Rate for 3 months) or LIBOR 3M CHF. Reference rates are influenced by macroeconomic conditions such as National Bank of Poland interest rates, foreign exchange rates, and international money market situation. Of course these factors cannot be affected by individual household and hence from household perspective reference rate change is an exogenous shock to the size of their mortgage payment. While National Bank of Poland sets interest rates taking into account macroeconomic situation, Poland is a small open economy and the interest rates are to large extent driven by international conditions (see Appendix Figure 5 for comparison of payments for WIBOR-based mortgage in Polish zloty and LIBOR-based mortgage in Swiss franc). Overall, the changes in reference rates are unlikely to be directly related to the situation in Polish mortgage market. Undoubtedly, however, they are related to overall economic conditions worldwide, which affects also labor market situation in Poland.

Figure 2 shows that there is a strong relationship between average level of interests in the data and the reference rate, which is an average of WIBOR and LIBOR rates. The relationship is not perfect for several reasons: interest payments consists of reference rate and fixed markup, banks adjust contract rate with some delays or do not adjust them at all if the changes are too small, some mortgages may use different reference rates and the exact split between WIBOR and LIBOR is unknown, etc. Nevertheless, the graph shows that the reference rate is an important driver of interests payments. Moreover, the magnitude of changes is large. Between 2006 and 2008 interests increased by over 40% and they went down again by almost 50% between 2008 and 2010. Table 2 confirms the relationship using regression analysis. There is a highly significant relationship between reference rate and the amount of interests payments, especially when we interact reference rate with the proxy for the size of the mortgage. Distribution of interests payments in 2008 and 2015 is shown in Appendix Figure 6, illustrating both the large changes in interest payments across years as well as substantial cross-sectional variation in exposure.

Endogeneity of Time Variation in Interests Payments. While most of the variation in interests paid is caused by the movements of reference rate, it is possible that some variation is related to household decisions. For example, when a household member loses his job, the bank may sometimes allow for suspending debt payments for a couple of months. Alternatively, when the household increases its income e.g. because of getting better paid and more stable job, it may decide to refinance the mortgage and receive a lower rate thanks to being now less risky borrower. While all these factors seem to be rarely playing a role and there is no clear indication in which direction they would bias the result, they do cast some doubt on the exogeneity of the amount of interests.

To alleviate these concerns and explicitly use only the variation from the reference rate I use Instrumental Variable strategy, exploiting only variation driven by the changes in reference rate and fixed differences in exposure. The identifying assumption in that specification is that the influence of macroeconomic situation captured by evolution of WIBOR and LIBOR – after controlling for age,

previous year's income, their interaction and time trends specific to these interactions – does not depend on the presence and size of the mortgage except through the size of mortgage payment. This assumption, while reasonable, is clearly not innocuous. What it precludes is that mortgage holders are more reactive to interest rate changes and that, within mortgage holders group, people with larger mortgages are more reactive than those with smaller mortgages. The rationale for the assumption is that there is no direct link between mortgage status and individual's job. Mortgage holders are hardly a very special group - it is common to have a mortgage and while there are demographic and income-level differences between mortgage holders and overall population (since purchasing a house is a decision usually made by young adults who are relatively well off), after controlling for these effects mortgage holders should not stand out as unique.

Nonetheless, to support the identifying assumption, I present results which suggests that macroeconomic considerations are not driving my results. I look at the patterns of consumption proxies and show that they move in the opposite direction than income. If the effects were due to different exposure to macroeconomic conditions, we would expect that income and consumption go in the same direction. However, if the observed effect is a response to higher mortgage payments, we should expect income and other consumption to go in the opposite directions, which indeed is the case (Table 7). I also look at the heterogeneity of the effect with respect to payment-to-income ratio and observe a clear monotone pattern (Figure 3), which would not to be expected if the effect was due to macroeconomic factors.

Endogeneity of Exposure. It is clear that households make a rational choice about the size of a mortgage and whether or not to get mortgage at all. When making this decision, the expectation about household's income stream is one of the key variables taken into account. I now discuss the implications of this potential endogeneity of the size of the exposure.

There are two elements of this potential concern. The first one is understanding whether observed effect can be generalized to the whole population. Suppose that we observe that mortgage holders increase income when their debt payment increases. If we randomly allocated debt in the entire population, should we observe the same reaction to the increased debt payments? Not necessarily, because people self-select into having a mortgage and may do so on the basis of their earnings upside potential. For example, a household considering taking a mortgage may rationally expect that payment may increase in the future, if the interest rates go up. If household members have limited possibilities of increasing earnings in case of payment increase, they may decide not to get the mortgage. This self-selection issue means that the results may not generalize to the whole population, even if we ignore demographic differences between mortgage holders and the rest of the population. The results obtained in this paper should be understood as effects observed in the population of mortgage holders. However, mortgage holders are large and important group and sheer size of mortgage balance sheets

makes it important for the overall economy.

The second concern is related to the causal interpretation of the results. If the choice of mortgage and its size is driven by some unobserved characteristics, such as expectations of high earnings growth, is not mortgage just a proxy for these characteristics? While this concern can be to some extent valid, its severity is greatly reduced by features of my analysis. All mortgages in my data are preexisting at the time of shock: a typical scenario is a household who decides to originate a mortgage in 2004, makes the payments for 4 years and in 2008 sees large increase in their payment. Of course it is theoretically possible that when choosing their mortgage 4 years earlier, the household had expected the increase in payment in 4 years and increase in their income in 4 years. This simple expectation story, however, does not seem plausible and it is very unlikely that the timing of the increase in payments and incomes would be the same. It is more likely that a household had a sophisticated belief about their earnings sensitivity to macroeconomic conditions. While I am not able to fully rule out this possibility, it does not seem very plausible given that the shock in interest rates in a small open economy does not always have clear relationship to conditions relevant for labor market. In my data, a large part of movement in interest rates is related to international financial markets but while most of Europe saw large GDP and employment drops during the last recession, Poland had no single quarter during which GDP decreased.

3 Results - Labor Supply

3.1 Main Results

The main result of the paper is presented in Table 3, which shows that an increase in interests paid by the household is associated with higher income. Columns 1 and 2 include only mortgage holders and use intensive-margin variation in the size of the mortgage payment. Column 3 includes uses the full sample, including individuals without a mortgage. Columns 2 and 3 include additional controls: interactions of age- and income-group fixed effects and trends specific to age-previous income bins. I control for individual's age using fixed effects with 1 year accuracy; in a similar way I control also for previous year family income, including indicators for 10 thousand zloty bins in the regression. I use 20 bins and incomes above 200 thousand zlotys are grouped in the last one. Because of computational considerations, in the interaction terms previous income is included through decile fixed effects, while age is included as 10-year age group. Dependent variable in all regressions is gross household income which is the sum of incomes of both spouses. Similarly, interests is the total amount of interests deducted by the household (since spouses are filing jointly, there is only one deduction; in fact even if they decided to file separately, they would be allowed to deduct interests only once). Standard errors

are clustered on the household level.

Basic specification in column 1 shows that 1 zloty increase in interests deducted leads to income higher by 0.13 zloty. In columns 2 and 3, which are the preferred OLS specifications, 1 zloty increase in the size of payment is associated with income higher by 0.3-0.35 zloty.

In columns 4 and 5 instrumental variable approach is implemented. Interests are instrumented with reference rate multiplied by the proxy for the size of exposure, i.e. average amount of interests paid in the entire period. Column 4 includes only individuals with a mortgage, while column 5 includes the whole sample. Both specifications produce positive and significant estimates of the impact of interests payments on labor income. Estimate from column 4 is almost identical to the corresponding OLS estimate (column 2); estimate in column 5 is larger, but still similar to OLS estimate from column 3. The first stage regressions for IV specification (column 5) is presented in column 4 of Table 2.

Interpretation of Magnitudes – Deduction Cap and Income Taxes. To interpret the magnitudes, it is important to discuss the cap on the mortgage size, out of which interests can be deducted, as well as highlight that the analysis is performed for gross as opposed to net income. These factors have the opposite consequences for the relationship of the estimated coefficient to the true effect of debt on labor supply and their joint effect is likely to be small.

Consider a household with mortgage size of 400 thousand zlotys and an applicable cap of 200 thousand zlotys. Suppose that the yearly interests for such household amount to 20 thousand zlotys. When these interests go up by 10%, it is a 2 thousand zloty increase in the real amount of interest paid. However, in my data, I only see half of this increase which will lead to overestimating the true effect of debt on labor supply. Unfortunately, the data is not rich enough to directly compute by how much the true effect is overestimated, but additional data sources allow me to perform back-of-envelope calculations to estimate the importance of this channel. The applicable cap on the size of mortgage is approximately 191 thousand zlotys.¹¹ Based on Amron Sarfin Reports ([AMRON, 2009](#)), the average size of newly originated mortgage varied between 76 and 139 thousand zlotys between 2002 and 2006, with the volume-weighted average being equal to 107 thousand. I do not have more information about the distribution of mortgage size between 2002 and 2006, but I use the information for 2008 and 2009 to estimate the share of mortgages above the 191 thousand and their average value.¹² This allows me

¹¹The cap varied between years and changed from 189 thousand zloty between 2002 and 2007 to over 326 thousand zloty in 2013 and later. To determine the size of the cap, the household first determines in which year their investment was completed (e.g. the house was built) and then uses the applicable value of the mortgage size limit. That is, even though the mortgage origination moment needs to be between 2002 and 2006 to use the deduction, the applicable limit depends not on the mortgage origination moment, but rather on the moment when the investment was completed. I assume that each investment is completed within 3 years of mortgage origination with uniform probability.

¹²For mortgages denominated in Polish zlotys, the growth in average mortgage size between 2006 and 2008 was around 60% and hence a mortgage of size 191 tho. in 2002-2006 would represent mortgage of size 305 tho. in 2008. In the first quarter of 2008 almost 22% of all mortgages were above 300 thousand zlotys with the average mortgage size in this tail

to estimate that on average, the interests reported in my data represent around 90% of interests paid and hence to obtain the true magnitudes we need to divide the coefficients by roughly 1.11.

To understand the effect of debt on labor supply one also needs to take into account that the dependent variable in my analysis is the gross income. By construction, part of the increase in interest payment is also automatically countered by the increased tax deduction. Each 1 zloty of extra interests decreases taxable income and hence the net increase in mortgage expenditures is typically 0.82 zloty.

In the end the cap on the mortgage size means that I overestimate the true effect while the tax shield means that I underestimate the effect on the net income. Back of envelope calculations suggest that the original coefficients should be divided by 0.82×1.11 , which implies that the estimated increase in labor income lies between 14.3% and 50.5%, with the preferred estimates being 34%-38%.

3.2 Effects by the Type of Income

Tax declarations require individuals to report their total income divided into different categories. While some of the income types are sparsely populated or rather obscure (e.g. other income), others can be used to get additional insights about the observed effect and test its plausibility. In Table 4, I analyze the effect of mortgage interests on wages, pensions and income from self-employment. Employment contracts may often be rigid: salary may not be directly related to effort and there may be no possibility for increasing the amount of hours worked (although, as demonstrated in Section 4, there are other ways in which employed persons can adjust their income). I expect that self-employed individuals have more opportunities to increase their labor supply and therefore the effect for business profits should be larger. Pensions, on the other hand, cannot be adjusted in the short term on the intensive margin and hence provide a useful placebo check. In fact, the characteristics of pension system may lead to an effect of the opposite sign: if an individual collects pension and receives income from employment which exceeds certain threshold, his pension can be reduced (the reduction is not proportional and hence from the individual's perspective it still makes sense to work). This mechanism may be especially important in my sample (in which only persons younger than 65 are included) because most persons receiving pensions are in working-age and are part of some early-retirement scheme. Such recipients are, compared to a typical retiree, more likely to work and have their pension reduced. In addition, it is possible that individuals delay retirement or application for related benefits, further contributing to potential negative impact on pension income.

To analyze these predictions, I employ two approaches. First, I analyze the absolute change in
 being 602 thousand. I am going to assume that between 2002-2006 there were 22% of mortgages above the cap with the average value of the mortgage being 383 thousand ($191 \cdot \frac{602}{300}$). This implies that the true value of interests paid for 22% of mortgage holders was higher than interests deducted and on average they have paid 2 times more than they deducted.

income from different sources in the full sample. This approach, however, does not take into account the baseline values of income from different sources and conflates both intensive and extensive margin response. For example, while higher interests can encourage extra effort of self-employed individuals and thus increase business profits, they may also discourage households from taking the risk of starting a new business. Second approach, therefore, analyzes the relative changes in each income class and limits the sample to households with positive value of income from given source in the last year. Table 4 presents the results. While in absolute terms (columns 1-3) increase in wages is the dominant mechanism of the increase in income, this follows from the fact that wages are by far the most common source of income (see Table 1). In relative terms (columns 4-6) the effect for business profits is 35% higher than the effect for wages. Nonetheless, we still see a positive and quite sizable response of the employment income. Coefficient for pensions is negative in absolute terms and positive, but insignificant in relative terms. The lack of intensive margin response confirms the lack of effect in the category of income which does not directly depend on individual's choice. The negative coefficient in column 2 suggests that extensive margin negative response, e.g. individuals delaying retirement or not applying for disability benefits, may contribute to lowering the pension income. Notice, however, that this decrease likely does not lower total income, since it is provoked by receiving high income from employment.

3.3 Heterogeneity with Respect to Debt-to-Income Ratio

Income response to mortgage payment changes need not be uniform in the whole population. In fact, one could intuitively expect that income adjustment should be coming from those households who have tighter budget constraint and hence it is more difficult for them to cover payment increase by reducing other consumption. A useful proxy for tightness of the budget constraint could be the relative size of the mortgage. Figure 3 presents coefficients from the regression in which interests variable is interacted with average interests-to-income ratio (the specification is otherwise the same as the basic specification in column 2 of Table 3). Notice that while the measure of mortgage size underestimates the true size of the mortgage (because it is based only on interests paid and does not include capital payment), it nonetheless allows for correct ordering of households from lowest to highest PTI ratio.

The coefficients show a clear montone pattern. Relationship of income and mortgage payment is stronger for those households, for whom mortgage payment constitutes larger share of their income. In fact, the effect for households with share of interests in income of less than 5% is not significantly different from zero. The effect is much higher for households with very large mortgages but, importantly, it is also positive and significant for a large part of the population with interests-to-income ratio around 10-15%, which includes majority of the sample.

The monotone pattern supports the proposed mechanism: households increase their labor supply because their budget constraint is tight and they need to cover increased mortgage payment to avoid costly bankruptcy. Intuitively, an increase in mortgage payment should matter less for high-income household with a small mortgage, compared to a household with large mortgage and relatively low income. For the first household the change in payments could be negligible and it can adjust other consumption more easily. The second household might have more troubles adjusting the consumption: given their low income and tight budget, their consumption may consists of higher share of necessities and be much harder to adjust.

Notice that while observed pattern of heterogeneity is not inconsistent with an alternative explanation based on different sensitivity to macroeconomic conditions, it is much less expected in this scenario. A potential concern is that mortgage holders are richer and therefore more sensitive to interest rates, e.g. high-level managers may have bonuses which vary greatly with business cycle, while factory-floor workers compensation is less volatile. However, empirically richer households have lower PTI ratios – this is because while their mortgages are larger, the effect of higher income dominates. We should therefore expect to see the opposite pattern - relationship between income and payment changes should be increasing in income level and thus decreasing in PTI ratio.

3.4 Heterogeneity with Respect to Unemployment Rate

Increasing labor supply is a viable strategy to increase your income only if the labor market provides appropriate employment opportunities. This is more likely to be the case in places with low unemployment rate, where it is easier to find an extra job or even to increase number of hours worked in the current job. Therefore one may expect that the labor supply adjustment is more pronounced for households who live in the areas with low unemployment.

To test this hypothesis, Table 5 interacts the interest rate with local level of unemployment rate. In the tax data I observe the location of the tax office to which the household sends their tax declaration which implies also their county of residence. Using this information, I merge county-level panel data on unemployment rate to analyze how the labor supply effect of higher mortgage payments varies with local labor market conditions.

Column 2, which includes controls for age-previous income cells and cell-specific time trends, reveals that the impact of higher interests is 0.026 lower if county unemployment is 1 pp higher. With median level of unemployment being 13%, the increase in income covers ~20% of the increase in interests for households facing median levels of unemployment. The increase in income, however, covers ~38% of the increase in interests for households facing unemployment levels higher by one standard deviation (which equals 6.8%). The magnitudes obtained when only using intensive margin

variation in mortgage size (column 2) are very similar to those obtained when using both intensive and extensive margin variation in mortgage existence and size (column 3). The results obtained in the IV approach (column 4, instruments are interaction of reference rate and mortgage size and triple interaction of reference rate, mortgage size, and unemployment rate) are also very close to those obtained in the main specification.

These results confirm that the strength of labor supply response depends on the available labor market opportunities. In healthy labor markets, households can easily find additional job or increase hours in their current position, and increase their income in that way. If unemployment is high, however, opportunities to benefit from increasing labor supply are greatly limited.

4 Mechanisms

What is the mechanism for the observed increase in income? Given that vast majority of gross income in my data are wages, part of the effect is likely driven by an increase in hours worked in the current job. Unfortunately, the tax data does not have information on hours worked, but the fact that income from self-employment increases more than earnings does lend indirect support to this mechanism. Nonetheless, on top of increased hours, there are several alternative channels which I am going to investigate: spousal labor supply, supplementary income, changing jobs and working in multiple jobs. Not all of these channels can be directly observed and hence I am unable to quantitatively assess their contribution to the income response. Instead, I provide qualitative evidence of their importance, which helps to understand the composition of the main effect. Some other channels, which I am not able to directly investigate, can also be playing a role. For example, an increase in interests can push individuals to take a tougher stance in bargaining with their employees and receive a wage increase.

4.1 Spousal Labor Supply

If only one spouse in a family works, the household can increase its income by having the other spouse enter the employment. Existing literature ([Fortin, 1995](#); [Del Boca and Lusardi, 2003](#)) shows that women are more likely to work if their household has a mortgage. In a similar way, one could expect that when mortgage payment increases, non-working spouse (who usually is a woman in my data) enters the labor force. But women labor participation in Poland is relatively high and, consistent with the mentioned literature, it is even higher in households with a mortgage. The margin for this adjustment can therefore be very limited. I investigate this channel in column 1 of Table 6. I limit the sample to couples who are filing jointly in the entire period (which allows me to disregard phenomena such as divorce etc.; on the other hand this may bias my estimates downwards because it is possible

that when one spouse does not work, the other is more likely to file taxes individually and hence this household is dropped from the sample). I define single earner household as a household where only one of two persons declares positive income from wages or personal income. This is to exclude categories in which income may be arbitrarily assigned to both spouses (for example, income from financial assets) and may not reflect true labor force participation.

The results indeed suggest that spousal labor supply adjustment is a significant contributor to the observed income effect. 1000 PLN increase in interest makes household 0.1 pp less likely to be single earner household.

4.2 Supplementary Income

Another possible way of adjustment is to perform additional, income-bearing gigs. An individual who works on a typical full time contract may decide to take extra after-hours jobs to supplement his main source of income. I am able to partially identify such activity by analyzing the “personal activity” income category in the tax form. This category includes income obtained from activity performed personally but not subject to a formal employment contract (subject to labor regulations). An example of income that should be reported in this category could be a consulting fee which a professor – who receives a salary from a university – gets from an outside firm. The indicator does not perfectly capture additional gigs: this category of income can also include standard employment income (for tax purposes declared as subcontracting) and the extra gig can also occasionally be reported as normal employment. Nonetheless, it is a very useful proxy for capturing this type of adjustment.

I define supplemental income indicator as 1 when individual receives salary income and declares non-zero personal activity income in a given year; and 0 otherwise. The result are presented in column 2 of Table 6. The coefficient of interests is positive and significant. Its magnitude is small in absolute terms but large relative to the base levels: it indicates about 16% increase in the probability of receiving supplemental income (the baseline rate is 1%). The result shows that even individuals with rigid employment contract may increase their income by performing income-bearing activities outside of their normal workplace.

4.3 New and Another Job

Employed individual can increase his income by changing the job to a better-paid position or deciding to take a second job. The latter is self-explanatory, but the former may sound a bit surprising: of course it is true that better-paid job increases income, but in the context of adjusting to higher mortgage payments, why should we expect that an individual takes better-paid job only when the mortgage

payment increases? If the better-paid job was available, why not to take it earlier? It is possible that jobs which pay more are worse in terms of non-monetary benefits: working conditions, required effort or location (Sorkin, 2017). An individual may be therefore hesitant to accept the better-paid position in normal times, but when extra money is badly needed, he can reconsider his choice and decide to take the job, sacrificing some non-pecuniary benefits for the sake of higher income.

I am using proxies for changing job and an indicator for working in multiple jobs based on the tax deduction available to every employee. Every worker with an employment contract can decrease its taxable income by an amount determined in the tax code. This amount is almost fixed and depends only on two factors: 1) whether an individual works in the same town in which he lives or not (higher deduction if needs to commute to different town); 2) whether individual works in a single job or in multiple jobs (higher deduction for multiple jobs). Based on this deduction I can define indicators for working locally and for working in multiple jobs. I define “change job” variable as any change in the local worker status: the variable takes value 1 if worker who worked in different town in year $t - 1$ works locally in year t and when worker who worked locally in year $t - 1$ works in different town in year t . In addition, I define a binary indicator for working locally. Change in these variables will capture either change of job or change of the place of residence but given the fact that I focus on mortgage holders, the second seems less likely.

The results are presented in columns 3, 4 and 5 of Table 6. When interests payments are high, workers are more likely to change jobs. Moreover, their new job is more likely to be outside of town of their residence. This is consistent with the compensating differential explanation if working locally is better because it reduces time needed for commute. Workers may therefore take more distant - and presumably better paid - jobs when their mortgage payment increases, sacrificing their short commute time to obtain higher income. There is no significant change in the probability of working on multiple contracts, possibly because this arrangement is rarely observed in general and is concentrated among lower-paid jobs.

5 Consumption Response

An increase in mortgage payment can be covered in two ways: increasing income or decreasing other expenses. The main results confirm the importance of the first channel, but the magnitudes of the effect leave a lot of room for consumption adjustment. Unfortunately, comprehensively measuring consumption is difficult (e.g. Di Maggio *et al.* (2017) focus on selected categories of expenditures, such as cars), and such a measure is not available in the tax data. Nevertheless, because the tax code allows for several deductions, I am able to create some consumption proxies. While imperfect, they

can provide useful evidence for the existence of consumption reduction response.

Proxies include charitable donations, contributions to private pension funds and expenses on internet access. Deduction of internet access expenses is very popular, but every household can only use it twice and has to do it in 2 consecutive years. For that reason, I limit my sample to households which used the deduction in the previous and current year, since for them the decrease in reported expenses indeed captures the reduced expenditures, as opposed to starting or stopping deducting them. Donations and contributions to private pension funds are less popular (Poland has a public pension system and private pensions are in infancy) but can be deducted each year. The results for all three proxies are presented in Table 7. Notice that some other deductions are available but are very sparsely populated in the data, e.g. deduction for purchasing disability-related equipment such as wheelchairs. The results for these proxies were never significant and are not reported.

The results confirm the negative consumption response. When interests payments are high, households reduce charitable donations, private pension contributions and their expenses on the internet access (notice that all the coefficients are relative to other households; in absolute terms consumption may be increasing but at a slower pace). This is consistent with findings of [Di Maggio *et al.* \(2017\)](#) and highlights the importance of performing additional analysis, perhaps with consumption survey data, which would allow to analyze the consumption response in more details.

The consumption response supports the labor supply adjustment explanation for the main results of the paper, as opposed to an alternative explanation based on differential sensitivity of mortgage holders to changes in interest rates. If we believe that the results are driven by unobservable characteristics of mortgage holders which make their income more sensitive to interest rate changes, we should expect positive response in consumption. Normally, when income increases, consumption also increases and hence if mortgage holders merely happen to earn more in years with higher interest rates, we should also see that they consume more. If households respond to the increase in payment, we should see the opposite: households need to cover higher payment and they do so by both increasing their income and decreasing their other consumption.

6 Theoretical Background

[This section is preliminary.]

The goal of this paper is to identify and measure the importance of the following mechanism: when the mortgage payment increases, households cover part of this increase by increasing labor supply. There are two theoretical approaches which can be used to understand this effect: budget constraint effect and consumption commitment effect.

The budget constraint effect can be illustrated in a very basic model of individual behavior. Suppose that an individual chooses labor supply and consumption bundle, given wages, prices and preferences over leisure. Suppose also that individual's consumption includes mortgage payment. An exogenous increase in the size of mortgage payment can be interpreted as an increase in the price of consumption, which tightens the budget constraint. The household can respond in two ways (ignoring possibility of bankruptcy and additional borrowing): increase labor supply or reduce consumption. In the generic case individual will do both and hence there will be a non-zero effect of debt on labor supply. In this simple model, debt is just a standard consumption – higher mortgage payments make individual poorer for any given level of labor and hence increase labor supply.

A more sophisticated model, which captures the specific characteristics of debt contracts, can be constructed based on the approach of [Chetty and Szeidl \(2007\)](#). Debt can be interpreted as consumption commitment, i.e. a part of consumption which can be adjusted only after paying a cost. This is particularly true for mortgages: reducing mortgage payment on an intensive margin is virtually impossible (while household can try to renegotiate with the bank, it is rather uncommon for individual borrowers) and extensive margin adjustment, that is stopping to pay the mortgage, is costly. It would either require selling a house, repaying the debt and buying another, cheaper house (which presumably requires another mortgage) or declaring the bankruptcy. Both of these are costly processes which households may prefer to avoid.

In such a setting, [Chetty and Szeidl \(2007\)](#) show that in the presence of consumption commitment income responds more strongly to negative shocks to household wealth. One could perform similar analysis in which instead of exogenously changing wealth, one exogenously increases debt payments. The implications remain the same: consumption commitment leads to larger income reaction (compared to the scenario in which debt is not a commitment, i.e. there are no adjustment costs). This is the exercise performed in this paper: I analyze the labor response to the exogenous increase in the debt payment. Consistent with Chetty and Szeidl results, I find that income responds positively to these shocks.

7 Discussion

In this paper I present an evidence that households cover increases in their mortgage payments with increased labor income. The effect is quantitatively sizable, as around 35% of the increase in payment is covered in that way, and hence might have important implications for understanding of the relationship between consumer debt and labor markets, as well as for monetary policy and debt relief policies.

The results I find are consistent with evidence in some of the existing papers. For example, [Brown and Matsa \(2016\)](#) use border-discontinuity design to analyze job search behavior of mortgage holders depending on whether their loan is a recourse loan or not. While they focus on ability to relocate, their results also show that households living in a state with recourse are in general more active in their job search. Stronger commitment to pay back the debt causes households to increase their labor supply and search effort, consistent with my results.

More generally, various data sources show positive association between debt and labor market outcomes. While causality is difficult to establish, separate analyses of Survey of Consumer Finance, Current Population Survey and Health and Retirement Study all suggest that debt is associated with working harder. Figures 7, 8 and 9 in the Appendix contain some graphical evidence from these analyses. It is evident that the positive relationship between debt and supply of labor is widespread and can have widespread implications.

On the other hand, it should be noted that in the period of my analysis (2005-2015), Polish economy was constantly growing and labor market conditions were relatively good, contrary to other countries in the same period. The positive effect which I document may be therefore large because it was relatively easy for households to increase income. During the recession the change in income may be more modest.

There are several practical implications of my findings. First, they are of interests to those responsible for monetary policy. I establish that the contractionary effects of interest rate increase, which happen through several traditional channels, are accompanied by an increase in labor supply of mortgage holders. This effect is most sizable for countries with a high share of mortgages with floating or adjustable rates. Nonetheless, it may be manifested also for households with a fixed-rate mortgage through refinancing channel.

Second, policymakers are often interested in helping households with high debt burden. US Government's HAMP program is a recent example of such an action. My research shows that when designing such policies, it is worth taking into account household's potential to increase labor supply. Optimal policy would probably give higher benefits to households which cannot easily increase labor supply, e.g. because they are located in areas with high unemployment. It might be also optimal to introduce some built-in incentives which encourage labor supply adjustment.

More generally, my results have implications for design of bankruptcy and recourse laws. Debt has important implications for labor supply and hence personal bankruptcy law can have important implications for labor market. The more lenient is the law in terms of bankruptcy and recourse, the lower is the motivation for households to increase labor supply. On the one hand this can be treated as moral hazard costs. On the other hand, if increasing labor supply leads to misallocation of resources (e.g. because highly-educated people are forced to accept jobs below their qualifications), more lenient

laws can improve allocative efficiency.

Finally, my results have implications for assessing credit worthiness of an individual. The potential to increase labor supply seems to be an important predictor of whether a household is a good or bad borrower. While this potential is not directly observable, it can be proxied with education, sector, labor market situation in local area and industry and current workload (i.e. persons with low current workload have more room for increasing labor supply).

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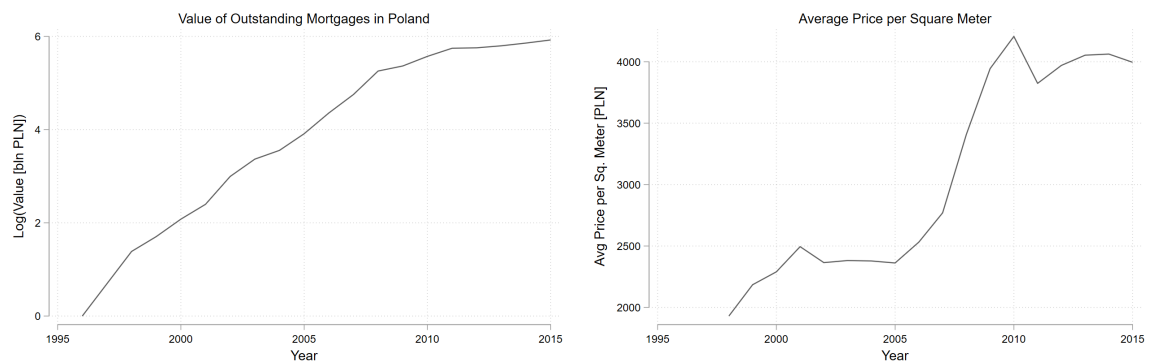


Figure 1: Value of Outstanding Mortgages and House Prices

The left panel shows the natural logarithm of the value of all outstanding mortgages, based on GUS (Statistical Office) data. The right panel shows the evolution of house prices, also from GUS data, based on the average price per square meter at the end of the 2nd and the 4th quarter of a given year for newly sold housing units.

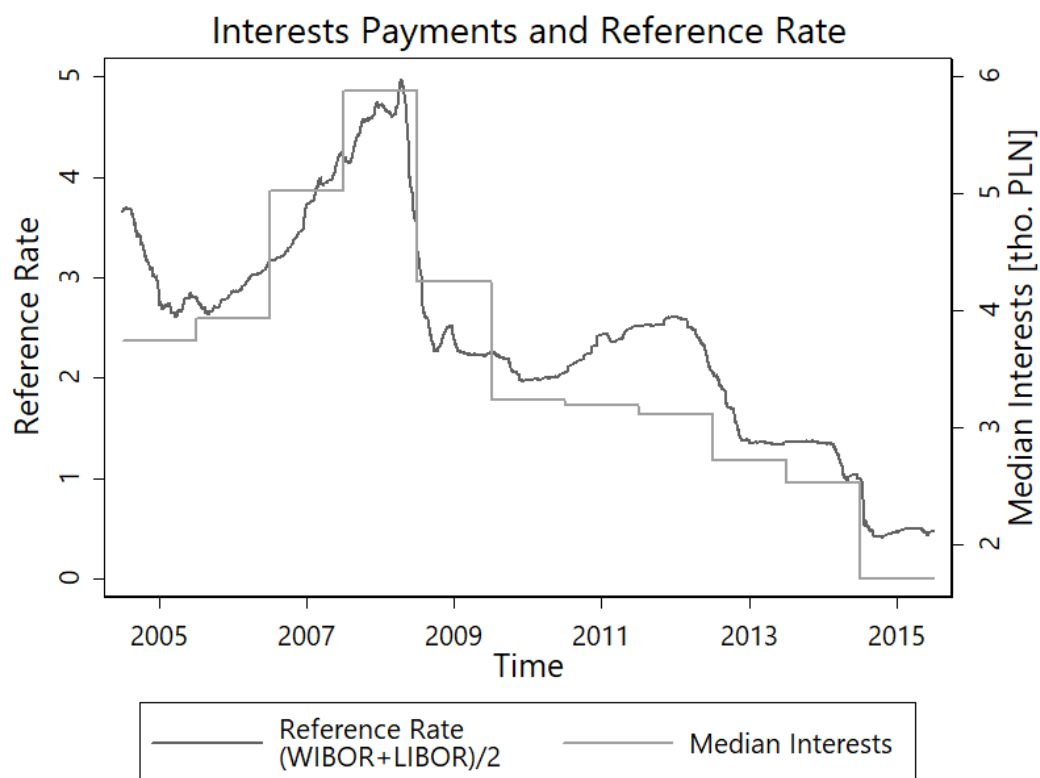


Figure 2: Median Interests Payments and Reference Rate.

The dark line is the median value of interests deducted by all mortgage holders using the deduction in a given year. Light-colored line is the average of 3-month WIBOR (Warsaw Inter-bank Offer Rate) and 3-month LIBOR CHF, which are the typical reference rates for mortgages in Poland. Absent borrower-level information on the reference rate used, I assume that equal share of loans are indexed to WIBOR and LIBOR.

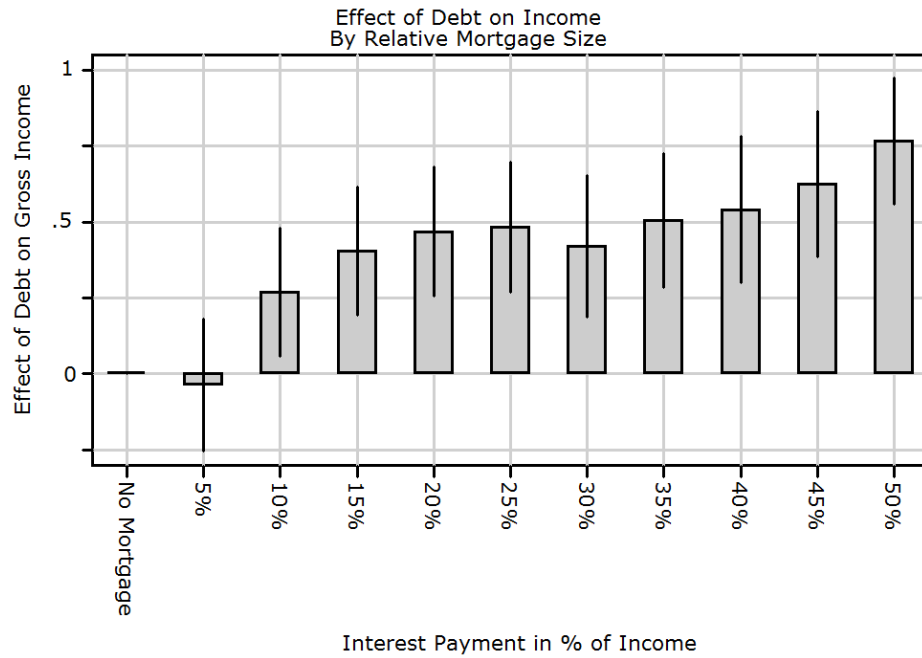


Figure 3: Heterogeneity of the Effect of Interest By Payment-to-Income Ratio.

The bars represent the coefficients from income-interests regression (analogous to the main specification) in which interests paid are interacted with the average size of interests paid divided by initial income (“mortgage size”; notice that the true mortgage size is higher because it also includes capital payment, although in the initial period of mortgage repayment, which is dominant in the data, interests constitute majority of the payment). The bars represent 95% confidence intervals. Only observations with mortgage size in the interval (0.05,0.5) are included; average mortgage size in this sample is 13% and the median is 10%.

Table 1: Summary Statistics by Mortgage Status.

Statistics are calculated for the main sample used in the analysis. The sample contains all individuals born between 1946 and 1986 who have tax records for the entire 2005-2015 period. I drop individuals with seemingly incomplete mortgage interests information. Family income is calculated as the sum of incomes of two individuals who file taxes jointly in a given year. Number of observations in each row is the same and given in the last row of the table, except for rows which condition on positive value (e.g. of wages or donations), where total number of observations is given next to variable name. For internet expenses top 1% of outliers was dropped, because of unrealistically high values most likely reflecting data error. For interests, only positive values were included (to exclude zero values for mortgage holders who started paying mortgage later than in 2005).

Variable	Mortgage = 0		Mortgage = 1	
	Mean	SD	Mean	SD
Gross Household Income	54004	62622	104271	88729
Wages	43459	55220	91414	86205
Business Profits	2724	30233	4783	20187
Pension	4924	12803	2962	11803
Share Self-Employed	15.5%	-	20.8%	-
Share Receiving Pension	20.6%	-	6.7%	-
Wages >0 (N = 84.8 ml)	51559	56568	97378	85647
Business Profits >0 (N = 10.0 ml)	27483	92406	32901	43340
Pension >0 (N = 20.5 ml)	23879	18498	30611	24361
Interests Paid	-	-	4376	3823
Donations	33.4	1096	91.2	2450
Expenses - Private Pension	6.37	191	16.5	310
Expenses - Internet	147	268	220	317
Donations (>0) (N = 2.6 ml)	1284	6681	2407	12368
Expenses - Private Pension (>0) (N = 0.2 ml)	3280	2840	3998	2718
Expenses - Internet (>0) (N = 25.7 ml)	581	177	606	209
Year Born	1966.8	10.5	1971.7	8.3
Number of Individuals (tho.)	8 998 141	-	156 229	-
Number of Observations	98 644 025	-	1 713 939	-

Table 2: Interests Payments and Inter-bank Lending Rates

The dependent variable is the amount of interests deducted by a household in a given year. The main independent variables are the reference rate, which is an average of 3-month WIBOR and LIBOR CHF rates, and its interaction with a proxy for mortgage size, which is the average amount of interests paid by a given household in all years. All columns use strongly balanced panel with individual fixed effects with observations weighted by the inverse of number of people in the household (1 or 2). In column 3, linear time trend is added. Column 4 presents the first stage of the 2SLS regression of income on interests payments (the main specification); it controls for individual age, previous income, year fixed effects and triple-interaction of these three factors. Standard errors are clustered on a household level. (***) denotes significance at 0.001 level.

	Interests Paid			
	(1)	(2)	(3)	(4)
Reference Rate	0.0135*** (0.0001)			
Reference Rate X Mortgage Size		0.335*** (<0.001)	0.335*** (0.001)	0.331*** (0.001)
N	100 314 612	100 314 612	100 314 612	91 164 643
Individual FE	✓	✓	✓	✓
Controls		✓	✓	
Trend			✓	✓
F-Stat				$1.3 \cdot 10^8$

Table 3: Interests Payments and Income

The dependent variable is the total gross household income in Polish zlotys. The main independent variable is the amount of mortgage interests deducted from the taxable income. The amount deducted may be smaller than the true amount paid for some borrowers which means the true effect on the gross income is lower - see the main text for the discussion of magnitudes. All columns use strongly balanced panel with individuals fixed effects with observations weighted by the inverse of number of people in the household (1 or 2). The data includes 9.1 ml individuals in 2005-2015 period. Columns 1, 2, and 4 use only intensive-margin variation in the size of mortgage, i.e. include only mortgage holders. Columns 3 and 5 include all households. In columns 2-5 age fixed effects represent individuals age in years and previous year income fixed effects represent previous year household income rounded to nearest 10 000 zł. Columns 4 and 5 present the specification from columns 2 and 3 in which interests variable is instrumented with the interaction of reference rate (average of WIBOR and LIBOR) with the proxy for mortgage size (average value of interests paid in the entire period, column 4). Standard errors are clustered on the household level. (***) denotes significance at 0.001 level.

	Gross Family Income				
	(1)	(2)	(3)	(4)	(5)
Interests	0.128*** (0.030)	0.347*** (0.028)	0.309*** (0.027)	0.351*** (0.052)	0.461*** (0.028)
N	1 557 718	1 557 718	91 164 643	1 557 718	91 164 643
Sample	Mortgage Holders		All	Mrtg Hold	All
Individual FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
Age X Prev. Income FE		✓	✓	✓	✓
Age X Prev. Inc Trends		✓	✓	✓	✓
IV				Ref Rate X Mrtg Size	Ref Rate X Mrtg Size
F-Stat				$4.3 \cdot 10^5$	$1.3 \cdot 10^8$

Table 4: Regressions of Interests Payments and Income from Different Sources.

All columns include individuals fixed effects as well as year, age, total previous income bin fixed effects (10 tho. bins) as well as binary variables for the previous year value of the level of dependent variable (wages, rounded to nearest 10 tho.; pensions and profits; rounded to nearest 5 tho.). Dependent variable is family gross wages or log wages (columns 1 and 4), pensions and log pensions (columns 2 and 5) and business profits and log profits (column 3 and 6). Main independent variable is the value of interests paid by the family in a given year expressed in thousands of zł (i.e., the value of interests divided by 1000, for readability of coefficients). Columns 1, 2 and 3 include the entire sample (and thus analyze both intensive and extensive margin effect), while columns 4, 5 and 6 only include those individuals whose family had non-zero income from given source in the previous year (focusing on intensive margin effect). (***) denotes significance at 0.001 level. Standard errors clustered on the household level are displayed in parentheses.

	Wages	Pensions	Profits	Log(Wages)	Log(Pensions)	Log(Profits)
	(1)	(2)	(3)	(4)	(5)	(6)
Interests /1000	239.2*** (17.1)	-10.3*** (1.8)	30.4*** (5.5)	0.0078*** (0.0002)	0.0007 (0.0006)	0.0105*** (0.0011)
N	91 164 643	91 164 643	91 164 643	75 126 227	16 886 003	8 176 337
Controls	Individual FE, Year FE, Age FE, Previous Income FE, Previous Income from Given Source FE					

Table 5: Interests Payments and Income: Heterogeneity by Unemployment Rate

The dependent variable is the total gross household income in Polish zlotys. The main independent variable is the amount of mortgage interests deducted from the taxable income interacted with unemployment rate in the county of residence in a given year. All columns use strongly balanced panel with individuals fixed effects with observations weighted by the inverse of number of people in the household (1 or 2). The data includes 9.1 ml individuals in 2005-2015 period. In column 2, age fixed effects represent individuals age in years and previous year income fixed effects represent previous year household income rounded to nearest 10 000 zł. Columns 3 and 4 present the specification from column 2 in which interests variable is instrumented with the interaction of WIBOR rate (the usual reference rate for the mortgage) with either an indicator for paying interests (column 3) or with this indicator multiplied by the proxy for mortgage size (average value of interests paid in the entire period, column 4). Standard errors are clustered on the household level. (***) denotes significance at 0.001 level.

	Gross Family Income			
	(1)	(2)	(3)	(4)
Interests	0.262*** (0.037)	0.563*** (0.032)	0.451*** (0.030)	0.643*** (0.062)
Interests x County Unemployment	-0.012*** (0.003)	-0.026*** (0.003)	-0.025*** (0.002)	-0.027*** (0.005)
N	1 557 718	1 557 718	91 164 643	1 557 718
Sample	Mortgage Holders		All	Mrtg Hold
Individual FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Age X Prev. Income FE		✓	✓	✓
Age X Prev. Inc Trends		✓	✓	✓
IV				Ref Rate X Mrtg Size

Table 6: Mechanisms of the Increase in Income

All columns use panel data with individuals fixed effects, yearly time dummies and age dummies. Dependent variables are indicators for: single-earner household (columns 1), getting supplementary income (column 2, personal income on top of wages), changing job (column 3) and for working in the same town (column 4) or on multiple contracts (column 5). Main independent variable is value of interests paid by the family in given year expressed in thousands of zł. Dependent variables are expressed in percentage points. Sample in column 1 is limited to all married couples filling declarations jointly through the entire time period; sample in columns 3-5 is limited to individuals with employment contracts (for whom decreases in taxable income can be used to proxy for job change). (***) denotes significance at 0.001 level. Standard errors clustered on the household level are displayed in parentheses. Mean of dependent variables are presented in the bottom of the table.

	Single Earner (%) (1)	Supplemental Income (%) (2)	Change Job (%) (3)	Local Worker (%) (4)	More Contracts (%) (5)
Interests / 1000	-0.0888*** (0.0102)	0.0178*** (0.0042)	0.2300*** (0.0130)	-0.0495*** (0.0137)	-0.0075 (0.0053)
N	42 296 262	91 164 643	48 034 080	48 034 080	48 034 080
Mean Dep. Var	31%	1.1%	12.6%	68%	2.7%
Controls	Individual FE, Year FE, Age FE				

Table 7: Regressions of Interests Payments and Consumption Proxies.

All columns include individuals fixed effects as well as year, age and previous income bin fixed effects. Dependent variable is log of charitable donations (column 1), log of contributions to private pension account (IKZE, column 2) and log of expenses on internet access (column 3). The sample in column 3 is limited to households which have used internet deduction in the previous year and have non-zero deduction in the current year (because of 2 consecutive years limit for using the deduction). Main independent variable is value of interests paid by the household in a given year expressed in thousands of zł. (***) denotes significance at 0.001 level and (*) at 0.05 level. Standard errors clustered on the household level are displayed in parentheses.

	Log(Donations)	Log(Expenses - Private Pensions)	Log(Expenses - Internet)
	(1)	(2)	(3)
Interests/1000	-0.0013*** (0.0003)	-0.0028*** (0.0002)	-0.0012*** (0.0003)
N	91 164 643	91 164 643	18 730 425
Controls	Individual FE, Year FE, Age FE, Previous Income FE		

Appendix Figures

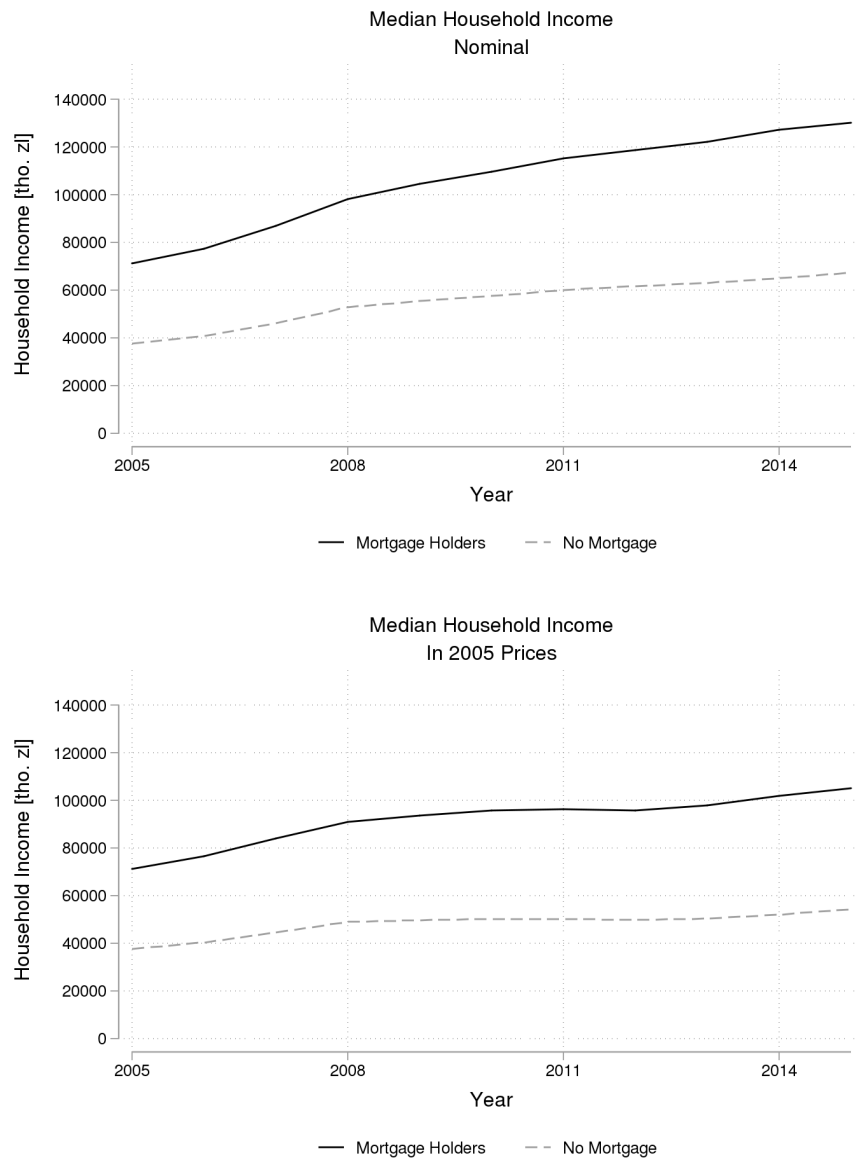


Figure 4: Median Household Income By Mortgage Status

The Figure shows the evolution of median household income by mortgage status. The upper panel shows nominal income, while the lower panel shows real income in 2005 prices (CPI used as the deflator). Both nominal and real incomes were consistently growing for the entire analyzed time period. Throughout the whole period mortgage holders were typically richer than households without a mortgage.

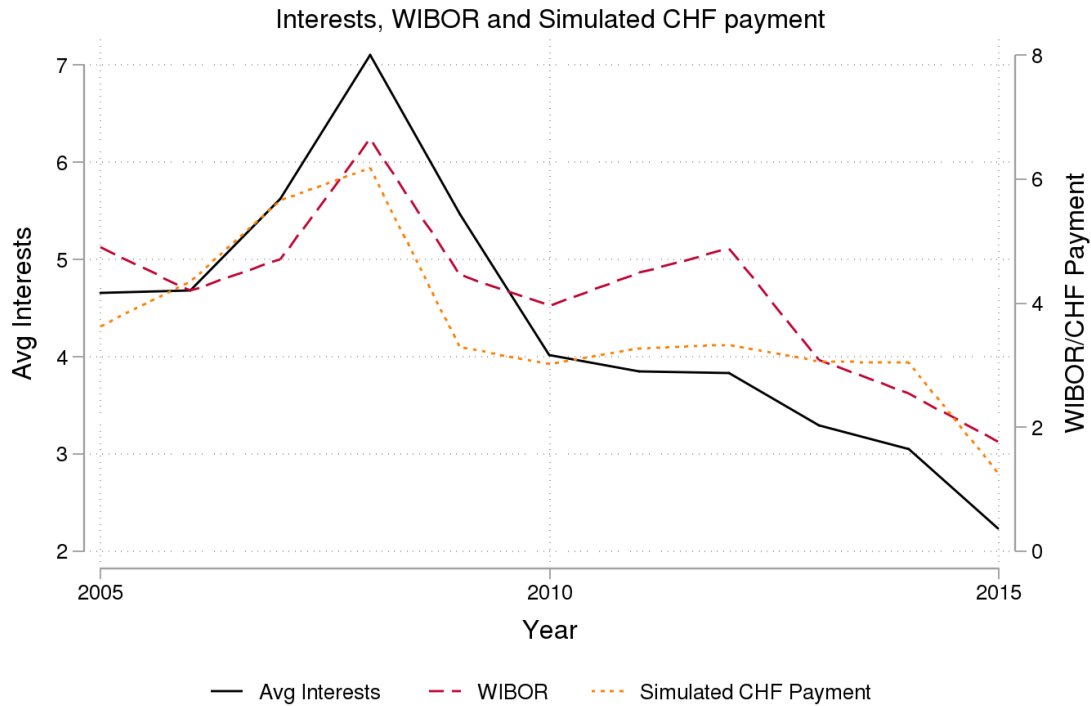


Figure 5: Average Mortgage Interests in the Data, WIBOR Rate and simulated LIBOR-based CHF payment.

Average interests rates are corrected by payment-schedule factor: since in typical mortgage with fixed monthly installment interests decrease in every month, I correct interests observed in the data by the scheduled factor calculated for mortgage originated for 25 years in 2004 with 3% markup and WIBOR 3M reference rate. The size of correction varies from 1.5% to 3%, depending on the year (notice that this mechanism leads to lower interests in subsequent periods but not to lower payment - interests part of the payment decreases but capital part increases accordingly). Estimated CHF-payment shows re-scaled hypothetical Swiss Franc denominated mortgage payments with interests based on LIBOR 3M. It incorporates both changes in LIBOR and in the CHF/PLN exchange rate.

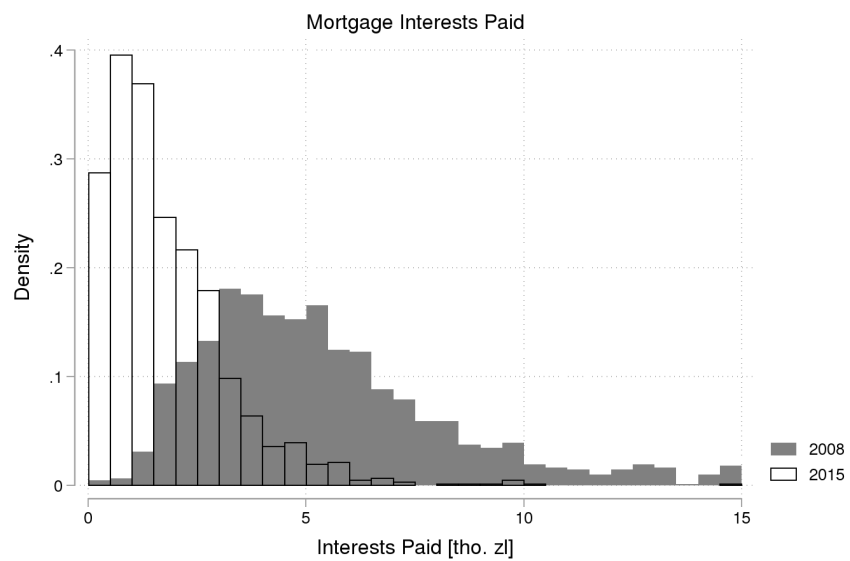


Figure 6: Distribution of Interests Paid in 2008 and 2015

The Figure shows the distribution of interests paid in 2008 (gray bars, year with highest interest rates) and 2015 (white bars, year with lower interest rates). The graph illustrates both the cross-sectional dispersion in the amount of interests paid, as well as the extent of changes in the size of interest payments over time. The value of interests is censored at 15 thousand zloty.

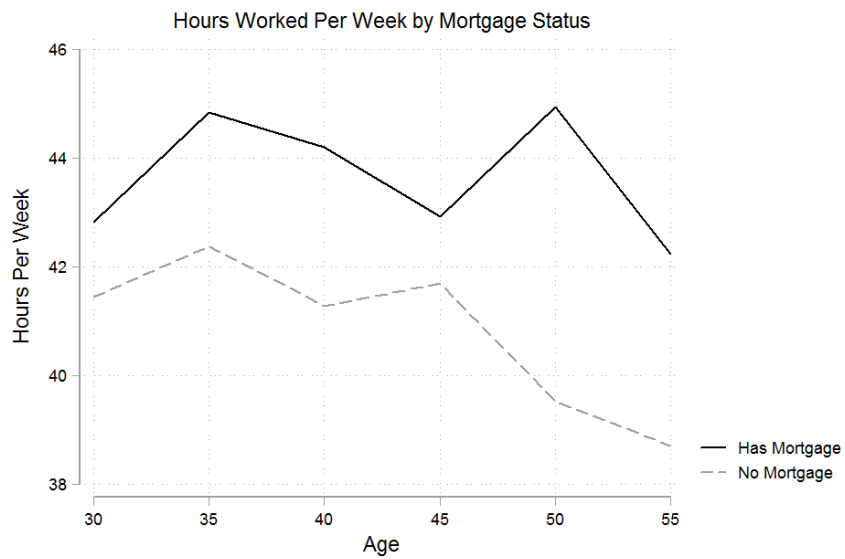


Figure 7: Hours Worked by Age and Mortgage Status (Survey of Consumer Finance 2016)

The data comes from Survey of Consumer Finance 2016 of United States Federal Reserve. Mortgage status is based on variable X723. Respondents with answer different than yes (1) and no (5) were dropped. Hours worked use variable X4110. Age, defined as the difference between 2016 and the year of birth, is rounded to the nearest multiple of five.

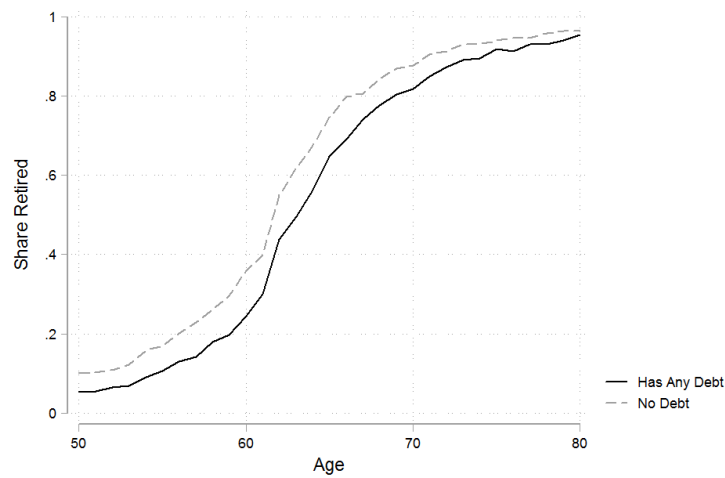


Figure 8: Share of Retirees by Age for Mortgage Holders and Non-Holders (Health and Retirement Study)

The data comes from RAND 2014 Health and Retirement Study longitudinal file. The sample includes all respondents between 50 and 80 years old. Retirement status is a binary indicator based on respondent's declaration if considers himself retired. If partly retired, the variable takes value 0.5. Respondents with answer "question irrelevant" were dropped. Has any debt is defined as total debt being above zero, where total debt is the sum of mortgage, other home loans, other debt and 2nd home mortgage. Age is rounded value of respondent age (agey_m variable).

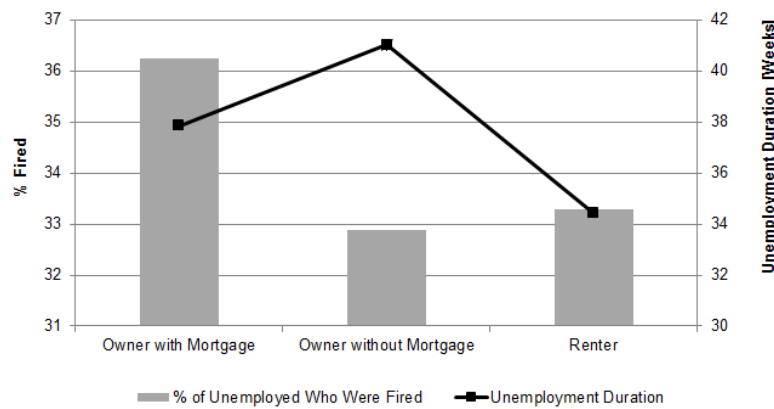


Figure 9: Quitting and Unemployment Duration by Housing Status (Current Population Survey)

The data comes from IPUMS CPS data (Sarah Flood, Miriam King, Renae Rodgers, Steven Ruggles, and J. Robert Warren. Integrated Public Use Microdata Series, Current Population Survey: Version 6.0 [dataset]. Minneapolis, MN: IPUMS, 2018. <https://doi.org/10.18128/D030.V6.0>). The sample contains observations from years between 2010-2017. Individuals are included in the sample if in any of these years their mortgage status is not missing (variable spmmort, which also defines the three groups presented on the graph). Quitting and firing identified based on declared reason for being unemployed. Duration of unemployment is measured using variable durunemp. The bars show the share of all respondents who are unemployed and declare that they are other job loser (excludes layoffs). The line shows the average value of unemployment duration (in weeks) for respondents who are currently unemployed and were fired.