More Tax, Less Refi? The Mortgage Interest Deduction and Monetary Policy Pass-Through

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Abstract

We study how fiscal policy affects the transmission of monetary policy using the Tax Cuts and Jobs Act (TCJA) of 2017 as a natural experiment. The TCJA capped deductions for state and local taxes, (SALT), and increased the standard deduction, causing many households to switch from itemizing to taking the standard deduction. Households that stopped deducting mortgage interest increased their after-tax mortgage rate, increasing both their refinance incentive and the return to accelerating their balance payoff. Using a difference-in-differences design with a novel method for inferring a loan's itemizing status, we compare the refinance and debt paydown behavior of households that likely stopped itemizing. We find that for households who stopped itemizing, the TCJA increased the refinance probability conditional on refinance incentive. The law change had no detectable effect on deleveraging for borrowers' existing mortgage through reduced cash-out refinancing, increased cash-in refinancing, or accelerated paydown.

*The analysis and conclusions set forth are those of the authors and do not indicate concurrence by other members of the research staff or the Board of Governors.

1 Introduction

Mortgage borrowing is a potentially important channel through which monetary policy stimulates household consumption. Interest rate cuts that lower the cost of mortgage borrowing can spur economic activity, especially during recessions. Frictions that disrupt refinancing, such as equity levels, (Beraja et al., 2019), competitive barriers, (Agarwal et al., 2015), or employment requirements, (DeFusco and Mondragon, 2020), can dampen the pass-through of monetary policy.

In this paper, we study an under-explored friction to refinancing with important implications for the geographic distribution of monetary policy pass-through, namely the fact that the mortgage interest deduction (MID) affects the degree to which changes in mortgage interest rates pass through to households. Households who itemize their taxes can deduct their mortgage interest from their taxes, effectively reducing the interest rate on the portion of their mortgage that falls above the standard deduction.[1] It follows that the change in the interest rate following a refinance is reduced proportionately according to a household's federal and state marginal income tax rate and the degree to which their itemized deductions exceed the standard deduction. The mortgage interest deduction therefore reduces the incentive of a household to refinance relative to a non-itemizing household, all else equal. The MID also changes the share of the payment reduction that households pocket when they refinance. Thus, changes in the share of households who itemize and therefore who use the MID may affect monetary policy pass-through, meaning the *aggregate* spending response to a given change in mortgage rates may depend on the share of households who itemize and those households' income tax rates. Additionally, because itemization rates vary based on local house prices and tax policies, the tax change may have particularly affected the *geographic composition* of monetary pass-through.

[1] Households can deduct charitable contributions, state and local taxes, and mortgage interest from their taxes. When the sum of a household's individual deductions exceeds the itemizing threshold, the household itemizes, or reduces their tax liability by the sum of their deductions. Households who do not itemize reduce their tax liability instead by the amount of the itemizing threshold.

Households who benefit from the MID have greater income and wealth which could separately influence their refinancing sensitivity. To overcome the endogeneity of the MID with household characteristics, we exploit a change in household tax policy in 2018 as a natural experiment. In December 2017, Congress passed the Tax Cuts and Jobs Act (TCJA), which made a number of changes to household and business taxes and deductions. Importantly, the TCJA doubled the standard deduction, causing many households to stop itemizing and therefore to stop deducting mortgage interest. For households who continued to itemize after the TCJA, the doubling of the standard deduction also substantially reduced the value of the MID. We use this shock to the incidence of the MID to estimate the effect of the MID on refinancing probabilities.

We predict a household's itemizing status using a rich loan-level dataset that allows us to estimate a household's state income tax liability and their mortgage interest, crucial inputs to their deduction amount. We compare households who do not itemize either before or after the TCJA, who never benefited from the interest subsidy, to households who had itemized in the pre-TCJA period - these households lost the interest subsidy. We then attribute any change in refinancing between these groups following the TCJA to their change in the interest subsidy.

We find that the refinancing hazard among households who lose the interest subsidy increases materially following the tax change. For borrowers who experience the largest effect of the TCJA, a decline of 19 basis points in the interest subsidy increases refinancing by 25% for borrowers with positive refinance incentives (i.e. whose rate will be reduced by refinancing).

We also show that the change in the refinancing rate between those who never itemized and those who lose the interest subsidy appears only following the TCJA and not before. We present evide.nce that the magnitude of the effect is increasing in the treatment intensity (i.e., the difference between pre- and post-TCJA tax subsidies), and that this pattern cannot be explained by changes in other factors that might influence refinance propensities, such as the pre-tax gains from refinancing, income, local house prices, etc. Lastly, we find that the increase in refinancing from those who lose the subsidy is concentrated amongst borrowers who are historically most responsive to changes in rates - those with interest rates 50-150 bps above prevailing mortgage rates.

The change in the tax law creates incentives that may offset the effect of increased refinance sensitivity on consumption. In particular, the mortgage interest deduction also affects the post-tax internal rate of return households face when they pay down their loan faster than scheduled. If borrowers pay down their loans faster as they stop itemizing, either by accelerating their payoff schedule or reducing cash-out refinances, households may consume less, even as they refinance more.

There's reason to believe households may increase debt paydown. In addition to theoretical models like Sommer and Sullivan (2018), recent empirical research has suggested that at origination, borrowers take on less debt in the absence of a mortgage interest deduction (Gruber, Jensen and Kleven (2021) and Hanson (2020)). But in the case of these empirical studies, it is difficult to separate the effect of the MID on debt choice from the effect of the policy change on house prices. Because one important dimension of policy interest is the influence of the MID on *leverage*, i.e. loan-to-value ratios, not just debt, we propose a novel approach, in this context, that focuses on the borrower's payment of their existing mortgage debt. We evaluate whether households accelerate their loan payoff as their mortgage interest subsidy declines following the change in the law, thereby decreasing their leverage.

We find no evidence of increased curtailments or cash-in refinances, and we find the law had no effect on cash-out refinance propensities or withdrawal amounts. Together, these results argue against meaningful reductions in leverage for existing mortgages. These findings also suggest that the reduction in mortgage balances and interest costs found in Gruber, Jensen and Kleven (2021) and Hanson (2020) are a function of households' choices at the time of home purchase, and they therefore may reflect a combination of salience at that point in time and the direct impact of the MID on the user cost of housing.

1.1 Related Literature

This paper contributes to a growing literature that uses the TCJA to explore various dimensions of the relationship between taxes and housing decisions. For example, Dantas and Hembre (2021) evaluate the impact of the change in the homeownership subsidy driven by the TCJA on homeownership and mortgage rates, and find that the TCJA reduced homeownership for those whose tax subsidy most declined. Li and Yu (2020), evaluate the impact of the tax change on house prices, liquidity and construction, and found that areas that saw the largest decline in the tax benefit saw reduced construction, market liquidity, and house price growth. But because the TCJA affected so many other dimensions of the tax code, including the deductibility of state and local income and property taxes, this research does not separate the effect of the mortgage interest deduction, per se, from the other tax changes that accompanied it, which also directly affected the value of both owner-occupied and rental housing.

Well before the TCJA, an active literature explored the effect of the mortgage interest deduction on decisions about homeownership, mortgage size, and the structure of household debt. The MID is a large tax expenditure, making it of obvious policy interest. The Joint Committee on Taxation (JCT)[2] estimates the mortgage interest deduction cost $64 billion in 2017, one of the largest US tax expenditures.

The mortgage interest deduction enters directly into the user cost of home ownership, and so it theoretically increases the equilibrium difference between house prices and rents (see, e.g. Himmelberg, Mayer and Sinai (2005) and Poterba and Sinai (2008) for a comprehensive discussion of user costs). But the salience of the after-tax cost of debt and how it influences household decision-making are empirical questions with outcomes that may depend on local market characteristics (such as the housing supply elasticity (Hilber and Turner, 2014) or the segmentation of the rental and purchase markets.

The empirical literature broadly shows that households are sensitive to the after-tax price

[2]See on Taxation (2017).

of mortgage debt in their home purchase and financing decisions. Although homeownership generally appears little affected along the extensive margin, the MID does appear to affect the intensive margin, i.e., how much home to buy (Hanson (2012) and Gruber, Jensen and Kleven (2021)). The MID also appears to affect the structure of household debt; households with a greater tax benefit increase their indebtedness (see e.g. Gruber, Jensen and Kleven (2021), Hanson (2020), and Ling and McGill (1998)). Additionally, Valentin (2021) offers evidence that the benefit of the MID is partially captured by intermediaries.

Sommer and Sullivan (2018) and Floetotto, Kirker and Stroebel (2016) calibrate dynamic models to understand the full implications of a repeal of the MID. Using different approaches, both show that repealing the MID would be welfare-improving. Sommer and Sullivan (2018) find that a full repeal would increase reduce house prices and therefore would increase homeownership and reduce leverage.

It stands to reason, given households' apparent attentiveness to their tax subsidy, that their refinancing decisions may also be affected. A large literature establishes mortgage refinancing as an important pathway for monetary policy to affect consumption (see for example Di Maggio et al. (2017), Di Maggio, Kermani and Palmer (2020), Abel and Fuster (2021), Anenberg, Scharlemann and van Straelen (2022), and Amromin, Bhutta and Keys (2020)). Although the aggregate effect of rate-term refinances is debated because gains to consumers are offset by losses to investors (Greenwald (2018)), the geographic distribution of consumption may be an important consideration for policymakers (Beraja et al., 2019). Because use of the MID has a clear geographic component (Brady, Cronin and Houser (2003)), changes to the MID may alter the geography of the consumption response to changes in mortgage rates.

2 TCJA Background

2.1 Overview of TCJA

Households can deduct mortgage interest from their income taxes once their deductions exceed the itemizing threshold, so households with high deductions are able to reduce their after-tax mortgage rate.[3] Above the itemization threshold, each dollar of mortgage interest reduces taxable income by one dollar, lowering households' tax liability in proportion to their marginal tax rate, t. Because there are fixed costs to refinancing the 30-year fixed-rate mortgage, households do not always refinance when the market mortgage rate dips below their existing mortgage rate. The fixed costs to refinancing create a wedge between the borrower's existing mortgage rate and the rate at which they are "in the money" to refinance, i.e., refinancing makes financial sense. That wedge should theoretically reflect the household's after-tax interest rate rather than their pre-tax interest rate, since the fixed costs to refinancing (other than points) are not tax deductible.

If households itemize their taxes, then they pay $r_t * (1 - t)$ interest on the portion of their mortgage that exceeds the standard deduction, given their other itemized deductions (such as state income taxes or property taxes). As a result, households that deduct mortgage interest realize a benefit of $(1-t)*(r_0-r_t)$ on the portion of the interest above the standard deduction when they refinance, as opposed to a benefit from refinancing of $(r_0 - r_t)$ for households who do not deduct mortgage interest. For this reason, the mortgage interest deduction should soften the sensitivity of refinancing to changes mortgage rates.

The TCJA made a number of changes to the household tax code that affected the after-tax cost of owner-occupied housing, especially when financed with a mortgage. Before the TCJA, a household could deduct mortgage interest on mortgages of up to $1,000,000. A household could also deduct all of their state income taxes and local property taxes (SALT). When deductions exceeded $12,700, a household filing jointly would itemize their taxes. Given

[3]Households with deductions above the itemizing threshold "itemize," or deduct certain expenses from their taxes.

this structure, households in high SALT areas and households with large mortgages (or high interest payments) generally itemized. Since itemizing is more common for households with high income (higher state income tax), high house prices (high property taxes and mortgage balance), households who benefited the most from the MID had more wealth and higher incomes.

The TCJA, passed in December 2017 and effective January 2018, reduced the maximum balance on which interest could be deducted from \$1,000,000 to \$750,000. In addition, the TCJA capped SALT deductions at \$10,000. Finally, the TCJA roughly doubled the standard deduction, to \$24,000 for joint filers. The doubling of the standard deduction and the cap on SALT deductions caused many households to stop itemizing and therefore to stop deducting mortgage interest. In 2017, 31 million households deducted mortgage interest.[4] Figure 1 indicates that by 2018, the number of households deducting mortgage interest fell 50%.

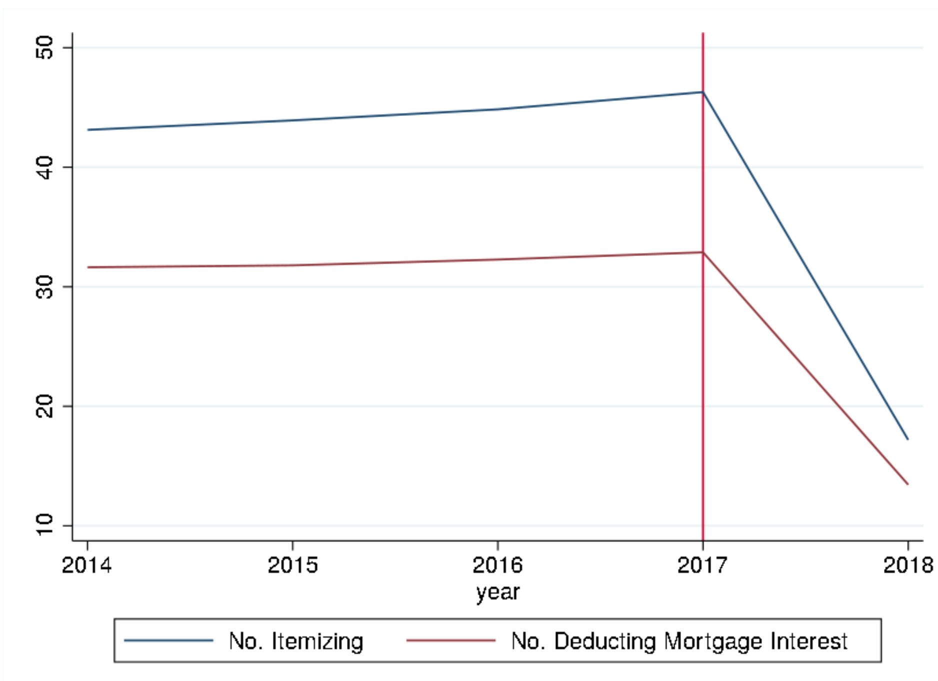

Figure 1. Households itemizing over time. This figure plots the number of households who itemized their taxes and who deducted mortgage interest over time, taken from the IRS SOI zipcode tax statistics.

The TCJA did not eliminate the mortgage interest deduction, but by increasing the

[4]See IRS SOI zipcode tax statistics.

standard deduction and capping the SALT deduction, the bill made it much less attractive to itemize and therefore to deduct mortgage interest. For a more detailed analysis of the incidence of the change in the after-tax cost of housing arising from these tax changes, see Ambrose et al. (2021).

3 Data and Summary Statistics

3.1 Data

3.1.1 Itemization status, tax rates, and the incidence of the subsidy

We use a number of different data sources in our analysis. We start with the McDash data of mortgage servicing records. This dataset tracks mortgage performance over time, allowing us to see when a loan prepays, the mortgage balance, rate at origination, and a host of borrower characteristics like credit score and mark to market LTV. However, the dataset does not report the reason for a loan's prepayment - i.e., whether the borrower prepays to move, rate-term refinance, cash-out refinance, or pay off the mortgage entirely. We use the Equifax Credit Risk Insight Servicing McDash (CRISM) dataset, which matches anonymized credit bureau records on consumers' credit histories to mortgage servicing records from McDash, to infer the prepayment type. We pull a 10% sample of fixed rate, 30-year mortgages from McDash over the period January 2016 to June 2020.

We do not directly observe whether a household deducts mortgage interest. We therefore infer a household's deduction status using proxies for the components of a household's deduction. To do this, we use the merged HMDA-McDash-CRISM dataset. This dataset merges HMDA information on borrower characteristics at origination, such as income, with mortgage servicing records from McDash tracking interest rates and loan performance, with credit bureau data from CRISM tracking all of a borrower's outstanding loans. We use this detailed dataset to calculate the inputs to a borrower's total deduction amount.

The largest components of a borrower's deduction are comprised of their mortgage interest, their state income tax, and their property tax. We use the data in this combined HMDA-McDash-CRISM dataset to proxy for each of these deduction components. First, we use the interest rate and mortgage balance variables from McDash to calculate the amount a borrower pays in interest. Second, we use the mortgage escrow variable in McDash to proxy for a borrower's property tax amount, as property taxes make up the bulk of the amount that households pay in escrow. We use income at origination as reported in HMDA to calculate a household's state income tax. Of course, income changes over time, so this measure of income introduces noise into our analysis. Our measure of property tax also introduces noise into the analysis as the escrow variable may also include insurance, meaning we overestimate a household's property tax amount (we exclude borrowers with PMI.) We consider a borrower a joint filer if they have a co-borrower. Finally, we feed the household's state, joint filing status, and income at origination into the NBER TAXSIM program to calculate the household's federal and state income tax burden.

We estimate the household's deduction amount as the sum of state income tax, property tax and mortgage interest. If the deduction is greater than the itemizing threshold in the pre-TCJA period, but not in the post period, then we classify the household as a "switcher" - meaning they stopped deducting mortgage interest after the TCJA. Finally, we use the CRISM portion of the HMDA-McDash-CRISM dataset to distinguish the reason for a loan's prepayment that we observe in McDash, and we focus on rate-term prepayments rather than prepayments for the purpose of moves or equity extraction.

For mortgages that refinance in the pre-TCJA period, we assign "switcher" status based on their interest and escrow payments in the final observation period. Likewise, for loans originated after the law passed, we assign "switcher" status based on their first observed interest and escrow payments. In both cases, we account the fact that SALT is only capped in the post-period.

We validate our construction of itemizing status by plotting the correlation between our measure of itemizing, aggregated to the zipcode level, against zipcode statistics on itemizing shares from the IRS SOI statistics in Appendix Figure A.3.

3.1.2 Refinance incentives

The interest rate environment changed rapidly around the passage of the TCJA, a fact that complicates comparing refinance rates before and after the law change. To ensure we are picking up a change in refinance behavior driven by the tax change, and not a change in the rate environment that altered refinance incentives in a manner correlated with borrowers' itemization status, we construct a measure of a household's refinance incentive that we call the "rate gap" using an approach that is now standard in the literature. This measure allows us to compare switcher with non-switcher households before and after the law change according to their refinance incentive.

We define the refinance incentive as the borrower's rate gap, or the difference between the borrower's outstanding mortgage rate $r_i^\star$ and the rate available to him if he were to refinance at time t (Berger et al., 2021).

$$rategap = r_i^\star - r_{i,t} \tag{1}$$

We estimate the rate available to the borrower at time t using a sample of mortgage rates at mortgage origination from Optimal Blue. Borrowers are in the money to refinance when they have a rate gap slightly above zero.[5] Consistent with Berger et al. (2021), we find that the probability of refinancing follows a non-linear pattern by rate gap (see Appendix Figure A.2).

Table I

Summary Statistics

This table shows descriptive statistics of mortgages from a 10% sample of fixed rate, 30-year mortgages from the merged HMDA-McDash-CRISM dataset, spanning 2016m1-2020m3. Never-itemizers are defined as borrowers with deductions below $12,700 in both the pre and post periods. Switchers are defined as borrowers with deductions above $12,700 in the pre period and below $25,000 in the post period. Always itemizers are defined as borrowers with deductions above $25,000 in both the pre and post periods. Deduction calculated as the sum of mortgage interest, state income tax, and property tax. Mortgage interest defined as 0.1 times the interest rate times the mortgage balance. To calculate income tax, income at origination is fed into TAXSIM along with state of residence. Mortgage escrow amounts from McDash are used for property tax. Restricted to joint filers only where joint filer defined as a household with a co-borrower. Households who refi in the pre-period are assumed to have their most recent deduction amount as their post-period deduction. Similarly, households who only appear in the post-period are assumed to have their earliest deduction observation as their deduction in the pre-period. The probability of a rate-term refinance has been multiplied by 100. We restrict to borrowers with rate gaps between -2 and 3, and borrowers with SALT amounts at origination less than $10,000.

	Never Itemizer		Switcher		Always Itemizer		All	
	mean	sd	mean	sd	mean	sd	mean	sd
Prob. Rate Refi	0.08	2.89	0.26	5.10	0.83	9.10	0.16	4.01
Loan Age	23.36	15.75	17.26	13.28	10.42	12.31	20.77	15.11
Orig. Rate	4.28	0.90	4.25	0.73	4.49	0.71	4.27	0.84
Rate Gap	0.18	0.97	0.12	0.83	0.33	0.78	0.15	0.91
Interest (Thous.)	4.06	1.91	8.68	2.95	20.58	4.52	6.08	3.64
Orig. LTV	76.06	20.63	82.27	16.51	80.30	13.18	78.61	19.26
Credit Score	7.43	0.81	7.42	0.75	7.47	0.65	7.42	0.79
Original Bal. (Thous.)	106.14	48.11	217.72	73.71	487.68	161.32	154.86	89.46
Curr. Bal. (Thous.)	97.69	47.81	207.84	72.85	474.57	156.61	145.80	88.39
Income (Thous)	73.37	160.45	99.41	315.39	163.21	118.52	84.76	233.79
Subsidy Change	0.00	0.00	0.07	0.05	0.13	0.04	0.03	0.05
Observations	6796914		4564460		128869		11603731	

3.2 Summary Statistics

Table I reports summary statistics on the sample of merged HMDA-McDash-CRISM loans. We report statistics separately for "never-itemizers," households who did not itemize in the pre or post periods, "switchers," households who stopped itemizing only in the post period, and "always-itemizers," households itemized both before and after the TCJA. Itemizing status is assigned based on a household's deduction amount, calculated as the sum of mortgage interest, property tax, and state income tax.

After the TCJA, state income and property taxes can only be deducted up to a cap, so the primary reason to continue itemizing following the TCJA is high mortgage interest. There-

[5] We consider borrowers to be in the money to refinance when they have a rate gap above 0.5, as opposed to when they have a rate gap above 0, to account for the fixed costs of refinancing.

fore, always-itemizers have higher mortgage balances and interest payments than switchers and never itemizers. Always-itemizers and switchers also have higher incomes. The sample of always-itemizers is smaller than the sample of switchers and never-itemizers. Refinancing rates are high for switchers and highest for always-itemizers, driven by these groups' high mortgage interest payments.

4 Identification

We want to estimate the effect of eliminating the MID on households' propensity to refinance into lower interest rates and to repay mortgage debt. But households are not randomly assigned into mortgage itemization. Itemization status and the subsidy associated with the MID vary with household characteristics that also predict refinance and debt paydown propensities conditional on their observable incentives. For example, mortgage balance, income, and arguably financial savvy are all independently correlated with a household's refinance and debt paydown propensity, and controls for these covariates are imperfect.[6] We cannot therefore compare itemizers with non-itemizers in the cross-section and confidently disentangle the effects of the MID from these confounders.

The TCJA suddenly changed the structure of the MID subsidy. We use the shock to the MID subsidy structure to address concerns about endogeneity, along with a wide variety of time-varying fixed effects to control for any change in the relationship between borrower and loan characteristics and refinancing behavior over time.

4.1 Structure of the Mortgage Interest Deduction Subsidy

We start by exploring the structure of the subsidy before and after the TCJA passed. The implications of the MID are different for refinance and repayment incentives, so we consider them separately.

[6](Cole, Gee and Turner, 2011) show that wealthier, higher-income households are most affected by the mortgage interest subsidy.

The mortgage interest subsidy exhibits a kinked pattern by deduction amount. The left panel of Figure 2 plots the average estimated interest subsidy (s) before and after the law change by deduction amount for borrowers with a positive refinance incentive (rate gap > 50 bps). We calculate the imputed tax subsidy rate (s) as tp where p is the portion of mortgage interest that falls above the itemizing threshold and therefore receives the subsidy, and t is the federal tax rate. The after-tax interest rate is $r * (1 - tp)$. For households who do not itemize, i.e., whose deduction falls below the itemizing thresholds highlighted by the vertical red bars in the figure, the share of mortgage interest receiving the subsidy is 0, and therefore the subsidy rate is 0. As households cross the itemizing threshold, they deduct only the portion of the interest that falls above the itemizing threshold; the after-tax cost of each marginal dollar of their mortgage balance falls from r to $r * (1 - t)$. For this reason, the magnitude of the subsidy increases gradually above the itemization threshold. The change in the tax subsidy also increases to the right of the itemization threshold because the federal income tax rate generally increases along with the household's total deduction. In our sample, the pre-TCJA federal marginal income tax rate increases by about 6 percentage points (from about 19 percent to about 25 percent) between $12,700 and $24,000 (the old and new standard deduction amounts for joint filers). [7]

Although the MID subsidy exhibits a kinked pattern, the change in the after-tax internal rate of return from paying down debt is sharp around the deduction thresholds, dropping from r to $(1 - t) * r$ as the borrower's itemized deductions exceed the standard deduction. The right panel of Figure 2 illustrates one way of visualizing the post-tax rate of return to households from voluntarily paying down mortgage debt. Households who repay their mortgage ahead of schedule save $F * r^m$ on each dollar of additional principal repaid, where F is equal to 1 for non-itemizers and to $(1 - t)$ for itemizers; t represents the household's income tax rate. The figure shows the average value of F (which we call the imputed

[7] As described in Section 2 the TCJA roughly doubled the standard deduction from $12,700 for joint filers to $24,000. Following the TCJA, households with deductions less than $24,000 lost their interest subsidy. Because the subsidy was increasing between $12,700 and $24,000 before the tax change, the change in the interest subsidy increases with deduction amount for borrowers in this region.

marginal return) by estimated deduction bin in our sample.[8] The TCJA sharply increased the rate of return on curtailments for households with deduction amounts above the pre-TCJA itemization threshold, as shown by the gap between the black and blue dots.

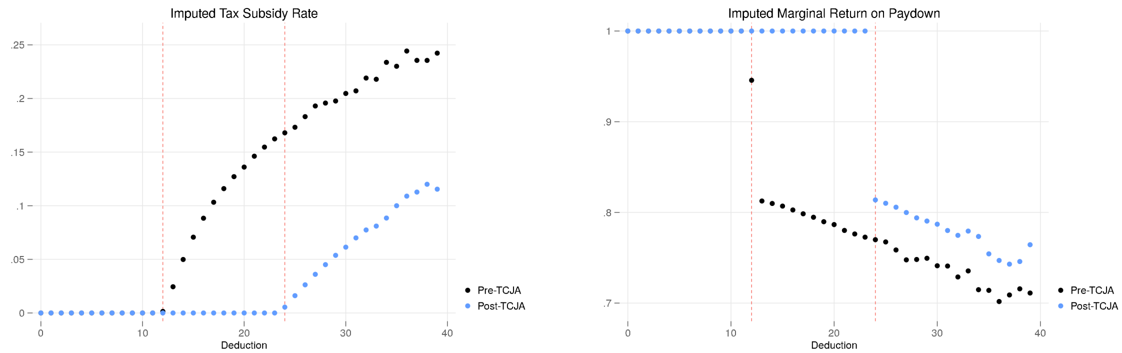

Figure 2. Structure of MID Subsidy by Deduction Amount. The left panel shows the structure of the MID, by deduction amount. We calculate the imputed tax subsidy rate (s) as tp where p is the portion of mortgage interest that falls above the itemizing threshold and therefore receives the subsidy, and t is the federal tax rate. The right panel shows the after-tax internal rate of return on debt paydown. Households who repay their mortgage ahead of schedule save $F * r^m$ on each dollar of additional principal repaid, where F is equal to 1 for non-itemizers and to $(1 - t)$ for itemizers.

5 Motivating Empirical Patterns

In this section, we present raw data that strongly suggests that refinancing patterns before and after the TCJA reflect the change in the structure of the subsidy illustrated in the left panel of Figure 2. In the left panel of Figure 3 we plot the relationship between the borrower's deduction and the refinance probability before and after the TCJA. [9][10] Before the TCJA, the slope of the relationship between refinancing and deductions is steep for low deductions. As households cross the pre-TCJA itemizing threshold, the slope of the relationship between

[8]For simplicity, we calculate F using only the federal tax rate.

[9]We restrict to in-the-money borrowers to focus on a sample who will be likely to refinance, and so that the broad change in mortgage rates does not create large changes in the refinance incentives before and after the law change. We define in-the-money to mean that the rate gap, or the difference between their current mortgage rate and the rate the borrower would receive if they were to refinance at time t, is at least 50 bps.

[10]The TCJA capped state and local taxes (SALT) deductions at $10,000, therefore lowering total deductions for high-SALT households. To ensure that we compare only households whose deduction does not change due to the SALT cap (so that their location on the deduction axis is relatively constant), we restrict this analysis to households with SALT deductions less than $10k.

refinancing and deductions flattens, consistent with these borrowers' refinancing becoming less sensitive to mortgage interest because borrowers now deduct mortgage interest from their taxes.

Following the TCJA, the slope of the relationship between refinancing and deduction amount steepens significantly for households with deductions between $12,700 and $24,000. These households can no longer reduce their mortgage rate via the tax code after the TCJA, and so their refinancing becomes *more* sensitive to their interest rate. Refinancing rates also increase absolutely for this group following the TCJA. Refinancing increases the most for exactly the borrowers who saw the biggest drop in their imputed subsidy rate.

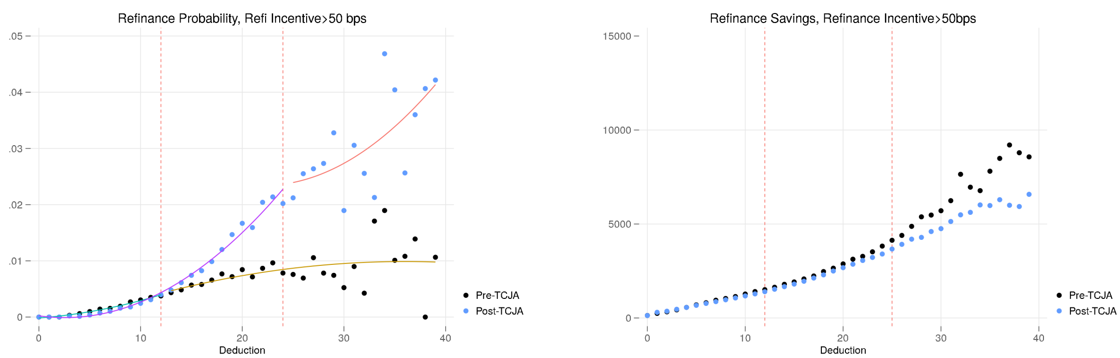

Figure 3. Refinancing Probability and Potential Savings from Refinancing. The left panel plots the the probability of refinancing, before and after the TCJA, by deduction amount. Deduction is defined as the sum of mortgage interest, state income tax, and property tax. Sample includes borrowers with a rate gap of at least 50 bps and whose SALT taxes amount to less than $10,000. The right panel plots the potential annual interest savings available to the borrower upon refinance for the same population.

Interest savings from refinancing is a prime driver of refinancing. If the potential interest savings from refinancing increased on average between the pre- and post-TCJA periods, that may suggest that refinancing increased not because of the law change but because of a change in refinance savings. To explore this possibility, we plot the savings from refinancing by deduction amount in the right panel of Figure 3.[11] We define refinance savings as the mortgage balance multiplied by the difference in the borrower's outstanding mortgage rate and the rate they could obtain if they refinanced. This is a somewhat more nuanced representation of the refinance incentive that may better reflect the fixed costs of refinancing than the rate

[11] As in the left panel, we restrict to low-SALT, in-the-money households.

gap. Potential refinance savings do not substantially change from pre- to post-TCJA – if anything they decline slightly – indicating that a change in refinance savings cannot explain the growth in refinancing after the TCJA observed in the left panel of Figure 3.

6 Empirical Strategy

We use somewhat different approaches to estimating the effect of the policy on refinancing propensities and on debt-paydown.

6.1 Refinancing

We primarily rely on a difference in difference framework to formalize the patterns we see in Figure 3. We compare three groups of borrowers: never-itemizers, switchers, and always-itemizers.[12] Motivating this regression analysis, our subsidy estimates from the left panel of Figure 2 suggest that "switchers" saw their subsidy rate decline markedly on average following the TCJA, and those who itemized both before and after the law change, ("always-itemizers"), saw their average subsidy reduced the most. Collapsing the data into these broad categories allows us to evaluate the effect of the law for borrowers with different exposure to the interest subsidy loss. Figure 3 likewise suggests different average refinance responses in these three groups.

A household's refinance propensity also depends critically on their refinance incentive, which we estimate as the difference between their current mortgage rate and the rate available to them if they refinance (rategap). A sharp increase in mortgage rates in January of 2018, immediately following the passage of the TCJA, complicates a simple before and after comparison of refinance propensities among those whose itemization status likely switched (see Appendix Figure A.1), because refinance incentives broadly dropped around the time

[12] We define never-itemizers as borrowers with deductions below $12,700 in both the pre and post periods. We define switchers as borrowers with deductions above $12,700 in the pre period and below $25,000 in the post period. We define always itemizers as borrowers with deductions above $25,000 in both the pre and post periods.

of the bill's passage. To circumvent this issue, we compare borrowers before and after the TCJA with the same refinance incentive. The identifying assumption is that any change in the relative refinancing rate among households with similar refinancing incentives is driven by a change in their itemization status. We estimate the change in refinance probabilities by rate gap for in-the-money borrowers, and show that, for households with the same refinance incentive, refinancing is increasing in the magnitude of the subsidy loss.

We estimate the following difference-in-differences style regression:

$$Pr(Refi_{i,t}) = \beta_1 * Post_t * SubsidyChange_i * RefinanceIncentive_{i,t} + \rho X_{i,t} + \psi_{i,t} + \varepsilon_{i,t} \quad (2)$$

This specification compares borrowers who lose the subsidy to unaffected borrowers, before and after the TCJA, and across refinance incentives. *Post* is defined as a dummy corresponding to post January 2018, when the TCJA came into effect. $SubsidyChange_{i,t}$ is defined as the difference in the borrower's mortgage interest subsidy rate before and after the TCJA. Using the terms from Section 4.1, $SubsidyChange_{i,t}$ corresponds to $tp_{post} - tp_{pre}$. $RefinanceIncentive_{i,t}$ refers to a borrower's rate gap, the difference between the borrower's current mortgage rate and the rate available if he were to refinance at time t based on his observable characteristics. $X_{i,t}$ is a vector of controls broadly meant to control for other determinants of a household's willingness and ability to refinance. These controls include quadratics of LTV at origination, mark to market LTV, credit score, loan age, remaining principal balance, and the log of income at origination. Fixed effects ψ_t include zipcode by quarter fixed effects, rate gap bins by quarter fixed effects, balance by quarter fixed effects.

One concern when evaluating refinancing by deduction amounts comes from the fact that the deduction amount is determined by SALT, mortgage balance, and rate gap, and that one of these components alone could drive the increase in refinancing, *not* the change in tax policy. For example, it is possible that high balance borrowers, who have higher deductions, increased their refinancing following the TCJA and that this increase drives our result.

We address this threat using a robust collection of fixed effects. Namely, in our specification we control for rate gap bins by quarter fixed effects, balance by quarter fixed effects, and SALT by quarter fixed effects, which may be correlated with income or may have other indirect effects on the refinancing probability. These fixed effects absorb any variation coming exclusively from one component of the deduction amount. We also control for zip x quarter fixed effects, to absorb any variation in refinance activity that is driven by other effects from the law that are highly geographically varied (e.g. via the direct effect of the law on house prices, or via changes in wealth (Dobridge and Hsu (2019)). These fixed effects help ensure that the effect we identify are driven solely by variation in subsidy change itself (and therefore by variation in tax policy), and not by any component of the deduction amount or other geographically-varying effects of the tax law.

We estimate all models using a linear probability model rather than a logit model because of the large number of fixed effects. We cluster errors at the zipcode level. The sample runs from 2016m1 to 2020m3.

6.2 Debt paydown

For debt paydown, borrowers' incentives are less dependent on the rate environment. We therefore rely primarily on the sharp change in the structure of the MID following the passage of TCJA to evaluate changes in household payment behavior, similar to the approach in Section 5. For the moment, this analysis is less formal: we summarize the debt paydown propensities, using a variety of strategies based on granular estimates of their total deduction amounts. The results are striking using the raw data, but future analysis will formalize the documented relationships.

7 Results: Refinancing

We formalize the motivating empirical patterns from Section 5 using the difference in differences design described in Equation 2 of Section 6. We estimate here three variations of Equation 2 to show that we see changes in refinance behavior along the subsidy, refinance incentive, and time dimension all at the precise points where we would expect if the tax policy is changing refinancing behavior.

7.1 Effect by Deduction Bin

First, we estimate the change in refinancing following the TCJA according to the intensity of the drop in the subsidy. Recall from Figure 2 that the TCJA change in the mortgage interest subsidy maps to deduction bin. This mapping motivates our estimation of the following variation on Equation 2:

$$Pr(Refi_{i,t}) = \beta_1 * Post_t * DeductBin_{i,t} * InTheMoneyCat_{i,t} + \rho X_{i,t} + \psi_{i,t} + \varepsilon_{i,t} \tag{3}$$

$DeductBin_{i,t}$ corresponds to \$1,000 bins of the borrower's estimated deductions. $InTheMoneyCat_{i,t}$ is a categorical variable indicating Negative (<0), "neutral" (0-0.5ppt), or positive (>0.5ppt and <1.5ppt) rate gaps. Controls and fixed effects are defined as in Equation 2.

We calculate the coefficients on $Post_t x DeductBin_{i,t}$ separately for in and out of the money borrowers and plot these coefficients by deduction bin in Figure 4. Figure 4 indicates two important results. First, refinancing increased following the TCJA only for in-the-money borrowers, and the effects are largest for those who are near the in-the-moneyness threshold. (Borrowers who are deeply in-the-money tend to be much less responsive to changes in the rate environment (Berger et al. (2021))). Refinancing did not change for out-of-the-money borrowers who have no incentive to refinance. Second, amongst the rate-attentive in-the-money group, refinancing increases with the intensity of the change in the mortgage interest

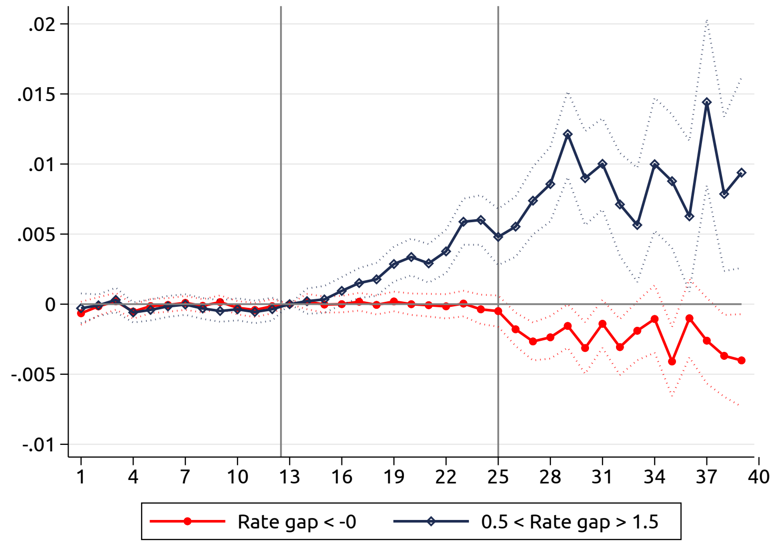

Figure 4. Change in Rate-term Refinances by Deduction Bin. This figure plots the effect of the interest subsidy decline on refinancing sensitivity calculated from a specification allowing the effect of the interest subsidy decline to vary by deduction bin. Estimates were calculated by regressing the probability of refinancing on an interaction of a post-TCJA dummy, with a dummy for being in-the-money to refinance (rate gap between 0.5 and 1.5), with a categorical variable for deduction bin. The figure plots the triple interaction coefficient by deduction bin along with associated 95% confidence intervals.

subsidy. Figure 2 indicates that the size of the subsidy loss is zero for deductions below \$12,700, increases linearly between deductions of \$12,700 and \$25,000, and plateaus after \$25,000. The rise in refinancing post-TCJA for in-the-money borrowers appears in the same place along the deduction distribution. The overall rise in in-the-money refinancing post-TCJA plotted in Figure 4 is increasing between deductions of \$12,700 and \$25,000 and is highest and constant for high deduction borrowers $> \$25,000$. Refinancing changes at the precise points in the deduction distribution that we would expect if this behavior reflected a response to the TCJA.

Figure 4 suggests that in-the-money borrowers were much more responsive to the TCJA than out-of-the-money borrowers. We next investigate precisely where in the rate gap distribution the effect of the TCJA appears.

7.2 Effect by Refinance Incentive

The probability of refinancing does not linearly respond to the refinance incentive, or rate gap. Appendix Figure A.2 plots the probability of refinancing by borrower rate gap. The figure plots the coefficients from a regression of refinancing on 20 basis point bins of borrower rate gap, controlling for borrower characteristics including quadratics of ltv, loan age, remaining principal balance, and for zipcode fixed effects. The figure illustrates that refinancing increases in a step-like fashion with rate gap. For out of the money borrowers, or borrowers with negative rate gaps, refinancing is flat by rate gap. As rate gaps become positive, refinancing linearly increases with rate gap up until rate gaps of approximately 1, and then plateaus. This pattern implies that borrowers with very positive rate gaps are not responsive to changes in the mortgage rate which push them further into the money to refinance. This lack of attention to the rate gap for very in the money borrowers has been attributed to burnout in the literature (Berger et al., 2021). The pattern of refinancing by rate gap in Appendix Figure A.2 implies that the borrowers who are historically most attentive to their refinance incentive are borrowers with rate gaps between 0 and 1.

We next investigate whether the most rate attentive borrowers are the ones who respond to the loss of the interest subsidy. To do this, we estimate the following version of Equation 2:

$$Pr(Refi_{i,t}) = \beta_1 * Post_t * SubsidyChange_{i,t} * RateGapBin_{i,t} + \rho X_{i,t} + \psi_{i,t} + \varepsilon_{i,t} \tag{4}$$

$SubsidyChange_{i,t}$ is a continuous variable corresponding to the difference in the borrower's imputed mortgage interest subsidy before and after the TCJA. $RateGap_{i,t}$ is a categorical variable referring to 25 basis point bins of borrower rate gap, where rate gap is the difference in the borrower's current mortgage rate and the rate available to them if they were to refinance at time t.

We calculate the coefficients on $Post_t x SubsidyChange_{i,t}$ for each bin of borrower rate gap and plot these coefficients in Figure 5. Figure 5 indicates that the difference in refinancing before and after the TCJA for borrowers who lose the subsidy relative to those unaffected by the subsidy loss is largest for borrowers with rate gaps between 0.25 and 1.25, exactly the borrowers who have been most attentive to their refinance incentive as suggested by Appendix Figure A.2. The interest subsidy has larger effects on the post-tax refinance incentive, $(1-t)*(r_0-r_m)$, of larger rate gaps, so we would expect the repeal of the subsidy to have a bigger effect for bigger rate gaps. In the region 0-1 in Figure 5, we do in fact see this behavior, that the effect of the TCJA is *increasing* in rate gap up until rate gaps of 1.25, at which point the effect flattens and disappears, consistent with borrowers with very high rate gaps being inattentive to their refinance incentive.

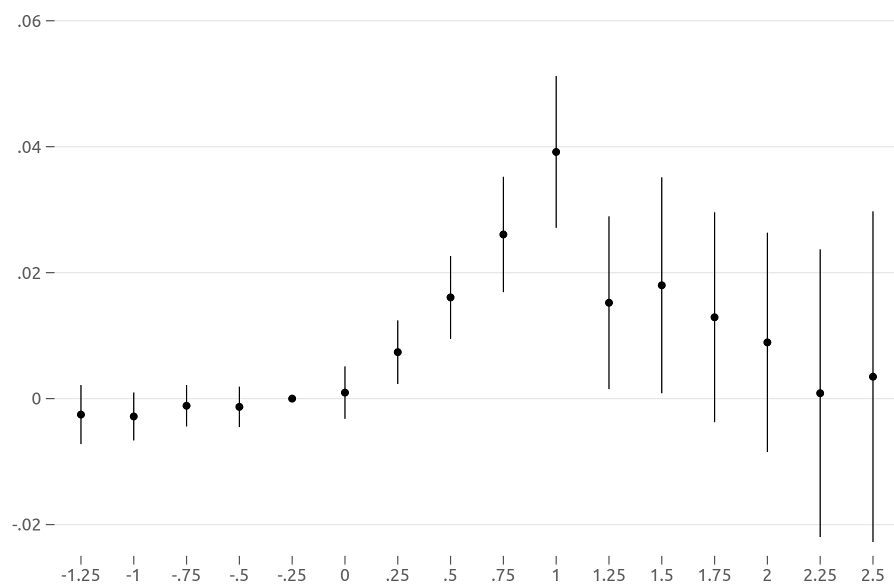

Figure 5. Change in Refinancing Probability by Rate Gap. This figure plots the effect of the the interest subsidy decline on refinancing sensitivity calculated from a specification allowing the effect of the interest subsidy decline to vary by rate gap. Estimates were calculated by regressing the probability of refinancing on an interaction of a post-TCJA dummy, with a continuous variable capturing the size of the subsidy decline, with a categorical variable corresponding to 25 basis point bins of borrower rate gap. The figure plots the triple interaction coefficient by rate gap bin along with associated 95% confidence intervals.

7.3 Effect by Time

We next test whether the increase in refinance propensities for borrowers who lose the subsidy emerges only following the TCJA and is not a continuation of a pre-existing trend. To do this, we estimate a flexible difference-in-differences regression. Specifically, we interact dummies for each quarter of the sample interacted with indicators for a household having lost their interest subsidy and interacted with indicators for the household being in-the-money to refinance.

Specifically, we estimate the following regression:

$$Pr(Refi_{i,t}) = \sum_{\tau} \delta_t * \beta_\tau ItemizerType_{i,t} * InTheMoneyCat_{i,t} + \rho X_{i,t} + \psi_{i,t} + \varepsilon_{i,t} \qquad (5)$$

$ItemizerType_{i,t}$ takes on three values: 1 “Never Itemizers," 2 “Switchers," and 3 “Always Itemizers.”[13] $InTheMoneyCat_{i,t}$ is a categorical variable indicating Negative (<0), "neutral" (0-0.5ppt), or positive (>0.5ppt) rate gaps. Controls $X_{i,t} + \psi_{i,t}$ are those as included in Equation 2. The omitted category is set to the fourth quarter of 2017.

We plot the coefficients on the triple interaction term β_τ in Figure 6. The coefficient for Switchers, plotted in red, captures the difference in refinancing for in-the-money borrowers relative to out-of-the-money borrowers for Switchers relative to Never Itemizers over time. The Always itemizers coefficient, plotted in black, has the corresponding interpretation. The figure captures the effect of the subsidy loss by refinance incentive over time.

The black and red lines only began to increase in 2019, meaning that in-the-money refinancing increased for Switchers and Always Itemizers only following the TCJA and not before, consistent with the TCJA causally affecting refinancing. The effect of the TCJA on

[13] Never-itemizers are defined as borrowers with deductions below \$12,700 in both the pre and post periods. Switchers are defined as borrowers with deductions above \$12,700 in the pre period and below \$25,000 in the post period. Always itemizers are defined as borrowers with deductions above \$25,000 in both the pre and post periods. Never itemizers experience no change in the subsidy. Switchers and Always itemizers see their subsidy decline and Always itemizers experience the largest decline.

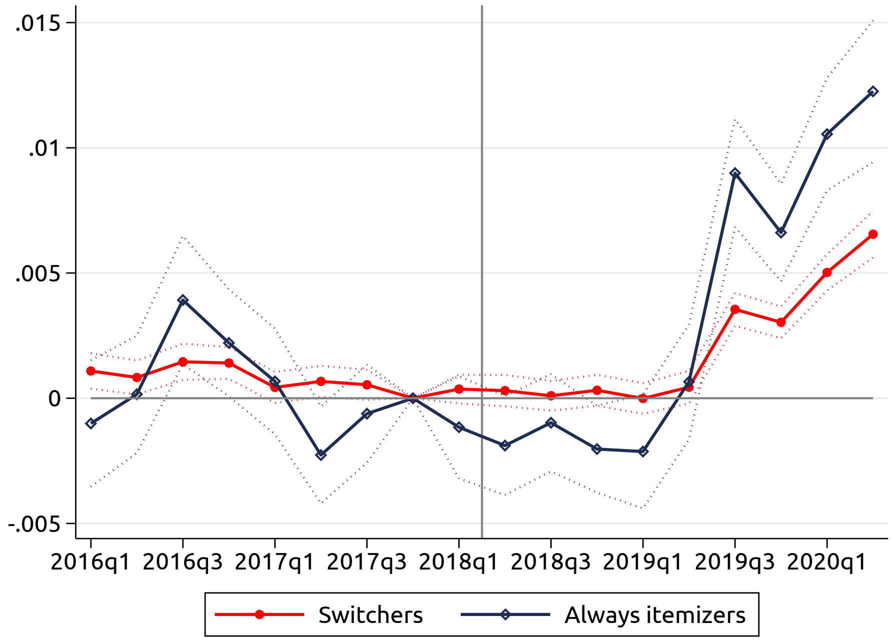

Figure 6. Change in Refinancing Probability over Time. This figure plots the effect of the interest subsidy decline on refinancing sensitivity calculated from a specification allowing the effect of the interest subsidy decline to vary by quarter. Estimates were calculated by regressing the probability of refinancing on an interaction of a categorical variable for itemizer type with a categorical variable corresponding to bins of borrower rate gap with dummies for each quarter of the sample. The figure plots the triple interaction coefficient by quarter along with associated 95% confidence intervals.

refinancing sensitivities does not appear immediately following the enactment of the TCJA in January 2018 but only in 2019. This delayed reaction likely reflects the timing of tax returns. The TCJA went into effect at the beginning of 2018, so would have first affected 2018 returns. Households do not file 2018 returns until 2019 and so would likely have not been aware of their changed subsidy amount until 2019, which is when we start to see an effect in the data.

The black line lies above the red line in Figure 6, meaning that borrowers with larger reductions in their subsidy ("Always Itemizers"), have larger responses in their refinancing sensitivities than borrowers less affected by the subsidy decline ("Switchers"). This result underscores the fact that the effect of the TCJA is increasing in the intensity of treatment and is consistent with Figure 4.

7.4 Aggregate Effects

The results from Sections 7.1, 7.2, and 7.3 indicate that the TCJA increased the overall refinancing sensitivity to rates: borrowers became more likely to refinance when in the money and less likely to refinance when out of the money. The TCJA steepened the slope of the refinancing probability by rate gap as plotted in Appendix Figure A.2. The effect of the bill on the aggregate refinancing rate therefore depends on the distribution of rate gap, whether mortgage rates are high or low. Our results suggest that if rates drop, and more borrowers are pushed in to the money to refinance, then more people will now refinance in response to the rate drop than had in the past.

Figure 7 below plots the aggregate refinance rate and the share of borrowers who are in the money to refinance over time. Although the share of borrowers in the money to refinance in 2019 is about 25% lower than in 2016, the refinance probability in 2019 is nearly as high as the refinance probability in 2016. This suggests that borrowers have now become more likely to refinance when in-the-money than they had in the past, consistent with the TCJA having increased the sensitivity of refinancing to rates.

We can use the TCJA shock to the interest subsidy to derive a causal estimate of the elasticity of refinancing to mortgage rates. Interpreting the coefficient on β_1 in Equation 3 for in-the-money borrowers with deduction bins of 22-26, for a decline of 19 basis points in the interest subsidy, (equivalent to a 19 basis point rise in the refinance incentive), refinancing increases by 0.5 percentage points, a 25% increase from the baseline refinancing probability.[14] This elasticity is large but in line with other estimates from the literature. For example, Di Maggio, Kermani and Palmer (2020) find that in response to a drop in mortgage rates of 40 basis points during QE1, refinancing increased by 56%.

[14]The elasticity of refinancing to mortgage rates is similar when we calculate the effect at other deduction bins: for in-the-money borrowers with deduction bins of 15, for a decline of 10 basis points in the interest subsidy, (equivalent to a 10 basis point rise in the refinance incentive), refinancing increases by 0.05 percentage points, a 10% increase from the baseline refinancing probability.

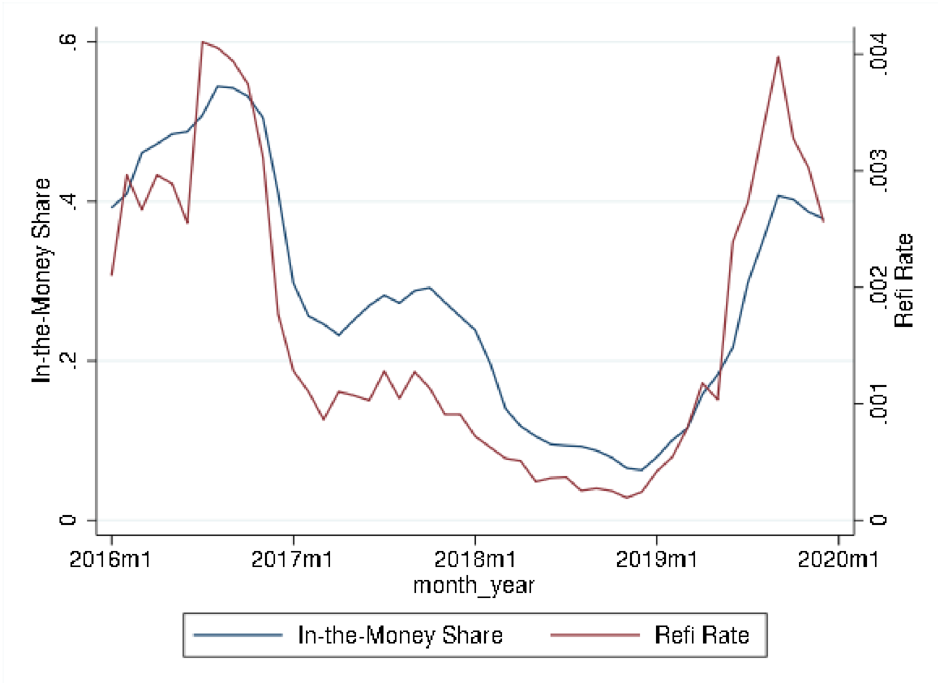

Figure 7. Change in Refinancing Probability and Share In-the-Money to Refinance over Time. This figure plots the mean refinancing probability and the share of borrowers in-the-money to refinance over time.

8 Results: Changes in Leverage

8.1 Debt Paydown

The TCJA increased the interest savings from paying down housing debt ahead of schedule for households who itemized before the tax law change. Households could advance their paydown schedule in several ways: making unscheduled principal payments ("curtailments"), paying down their balance when they refinance, or shortening their amortization term when they refinance. We test the impact of the TCJA on the first two paydown methods here, and leave the third for future work.

To estimate unscheduled principal payments, we construct a measure of "excess debt paydown" as the amount of principal paid down relative the scheduled principal payment based on the mortgage terms. Specifically, excess paydown is calculated as $\frac{P_A}{P_S}$ - 1, where P_A is the actual principal paid in a given month and P_S is the scheduled principal amount. This measure has a minimum value of -1 (indicating a missed payment) and a median value of 0.

We winsorize at the 99th percentile to handle extreme positive values, but the qualitative results are robust to unwinsorized inputs and log transformations. Delinquent loans are excluded.

The left panel of Figure 8 shows average monthly excess paydown by deduction amount before and after the TCJA went into effect. In contrast with refinance behavior, where we see large response to the change in incentives, we find no detectable change in debt paydown behavior following the law change. The right panel of Figure 8 plots the percent of the household's original mortgage balance that was paid off during a rate-term refinance. A value of 10% implies that the household reduced their mortgage balance by 10% while rate-term refinancing. Following the TCJA, households face a higher rate of return for paying down their mortgage debt, so if the loss of the MID in the TCJA incentivized deleveraging, we may see an increase in the cash-in percent amongst borrowers with deduction amounts above the pre-TCJA itemization threshold [15] Similar to our results looking at excess debt paydown, we find no clear change in deleveraging through cash-in rate-term refinances following the TCJA, either in terms of the cash-in probability (not shown) or the cash-in amount. We conclude that eliminating the MID did not cause existing mortgage borrowers to delever.

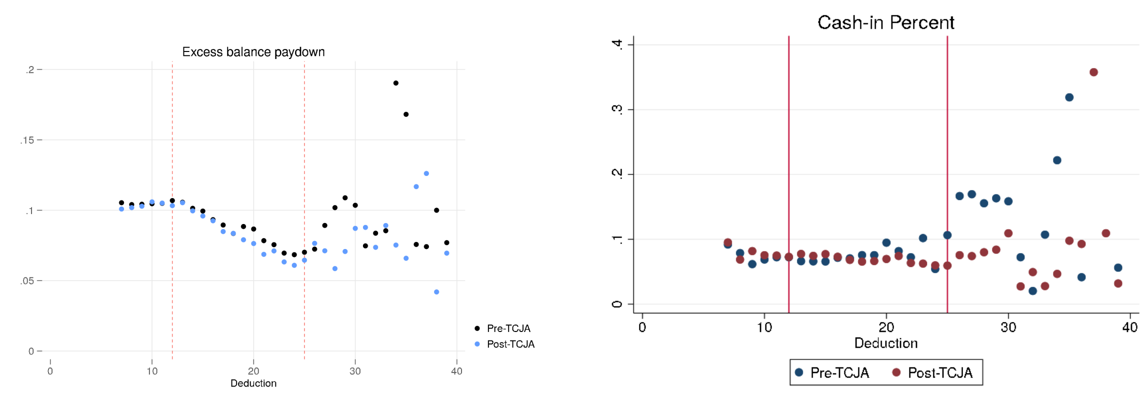

Figure 8. Excess debt paydown. This figure plots excess debt paydown and the percent change in the existing mortgage balance at the time of a cash-in refinance.

[15]We also restrict to cash-in refinances with at least a 2% reduction in mortgage balance to ensure we are not mis-measuring non-cash-in rate-term refinances.

8.2 Cash-out Refinancing

Some literature suggests that being in-the-money to refinance induces cash-out refinances (e.g. Eichenbaum, Rebelo and Wong (2018)), because the interest savings from the rate-term refinance allows households to overcome the fixed costs associate with extracting equity. Although the TCJA made mortgage debt more expensive on the margin (especially equity extraction, which is no longer tax deductible at all), this literature implies that the net impact of the law change on equity extraction is ambiguous: more in-the-money borrowers may drive more cash-out refinancing, but eliminating the tax subsidy may lead to less extraction.

In addition to exploring broad patterns of leverage changes, we need to ensure that the increase in rate-term refinance we document in Section 7 is an increase in total refinancing, not substitution away from cash-out refinances toward rate-term refinances.

In this section, we evaluate whether the TCJA changed households' propensity to cash-out refinance or their extraction amount. The right panel of Figure 9 shows the percentage change in LTV during cash-out refinance, a measure of the amount extracted. We track changes in LTV rather than dollar extraction amounts because the loss of the mortgage subsidy may have affected house prices (Sommer and Sullivan, 2018). Changes in house prices could directly impact borrowing amounts separately from the subsidy change, though Li and Yu (2020) suggest that in practice, over our sample period, the effect on average LTVs is small.[16] The right panel of Figure 9 indicates no change in the extraction amount during cash-out refinancing following the TCJA.

The left panel of Figure 9 shows the monthly probability of cash-out refinance before and after the TCJA, for borrowers who are in the money to refinance (rate gap > 50 bps). The figure shows a clear zero effect: households who lose the interest subsidy do not become less likely to do a cash-out refinance. This suggests the increase in rate-term refinancing we document in Section 7 following the TCJA is not due to substitution from cash-out refinances into rate-term refinances. This zero effect may reflect either no impact of the TCJA on cash-

[16]The results look similar we plot levels of equity extraction as well as LTV changes.

out refinancing, or the offsetting effects of increased rate-sensitivity and a reduced interest subsidy.

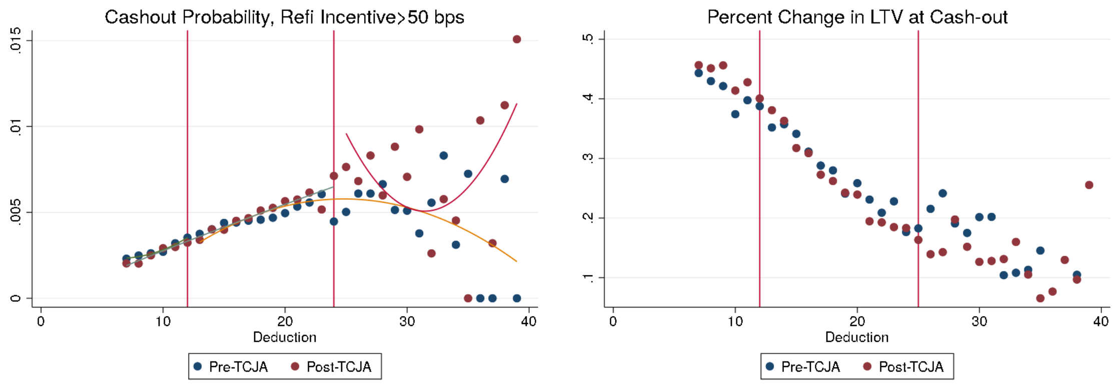

Figure 9. Cash-out refinancing. The left panel plots the probability of cash-out refinancing by deduction amount, before and after the TCJA passed. The right panel plots the percent change in mark to market LTV at the time of a cash-out refinance.

In this section, we tested for changes in leverage in response to the loss of the interest subsidy across several mechanisms: borrowers making greater than scheduled mortgage payments and balance changes at the time of refinancing. We find no evidence that existing homeowners responded to the loss of the subsidy by deleveraging. This result suggests that the response of mortgage debt to the interest subsidy operates entirely through new homeowners taking on more debt at origination and by buying larger homes. The lack of a response amongst existing homeowners to the loss of the interest subsidy could be due to either salience, or to having insufficient cash on hand to delever when the interest subsidy disappears.

9 Conclusion

This paper studies how the mortgage interest deduction affects refinancing and debt paydown. The MID allows households to deduct their mortgage interest from their taxes and so the benefit to refinancing and debt paydown is discounted by the tax rate. We study how this tax benefit affects household refinancing and borrowing behavior.

We use the TCJA as a natural experiment to study the effect of the mortgage interest deduction (MID). The TCJA of 2018 changed the incentives to itemize, causing many households to stop deducting mortgage interest. We find that in response to the loss of the MID, households became more likely to refinance in response to drops in the mortgage rate. For the most affected borrowers, we find that a decline of 19 basis points in the interest subsidy increases refinancing by 25% when in-the-money. We also show that the difference in refinancing rates between those who lost the subsidy and those who never had the subsidy appeared only following the TCJA and not before. The effect is largest for borrowers most affected by the loss of the subsidy and cannot be explained by other factors that drive refinancing, like pre-tax refinance savings. Finally, we find the effect of the TCJA is strongest for borrowers most attentive to their refinance incentive.

We likely understate the full effect of the TCJA on the refinancing channel because the TCJA also increased the share of refinance savings pocketed by households who would have refinanced even without losing the interest subsidy. The TCJA therefore may have increased the MPC out of refinancing, increasing total monetary pass-through.[17] We investigate this possibility in future work.

On the other hand, we may overstate the long-run sensitivity of households to their after-tax mortgage rate. The TCJA suddenly brought a number of borrowers into the money who were not in the money to refinance before the law-change; some catch-up refinancing may therefore both be expected and impossible for us to measure.

We also present evidence that strongly suggests the law change had no effect on borrowers' propensity to pay down their existing mortgage debt. This suggests both that the consumption effects of the law change are not offset by increased debt paydown, and also that the law change had little effect on loan-to-value ratios of existing homeowners, an important financial stability consideration.

Our work suggests that the MID has important and underappreciated interactions with

[17]This effect of the TCJA on aggregate consumption via refinancing would not be offset by a reduction in lender income.

the pass-through of monetary policy.

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Internet Appendix for:

“More Tax, Less Refi? The Mortgage Interest Deduction and Monetary Policy Pass-Through”

Tess Scharlemann and Eileen van Straelen

December 20, 2022

A Mortgage rate over time

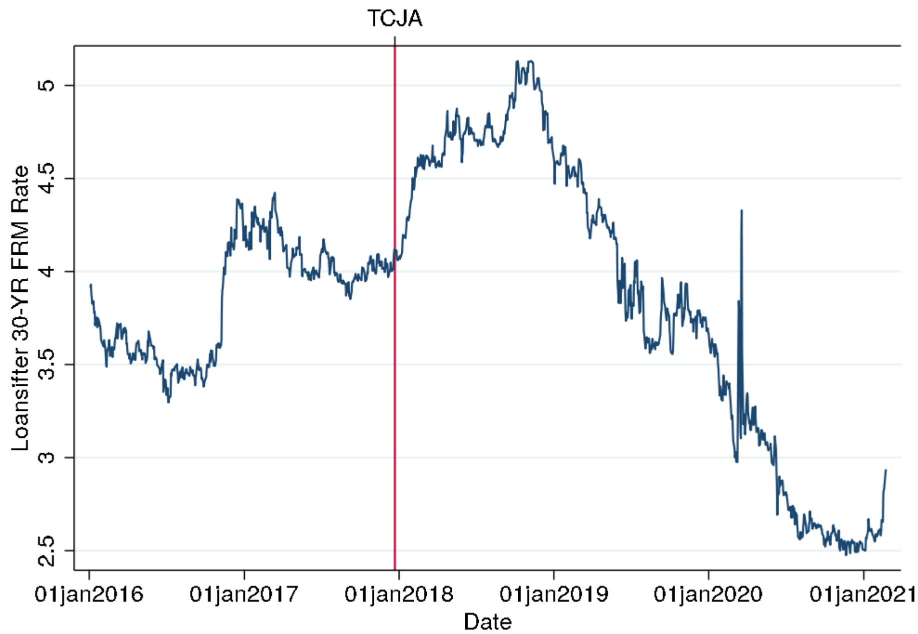

Figure A.1. Mortgage rates following the TCJA. This figure shows the 30-year fixed rate mortgage rate over time. The red line indicates the time period when the TCJA came into effect, in January 2018.

B Refinance probability conditional on rate gap

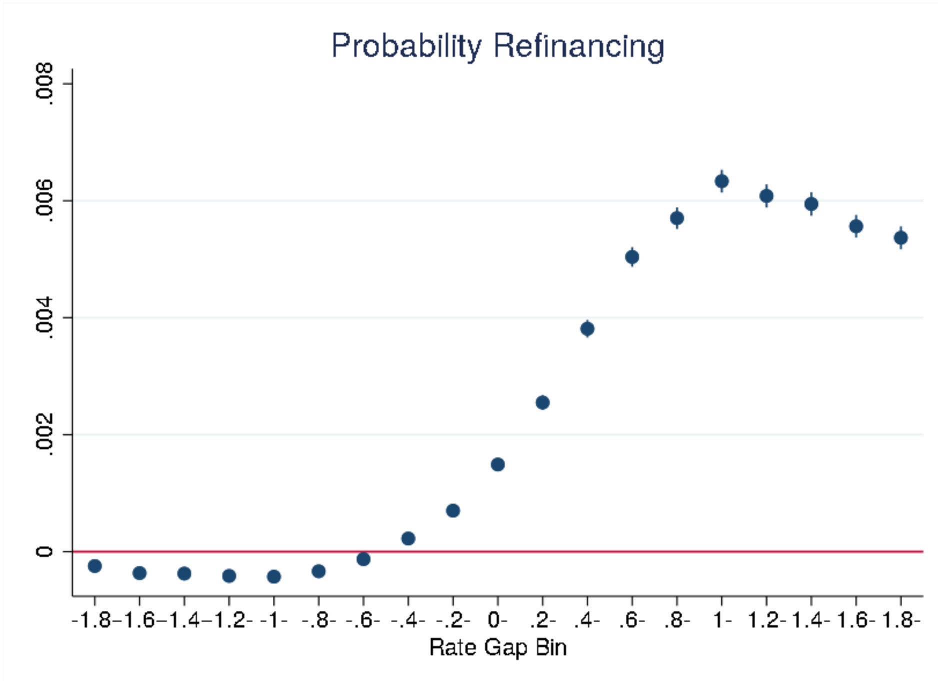

Figure A.2. Refinancing probability by rate gap. This figure plots the probability of refinancing by 20 basis point bins of borrower rate gap. Rate gap defined as the difference between the borrower's current mortgage rate and the rate they are predicted to receive if they were to refinance. A household's predicted mortgage rate is estimated from a regression of mortgage rates on borrower and loan characteristics from Optimal Blue.

C Validate itemizing status using IRS SOI statistics

To validate that we correctly assign itemizing status to borrowers, we compare our measure of itemizing, aggregated to the zipcode level, against zipcode statistics on itemizing shares from the IRS SOI statistics in Figure A.3. In this analysis we restrict to zipcodes with at least 530 personal property tax returns because mis-classifying just a small number of households witin a low population zipcode could generate large swings in the match rate within the zipcode.

Figure A.3 shows that in both 2017 and 2018, the two years of our sample for which we have IRS SOI data, there is a tight correlation between the itemizing share in a zipcode in the IRS SOI statistics and the itemizing share in a zipcode based on our calculations from the HMDA-CRISM dataset, indicating we have correctly identified itemizing status amongst borrowers. There are far fewer zipcodes with large itemizing shares in 2018 than in 2017, reflecting the overall decline in the itemizing share following the passage of the TCJA as seen in Figure 1, and consistent with the TCJA reducing the attractiveness of itemizing.

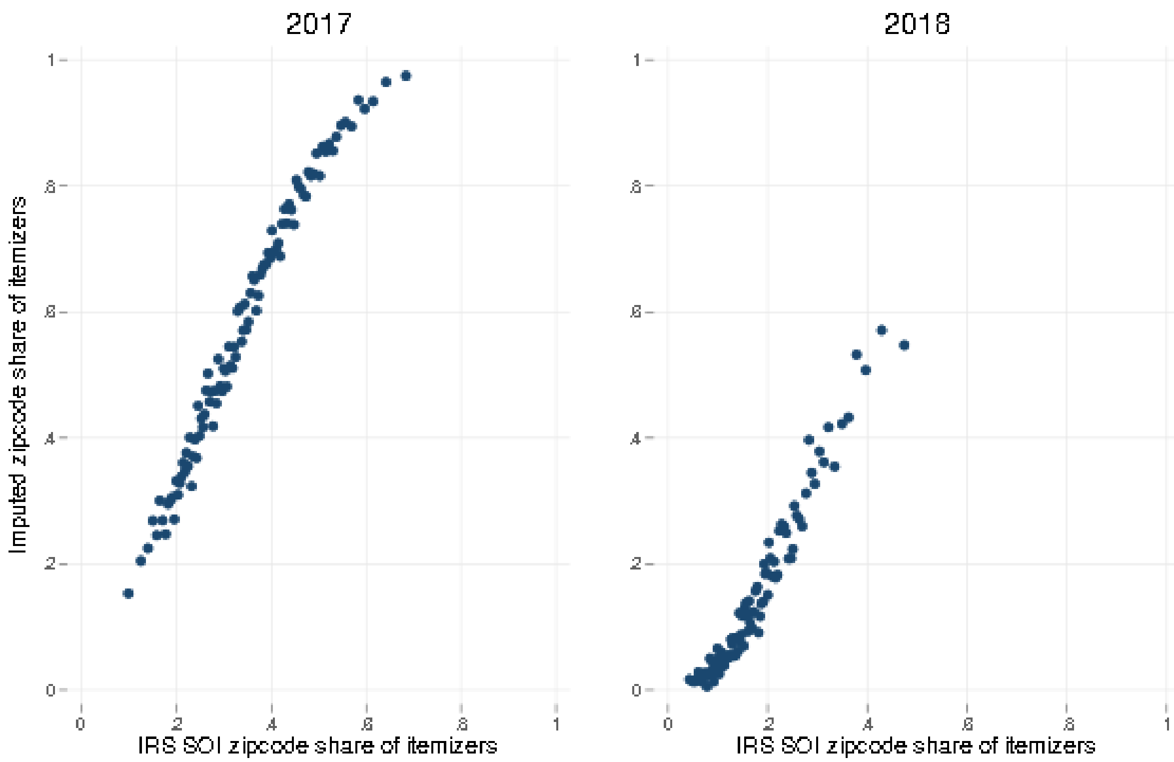

Figure A.3. Correlation between the IRS zipcode share of itemizers and the imputed HMDA-CRISM-Taxsim zipcode share of itemizers. This figure plots binscatters of the zipcode share of itemizers from the IRS SOI statistics against the zipcode share of itemizers calculated using HMDA, CRISM, and Taxsim as described in Section 3.1.1 separately for 2017 and 2018. The unit of observation in the plots is the zipcode-year. Zipcodes with fewer than 530 personal property tax returns have been removed from the sample.