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# Housing assistance policy for mortgage borrowers: liquidity improvements or price acceleration?

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## Abstract

Public subsidies to support the downpayments of mortgaged home purchasers can be absorbed in the housing market in a number of ways. Using granular data on loans and borrowers in Ireland, we assess three possible transmission channels of an enhancement to subsidy payments introduced in mid-2020: borrowers' liquidity, equity (or indebtedness), and home purchase values. Our estimates suggest that out-of-pocket downpayments fall by almost the size of the increase in the subsidy value, suggesting improvement in liquidity position of eligible borrowers. We also find that this liquidity improving effect is present across all income levels, but highest in the middle of the borrower income distribution. Equity enhancements (lowering Loan-to-value ratios) and house price increases are smaller in magnitude and more prevalent among higher income borrowers.

**Keywords:** Downpayment constraint, housing assistance schemes, macroprudential policy, borrower liquidity.

**JEL codes:** D04, E58, H24, R28.

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## Non-Technical Summary

How are public subsidies absorbed in the markets to which they are targeted? Do they achieve their stated up-front aims? Do they benefit particular groups more than others? Do they have unintended adverse consequences? Given that public funds are scarce, studies that ask these questions are a critical and necessary part of the assessment of any fiscal program. In the case of housing assistance schemes, research has typically focussed on broad questions, for example whether or not such schemes have added inflationary pressure to house prices, or whether they have stimulated housing supply.

In this study, we take a granular view using borrower-level data available to the Central Bank of Ireland on new mortgage lending in Ireland. We focus on the Help to Buy (HTB) scheme, which provides cash grants to support downpayments of new mortgage borrowers in a subset of the Irish mortgage market. With our detailed dataset on borrowers, we focus on the borrower-level responses, rather than macroeconomic effects, of a substantial enhancement to the scheme introduced in July 2020.

We assess three ways in which borrowers can respond to an enhanced grant payment for house purchases: liquidity, equity, and purchase prices. Methodologically, we construct treatment and control groups, by virtue of the eligibility criteria within the scheme, to allow a difference-in-difference estimation of the causal effects of the policy change to be carried out.

We find that liquidity enhancement is the dominant response: once borrowers can access grants that are up to €10,000 larger, they reduce the size of their posted out-of-pocket downpayment by almost exactly as much. The implication is that these funds are now available either to boost consumption, or to improve liquidity buffers for the household. Looking across the income distribution, we find stronger effects among low to middle income borrowers, suggesting that liquidity constraints are most salient for this group. We find only modest effects on either equity improvements or purchase prices. On equity, we show that only higher-income borrowers reduce their LTV ratio or loan amounts. Similarly, we find that only the highest-income borrowers increase their purchased prices in response to the more generous subsidy.

Of particular interest to policymakers is that we are studying housing assistance payments in an environment where macroprudential mortgage regulation is in place. Since 2015, these measures have restricted mortgage borrowers' maximum borrowing amount relative to income and purchase price. HTB, at the same time, boosts the resources available to potential house-buyers thereby relaxing the downpayment requirement, or in some cases, reducing the required mortgage amount. We are unaware of a previous

study that shows how housing grants are absorbed into the market when macroprudential regulation is imposing credit limits.

Our findings suggest that liquidity retention is the main effect of the HTB policy for these borrowers. This would be consistent with HTB easing some of the liquidity costs associated with building the downpayment for house purchase. We find no evidence of any changing composition of mortgage borrowers after the policy change, suggesting that entry of households with very different characteristics (for example, income or age) was not a consequence of the change in the scheme. Finally, our estimates suggest that borrower leverage does not noticeably change when subsidies become more generous, nor do we find any borrower-level evidence that would point to widespread inflationary effects of the changes in the HTB scheme in 2020, although the analysis - by design - is not general-equilibrium in nature.

# 1 Introduction

How do mortgage borrowers respond to housing assistance schemes that provide up-front support for downpayments? Are such schemes inflationary in the housing market? Do these schemes alleviate certain costs that are imposed on borrowers as a result of credit supply tightening or macroprudential policies? We investigate these questions, using for our research design a reform to Ireland's Help to Buy (HTB) scheme, which unexpectedly increased the size of downpayment subsidy available by one half, in 2020.

HTB was originally introduced in 2016 to provide up-front, non-repayable grants towards borrowers' downpayments on specific types of home purchase.<sup>1</sup> The scheme was introduced in the context of weak housing supply and the 2015 introduction of the Central Bank of Ireland's macroprudential mortgage measures.

While the implications of credit supply decisions, macroprudential mortgage policy and government housing assistance have been extensively studied in the finance and housing economics literature ([Acharya et al., 2022](#); [Bianchi and Mendoza, 2018](#); [Parker et al., 2013](#); [Agarwal et al., 2021](#); [Tracey and van Horen, 2022](#)), we are unaware of research that directly studies their interaction. In this paper, we aim to fill this void. We take a borrower-level approach and study whether housing assistance grants are used by borrowers to improve their liquidity position, reduce their indebtedness, increase their purchased property price, or some combination thereof. Our study does not test whether or not the policy change had general equilibrium effects on housing supply or house price indices.

Our three transmission channels are tested as follows. Firstly, we capture a liquidity transmission channel by assessing changes in the out-of-pocket downpayments of HTB-eligible recipients. Second, we measure an equity/indebtedness transmission channel, using the same framework to focus on changes in loan-to-value ratios (LTV) and loan amounts. Lastly, we capture a financial accelerator channel, measuring the change in the purchase

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<sup>1</sup>These schemes may take different forms, for example; credit market interventions reducing interest rates such as in the United States, China and India; mortgage guarantees such as in the United States and the Netherlands; government loans for home purchase such as in France or the United Kingdom. The HTB-styled schemes on the other hand offer tax refund or stamp duty rebates, thus relaxing the downpayment constraint of potential buyers. Similar examples include the Home Builder Bonus (HBB) in Australia and Help to Buy in the United Kingdom ([Carozzi et al., 2020](#); [Agarwal et al., 2021](#)).

price of HTB-eligible FTBs. To the best of our knowledge, this is the first assessment of housing assistance schemes that focusses on this range of borrower level effects.<sup>2</sup>

Our key findings suggest that a combination of all of the above channels is at play, but that the liquidity-enhancing effects of the policy enhancement appear to be the most economically meaningful. We estimate that out-of-pocket downpayments fall by almost the size of the enhanced subsidy among the treated group after July 2020, suggesting almost full absorption on average of the policy change. We find smaller but statistically significant effects on equity (with LTVs and loan amount falling after policy introduction) and on house prices (which rise among the treated group) as a result of the policy change. We investigate heterogeneity across the income distribution, and find that a strong liquidity response occurs across the five quintiles of the FTB income distribution. The equity-enhancing and price-increasing effects only appear strongly among the fifth income quintile.

Our findings have important policy implications. One viewpoint expressed in public debate is that housing assistance schemes risk being inflationary in the housing market, particularly where housing supply is tight, as is the case in Ireland in recent years. [Tracey and van Horen \(2022\)](#) confirm that housing assistance in the UK led to higher house prices in areas with tighter supply elasticity after introduction in 2013. Another criticism is that the policies result in “deadweight” type transfers to borrowers who would have entered the housing market regardless of the subsidy. Our framework does not allow us to cleanly identify the macro implications of the scheme on house prices, nor do we have a framework that can assess whether the scheme results in deadweight loss. We do not find borrower-level evidence that would point to widespread inflationary effects of the changes in the HTB scheme in 2020, although the analysis - by design - is not general-equilibrium in nature. Our results also suggest that entry of households with very different characteristics (for example, in terms of income or age) was not a consequence of the changes made in the scheme.

We position our findings on liquidity and indebtedness in the context of deepening our understanding of potential costs of downpayment requirements, with implications for macroprudential policy. The literature internationally is beginning to identify liquidity-erosion as a risk of borrower-based macroprudential policy, with household portfolios overweighted in illiquid housing downpayments at the expense of liquid assets ([Aastveit et al., 2020, 2021, 2022](#)). Our findings suggest housing assistance schemes may alleviate certain

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<sup>2</sup>We do not assess the impact of HTB enhancement on general housing conditions and housing supply. Furthermore, we do not assess the policy-debate around HTB incidence or the associated deadweight loss.

“intensive margin” costs of downpayment requirement by improving the borrower liquidity position, without eroding the borrower resilience benefits of tighter policy calibration, seeing as the government-provided equity is used to reduce LTV, thereby improving rather than eroding ex-ante measures of resilience. We do not have a modelling framework to measure whether these effects are welfare improving at aggregate level, or whether such assistance represents an optimal use of public funds, relative to other priorities. However, we do conclude that the scheme appears effective to alleviate short-run, liquidity costs associated with downpayment requirements among those households entering the mortgage market as FTBs.

The remainder of this paper is organised as follows. Section 2 presents review of relevant literature, section 3 discusses the policy context, conceptual framework as well as empirical challenges, section 4 presents data and descriptive statistics, section 5 presents the methodology, section 6 discusses the main results, section 7 presents heterogeneous analysis, while section 8 discusses the robustness checks. The paper concludes in Section 9.

## 2 Literature Review

Our research is related to three broad strands of the literature. Firstly, our finding on borrowers’ retention of cash as a response to the subsidy is relevant for studies on liquidity constraints and consumption responses of mortgaged homebuyers. Secondly, our study links to the literature on the effects of macroprudential policy on credit conditions as well as their overall implications for household financial resilience. Finally, our work relates to the literature on housing assistance schemes.

An extensive body of research has focussed on household liquidity and consumption as an outcome of housing market developments.<sup>3</sup> In general, without any access to gifts or bequests, households wishing to purchase a property tend to restrain consumption as they face liquidity constraints related to mortgage downpayment requirements. An early empirical assessment of the existence of downpayment constraints by [Engelhardt \(1996\)](#) suggests that household consumption increases significantly in the period after house purchase. The nature of this constraint is generally binding for young first time buyers

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<sup>3</sup>As noted in [Tracey and van Horen \(2022\)](#), housing market developments can affect household consumption and liquidity decision through different channels that include house price changes ([Lydon et al., 2017](#); [Berger et al., 2018](#); [Kaplan et al., 2020](#)), existence of downpayment constraints ([Engelhardt, 1996](#); [Aron et al., 2012](#); [Ortalo-Magne and Rady, 2006](#); [Gabriel and Rosenthal, 1991](#); [Rosenthal et al., 1991](#)) as well as macro-prudential policy changes ([Acharya et al., 2022](#); [Van Bakkum et al., 2019](#)).

who face difficulty in saving for downpayments or may be credit-constrained by macroprudential regulation such as loan-to-value (LTV) and loan-to-income (LTI) requirements (Tracey and van Horen, 2022; Aikman et al., 2021; Fuster and Zafar, 2021; Carozzi et al., 2020; Aron et al., 2012; Ortalo-Magne and Rady, 2006; Engelhardt, 1996; Duca and Rosenthal, 1994; Linneman and Wachter, 1989).

The central theme that ties our research to the literature on macroprudential policy in the mortgage market is that macroprudential measures and housing assistance programmes can act in opposing directions on the downpayment constraint of the buyer. From the macroprudential perspective, measures such as LTV requirements impose a maximum limit on the credit available to borrowers for a given downpayment amount (Kelly et al., 2018; Aikman et al., 2021).<sup>4</sup> Therefore, the remaining difference between the house value and available credit imposes a binding constraint for the downpayment required to complete the house purchase (O'Toole et al., 2021; Biesenbeek et al., 2022; Kinghan et al., 2022). More recently, Aastveit et al. (2021) and Aastveit et al. (2022) find that households, to fulfil the downpayment prescribed by LTV requirements, tend to deplete their savings.<sup>5</sup> While building resilience of households to adverse shocks to house prices, this rebalancing of assets from liquid savings to illiquid housing stock can also have negative, short-term consequences from a liquidity perspective such that, upon unemployment, there is a higher likelihood of house sale, given that the precautionary liquid buffers deplete during the house purchase. Therefore, part of the beneficial impact of macroprudential measures in boosting households' debt resilience may be offset by the countervailing effect of lower household liquidity resilience- a result of the binding downpayment constraint (Svensson, 2020; Aikman et al., 2021). Pointing in the same direction, in novel new research on a partial loosening of the Irish borrower-based measure regime in 2017, McCann and Durante (2022) show that borrowers respond to looser LTV limits by retaining more liquidity, rather than by purchasing more expensive homes.

Additionally, other costs of macroprudential policy, or any tightening of banks' lending policies in response to shocks, may include difficulty for buyers to enter the housing market due to reallocation of credit from low to high-income borrowers (Duffy et al., 2016; Lydon et al., 2017; Corrigan et al., 2019; Acharya et al., 2022; Peydró et al., 2020).

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<sup>4</sup>The use of macro-prudential measures is to address the cyclical nature between the credit supply and house prices to avoid agents over-borrowing in good times (Bianchi and Mendoza, 2018; Acharya et al., 2022), which generally contributes to higher house prices (Mian and Sufi, 2012, 2009, 2022).

<sup>5</sup> Aastveit et al. (2021) find that households depleted their savings by 9% post LTV tightening in Norway leading to absorption of liquid assets into illiquid housing asset.



Recent literature on borrower assistance schemes focusses on outcomes such as demand-side affordability, associated consumption and wealth effects, as well as overall supply-side responsiveness of the housing sector. Housing assistance schemes like HTB, by directly contributing to downpayments, tend to improve household financial resilience against the depletion of liquid assets to meet LTV regulations (Agarwal et al., 2021; Carozzi et al., 2020; Tracey and van Horen, 2022; Szumilo and Vanino, 2021). Agarwal et al. (2021) suggest stimulative effects associated with a housing assistance scheme in Australia,<sup>6</sup> whereby households receiving more subsidies significantly increased their new car purchases. Research by Tracey and van Horen (2022) compares household consumption before and after the HTB implementation in the UK<sup>7</sup> by considering heterogeneity in the exposure levels to the scheme. The main result of this study suggests that HTB assisted in loosening the downpayment constraint for buyers, which resulted in an increase in real household consumption by almost 6% between 2013 and 2016. Further, similar to Parker et al. (2013) and Agarwal et al. (2021), Tracey and van Horen (2022) delve further into the analysis of consumption stimulus effect and find an additional 2.4% increase in new car purchases per standard deviation of HTB exposure.

On the effects of housing assistance policies on the broader housing market, the literature has shown that the effectiveness of such policies in easing the downpayment constraint greatly depends on the supply-side responsiveness of the housing and construction sector. For example, Hilber and Turner (2014) find that the mortgage interest deduction in the US increased home-ownership only in areas with more relaxed land use regulation, while the policy resulted in increased prices in tightly regulated markets that had inelastic long-run housing supply. With respect to HTB, Tracey and van Horen (2022) find that the scheme resulted in greater house price increases in the London area, where supply is more inelastic, when compared to outside of London. Similarly, Carozzi et al. (2020) find that the scheme failed to trigger the supply of new housing in the Greater London Area (GLA), which ultimately led to an increase in the prices.

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<sup>6</sup>The focus of Agarwal et al. (2021) is Home Builders Bonus (HBB) scheme that was introduced in New South Wales in July, 2020. The HBB offered a stamp-duty exemption to purchasers up to AUS\$600,000, representing a total saving of up to AUS\$22,490.

<sup>7</sup>The HTB scheme in the UK is not exactly the same as in Ireland. For more information, please see here <https://www.gov.uk/affordable-home-ownership-schemes>. Accessed on: 25th May, 2023.

## 3 Policy Context, Conceptual Framework and Empirical Challenges

### 3.1 Macroprudential mortgage measures in Ireland

Macroprudential mortgage measures in Ireland were introduced in February 2015. The aims of these limits were twofold: first, ensuring resilience of borrowers and banks to adverse economic shocks; second, minimising the pro-cyclical dynamics between house prices and mortgage credit that may lead build-up of adverse economic effects at excessive levels. Specifically, limits are imposed on two ratios; the Loan to Income (LTI) and Loan to Value (LTV) at mortgage origination that determine the credit availability as minimum of the two resulting amounts. Moreover, the prescription of these limits is different for first time buyers (FTBs), the second and subsequent buyers (SSBs), and the buy to let buyers (BTL) respectively.

Initially, for FTBs, a flat LTV was fixed at 90% for properties valued under €220,000, while a ratio of 80% was imposed for house prices above this threshold. However, at the start of January 2017, the LTV ratio for all FTBs was relaxed to 90% irrespective of the property purchase value. With regards to the SSBs, the LTV ratio has been maintained at 80%, while for BTLs the ratio is set at 70%. In terms of the LTI, mortgage availability was determined by 3.5 times of the gross annual income across the three types of buyers respectively. Since 2015, a system of proportionate allowances has been in place, which has meant that a certain proportion of lending can take place above each of these limits, to allow for lender discretion to take idiosyncratic borrower characteristics into account.

To illustrate how these measures work in practice, imagine a FTB 'A' with gross annual income of €100,000 purchasing a property valued at €400,000. As per the LTV limit, buyer 'A' is entitled to mortgage credit up to 90% of the house value bringing the mortgage amount to €360,000. However, the LTI ratio allows credit only up to 3.5 times of the gross annual income. Hence, in the case of FTB 'A', a mortgage of €350,000 shall be available, given that the minimum of the two allowable credit amounts binds the final available credit.

The Central Bank's first mortgage measures framework review<sup>8</sup>. was concluded in October 2022. Under the revised framework in place since January 2023, the LTI limit has moved from 3.5 times to 4 times of the gross annual income for FTBs, with the existing LTV

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<sup>8</sup>For more details, please refer to Mortgage Measures of the Central Bank of Ireland, available here: <https://www.centralbank.ie/financial-system/financial-stability/macro-prudential-policy/mortgage-measures>. Accessed on: 25th May, 2023.

unchanged at 90%. For SSBs, the LTV ratio has now been revised from 80% to 90%, while this remains unchanged at 70% for BTL buyers. The LTI ratio for SSBs is maintained at 3.5 times of the gross annual income.

## 3.2 Help to Buy in Ireland

Help to Buy (HTB) was introduced in July 2016 as part of the Rebuilding Ireland Action Plan.<sup>9</sup> The scheme came into effect in January 2017 and was due to end in December 2019; however, it was renewed in subsequent years and is now set to continue until the end of 2023. In terms of the assistance, HTB offers FTBs a refund of income tax and Deposit Interest Retention Tax (DIRT) towards the house purchase, limited to a maximum of 5% of the house value and capped at €20,000.<sup>10</sup> In 2020, the July Jobs Stimulus package announced enhancement in the HTB benefit to counter the economic uncertainties posed by COVID-19 pandemic. This enhancement increased the relief effective immediately from the original 5% of the house value to 10%, with the maximum claim increasing from €20,000 to €30,000 in value.<sup>11</sup>

The housing assistance available under HTB has a number of qualification criteria. Primarily, the applicant must be a FTB, purchasing a new property or seeking the grant for a new self-build, with the house-value not exceeding €500,000.<sup>12</sup> Furthermore, the house in question should remain a principal dwelling for 5 years with the purchase facilitated through a Revenue Commissioners ("Revenue") approved contractor. Finally, the HTB beneficiary should have a mortgage taken out on the property through a qualifying lender with a minimum LTV ratio of 70%. Once all these conditions are met, the refund based on total income tax and DIRT paid in the last four years subject to the maximum HTB limit, is

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<sup>9</sup>Action Plan for Housing and Homelessness. Available here: [https://www.ipav.ie/sites/default/files/rebuilding\\_ireland\\_action\\_plan\\_for\\_housing\\_homelessness.pdf](https://www.ipav.ie/sites/default/files/rebuilding_ireland_action_plan_for_housing_homelessness.pdf). Accessed on 25th May, 2023.

<sup>10</sup>The upper limit of €20,000 implied a benefit of 5% up to €400,000 of the house price.

<sup>11</sup>There is not much evidence with regards to the timing of any clear indication by the government for the planned increase in HTB. Although, there is a possibility that this increase was not fully unanticipated as the Fine Gael election manifesto in Jan 2020 says "We will increase the maximum HTB refund to €30,000 for first-time buyers for new or self-build properties valued at up to €500,000." The Fianna Fáil manifesto is vaguer, but says they will increase funding. However, this announcement was not in popular news before it came into effect.

<sup>12</sup>In the earlier part of the scheme, for properties purchased between 19th July 2016 up to 31st December 2017, the eligibility criterion for house price was capped at €600,000 before it was reduced to €500,000 in 2017.

provided to the claimant. This can then be used towards the total downpayment required for the house purchase. By the end of 2021, around 31,000 HTB claims were approved, with the total value of claims recorded just under €560 million ([Revenue and Customs, 2021](#)).

TABLE 1. Help to Buy Annual Approved Claims (2017-2021)

Year	Approved Claims
2017	5,321
2018	5,007
2019	6,646
2020	6,163
2021	7,826
<b>Total</b>	<b>30,963</b>

Source: Revenue Help to Buy (HTB) annual statistics

Table 1 provides an intertemporal distribution of approved HTB claims from 2017 to 2021, whereby an increase in HTB claims in post-enhancement period is noted.

### 3.3 Conceptual framework for borrowers’ reaction to policy enhancement

We use the unexpected nature of the HTB policy change in 2020 to set up a quasi-experimental design for this assessment. This facilitates a comparison of key outcomes of interest across the HTB buyers against a representative counterfactual between the post and pre-policy enhancement periods. Theoretically, we foresee three possible transmission channels that may affect the liquidity, equity and asset position of HTB eligible buyers.

To illustrate these transmission channels, let us assume an HTB eligible buyer ‘A’ purchasing a house valued at €400,000. Further, let us assume that a mortgage of €360,000, representing the LTV ratio of 90% is drawn from a qualified lender to purchase the house. As it stands, a downpayment of €40,000 shall be required to complete the house purchase. Assuming that the contract for this house was signed before the policy enhancement was announced, HTB qualification would provide buyer ‘A’ with a refund of €20,000 towards the total downpayment.<sup>13</sup> This would imply a downpayment of €20,000 to be paid out-of-pocket in order to complete the house purchase. Now, consider buyer ‘B’, who is very similar to buyer ‘A’ in terms of house purchase value and loan amount, the only difference being that buyer ‘B’ signs the contract after the policy change was

<sup>13</sup> Assuming that buyer ‘A’ has contributed enough Income Tax or DIRT to avail the full support provided by HTB.

announced in July 2020. Given the enhancement in the HTB benefit, buyer 'B' qualifies for €30,000 refund from HTB,<sup>14</sup> bringing a downward shift in the out-of-pocket downpayment constraint from €20,000 to €10,000 to complete the house purchase. Overall, the policy change reflects a €10,000 difference in the required out-of-pocket downpayments between buyer A and B respectively.

From the example illustrated above, we can list three potential channels of transmission of this additional HTB benefit, which are as follows:

***Transmission Channel 1: Liquidity***

Borrower B can reduce her out-of-pocket downpayment by €10,000, without any change in the loan amount or the value of the house purchased. We refer to this as full absorption of the subsidy. In this instance, the borrower's liquidity position improves by the value of the €10,000 that is retained.

***Transmission Channel 2: Equity***

It may well occur that buyer 'B', instead of fully absorbing the additional HTB benefit towards enhanced liquidity, decides to continue with the initial planned out-of-pocket downpayment value of €20,000, thereby using the additional HTB claim of €10,000 in full to increase the total downpayment from €40,000 to €50,000. Here, the assumption that buyer 'B' does not change the house price (keeping the asset position unchanged at €400,000) implies a downward adjustment to the loan amount, such that the required mortgage reduces from €360,000 to €350,000. In this case, the LTV ratio that reduces from 90% to 87.5%.

***Transmission Channel 3: Purchase price***

Keeping the same liquidity position by maintaining the pre-committed out-of-pocket downpayment of €20,000 and an unchanged loan amount of €360,000, buyer 'B' could potentially use the additional HTB benefit of €10,000 to leverage a larger downpayment in the purchase of a more expensive property. This response is available only to buyers with headroom below the maximum property value threshold. This improvement in asset position simultaneously improves the equity position of the buyer because the purchase of a more expensive house remains independent of the mortgage size, demonstrated by the reduction in LTV ratio from 90% to 87.8%.

The purchase price can be boosted even further if the borrower keeps the LTV ratio at 90% and increases the loan amount to facilitate a more expensive purchase. Given that

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<sup>14</sup> Assuming that buyer 'B' has also contributed enough Income Tax or DIRT to avail the full support provided by HTB.

buyer 'B' now has a total downpayment of €50,000 (€30,000 from HTB and €20,000 from out of pocket), the availability of loan amount at LTV ratio of 90% increases from €360,000 to €450,000 allowing the house price affordability to as high as €500,000. However, the availability of additional loan amount is also subject to the LTI ratio of buyer 'B' irrespective of a qualifying LTV ratio of 90%. For example, the assumed loan amount of €450,000 shall only be available to buyer 'B' if the gross annual income is at least €128,572.

Additionally, there could be a mix of each of these transmission channels. For example, buyer 'B' might improve the immediate liquidity position (transmission channel 1) by absorbing some part of the enhanced benefit, while using the remainder to improve the equity or asset position through reduction in the loan amount (transmission channel 2) or by purchasing a more expensive house (transmission channel 3). We rely on our *DiD* estimates to isolate each of these transmission channels.

### **3.4 Empirical identification: difference-in-difference**

We aim to estimate the causal effect of government housing assistance on borrowers' liquidity, debt, equity and house price. The enhancement in HTB in July 2020 is the event we use for quasi-experimental design, as it creates exogenous variation in the generosity of assistance available to those using the scheme. We therefore use the increased assistance payment available for participants after versus before the policy change as our treatment event. A naïve comparison of outcomes of interest among participating borrowers either side of July 2020 would suffer from classic concerns of micro-econometric research: rather than driven by the policy itself, the changes may have been driven by other confounding forces that themselves vary either side of the July 2020 policy change, such as changing economic circumstances, or changes in the composition of borrowers purchasing housing.

To address these classic concerns, our identification involves estimating the differences between policy participants (treated) and non-participants (control) across the two periods (after and before the July 2020 policy enhancement). The comparison between participants and non-participants ensures that any difference observed in the either side of July 2020 is not attributable to broader changes in the economy that may have coincided with the policy change, subject to a range of standard assumptions. Like many studies in the mortgage market, we do not avail of panel data, but rather observe distinct mortgage transactions in each of our four groups (pre-treated, post-treated, pre-control, post-control).

When using a separate, unaffected group as a control group, *DiD* analysis must always ensure that the control group represents a reasonable counterfactual for the treated: changes observed in the control group after the policy introduction are a reasonable approximation for what would have happened to the treated in the absence of policy change. This assumption is typically tested by observing parallel trends in the pre-policy

period: the treated and control groups do not need to be observably identical, but they do need to have been evolving along the same trend during the pre-period.

In order to deal with this challenge, we impose certain restrictions on the choice of our control group to facilitate reasonable comparison with the treatment. Specifically, we restrict the control group to include only FTBs and where the value of house is less than or equal to €500,000- similar to the HTB treatment cohort. Restricting the control group to include only FTBs ensures homogeneity with the treatment cohort because the same set of macroprudential mortgage measures govern the credit availability for the control and treatment groups.<sup>15</sup> Additionally, imposing a house value restriction of €500,000 would in part capture similar purchasing power between the treatment and control, and restrict the regression sample to a common segment of the housing market. As a final step, to achieve further comparability, we conduct matching between the treatment and control groups, using exhaustive set of observables in the Monitoring Template Data (MTD), to allow the assessment within the region of common support for the main analysis. In essence, when imposing these restrictions, we finish by comparing those purchasing newly built housing with a minimum of 70% LTV ratio (eligible for HTB) with those purchasing any property-old or new, with no minimum LTV ratio requirement (ineligible for HTB) within a common market segment.

Having imposed the aforementioned restrictions on the choice of control group, we conduct a visual check to validate the parallel trends assumption. These are presented in Figure 1, where we provide trends for the treatment (navy) and control (maroon) groups across the quarterly average values of the key outcomes,<sup>16</sup> out-of-pocket downpayments,<sup>17</sup> LTV ratio, total loan amount, and collateral value (house price). The key outcomes before HTB enhancement (red vertical line) for the two groups seem to follow a very similar/parallel trend across all four sets of graphs, with the intertemporal variation in

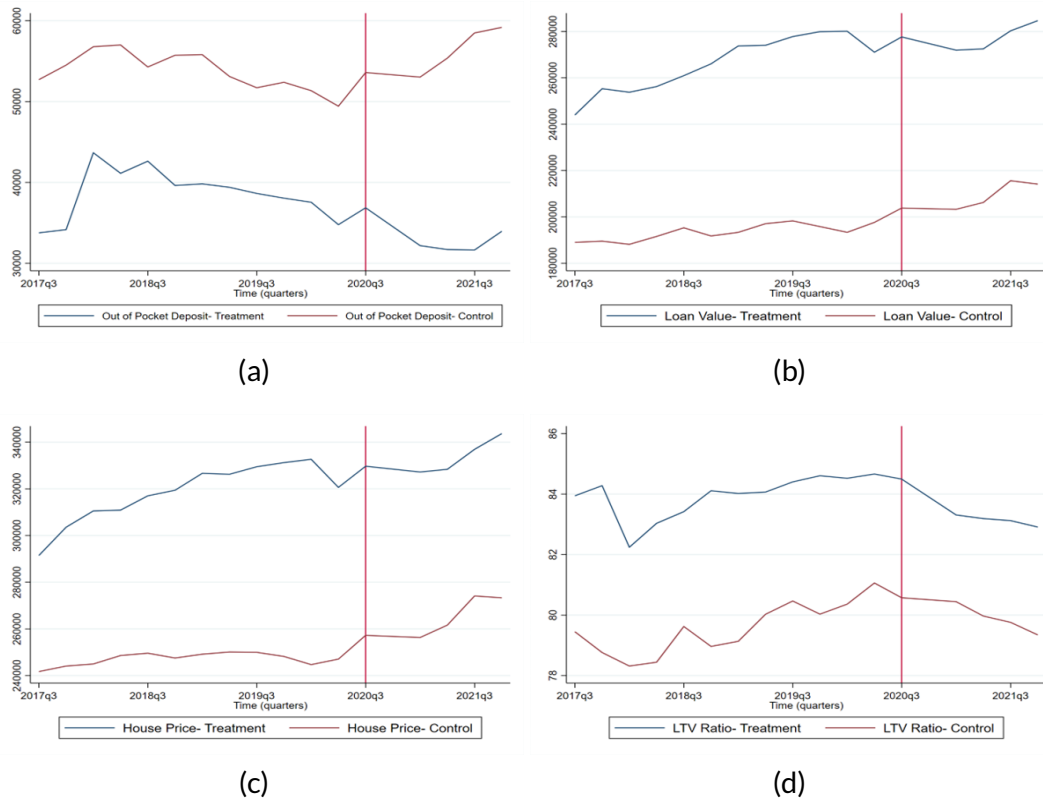
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<sup>15</sup>The Central Bank of Ireland mortgage measures for the FTBs in the period of analysis prescribed credit availability to a maximum of 3.5 times of the total income ( $LTI \leq 3.5$ ) or 90% of the house value ( $LTV \leq 90\%$ ), whichever is minimum.

<sup>16</sup>We capture existence of transmission channel 1 (liquidity) by assessing the out of pocket downpayments, transmission channel 2 (equity) by assessing total loan amounts and LTV, and transmission channel 3 (asset position) using total collateral value (house price).

<sup>17</sup>The parallel trends assumption is tested for the out of pocket downpayments derived as the difference between total downpayment and the HTB claim amount (original MTD values as well as the imputed values). For details on the rationale for imputation and empirical methods use, kindly refer to sub-section 'Measurement Challenges and Data Manipulation' and sub-section 'Methodology'.

FIGURE 1. Parallel trends assumption (a) Out of pocket downpayments (b) Total loan amount (c) Collateral value (House price) (d) LTV ratio



the differences between the two groups appearing economically negligible. This confirms the underlying parallel trends assumption and re-enforces confidence in the choice of our control group before a formal DiD estimation is employed.

## 4 Data

We conduct our analysis on the Monitoring Template Data (MTD) collected every six months by the Central Bank of Ireland. MTD is a detailed cross-section of mortgages issued by the eight lending institutions required to submit granular data to ensure compliance with the macroprudential mortgage measures. The submission group includes five banks and three non-banks. The dataset holds rich information on loan characteristics such as the loan size, loan-term, interest rate, total deposit, LTI and LTV as well as borrower characteristics such as total income, age and occupational status. In addition to these, MTD also provides other relevant information such as the collateral value and location (county), buyer status (first time buyer and second or subsequent buyer), property type, HTB status and associated relief. Our analysis considers three years of first-time buyer mortgage data, beginning from 2019 up to the end of 2021. With the HTB enhancement coming into



effect in July 2020, we split the pre and post-policy periods evenly around the enhancement announcement date, such that there are 18 months in each period.<sup>18</sup>

## 4.1 Measurement challenges and data manipulation

One of the core empirical challenges here is the identification of HTB buyers and the associated monetary value of the claim. The MTD used in this research provides an indicator for HTB; however, discrepancies exist between the number of claimants visible in MTD and the actual HTB statistics from the Revenue (shown in Table 1). A possible explanation for this mismatch across MTD and Revenue is that some financial institutions in MTD do not record HTB information, while others only capture this information during the time of mortgage application but not at the time of drawdown.

To mitigate this missing information in MTD, we use the information on the house value, loan amount, buyer status and the nature of the house as conditions to trace the eligibility criteria for the scheme and construct our own HTB flag. Specifically, we enforce all of the following eligibility conditions for a buyer to be assigned within the HTB cohort: being an FTB, purchasing a new house of value less than or equal to €500,000, to be used as a principle dwelling, and with an LTV ratio of 70% or more. Given the popularity and non-conditionality of HTB in Ireland, we assume that a buyer conforming to all of the above eligibility requirements would avail of the benefit. We believe that it is very unlikely for a buyer to meet all the eligibility conditions and leave money on the table by not applying to the scheme. We draw support for this approach by comparing the resulting HTB flag constructed from MTD (column 3) with the actual HTB claims data available from Revenue (column 4) in Table 2. The constructed HTB flag from MTD captures around 91% of the actual HTB claims reported by the Revenue. In comparison, the original MTD information on HTB traces only 54% of the total claims.

Although we draw confidence in this approach, we acknowledge the uncertainty associated with our constructed indicator. Therefore, in addition to our main analysis, we conduct a robustness check using the original HTB identifier in the MTD, while simultaneously disregarding buyers who despite being eligible are recorded as a non-HTB buyer in the MTD.

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<sup>18</sup>In our baseline model, we exclude the first six months from the post-policy sample beginning from August to December 2020, leaving 12 months of sample in our post-policy enhancement period beginning from January 2021. The rationale for this exclusion is explained in detailed in sub-section ‘Measurement Challenges and Data Manipulation’.

TABLE 2. Help to Buy Approved claims-original MTD, constructed HTB flag and actual claims from Revenue (2019-2021)

Year	HTB Claims (Original MTD)	HTB Claims (MTD eligibility flag)	HTB Claims (Original Claims from Revenue)
2019	3,007	6,307	6,646
2020	3,537	5,680	6,163
2021	4,528	6,748	7,826
<b>Total</b>	<b>11,072</b> (54%)	<b>18,735</b> (91%)	<b>20,635</b> (100%)

**Source:** Revenue Help to Buy (HTB) Incentive annual statistics and Monitoring Templates Data from Central Bank of Ireland

Imposing HTB eligibility checks allows us to resolve the issue of missing information in the MTD; however, we still face the challenge of missing data on the nominal euro value of HTB claims for these eligible, yet unidentified HTB buyers in the MTD. The information on HTB claims is crucial because the total out of pocket downpayments used for the assessment of transmission channel 1 (liquidity position of borrower) is estimated as the difference between the total FTB downpayment and the HTB assistance. As a solution, we rely on the original distribution of HTB values to impute missing HTB claims. We follow a multiple (stochastic) imputation (MI) technique to impute HTB values where the data is unavailable/missing in the MTD, despite their eligibility into the scheme. By using the MI technique to address the missing values for unidentified HTB claims, we are able to minimise this data limitation. The section on methodology describes the imputation method in detail while the performance of this method, based on post-imputation diagnostics is discussed in Appendix B.

Finally, the last empirical challenge here relates to the timing of the policy change. HTB enhancement was announced on 23rd July, 2020. All housing contracts signed on or after this date were eligible for the enhanced HTB claim. Hence, it would be ideal to consider the period after this date as the post-policy enhancement period with the allocation of FTBs to the pre and post-policy periods as per this date. However, the MTD does not record the signing date of the home purchase contract, but rather only captures the date of mortgage drawdown for the FTBs. Here, relying on the drawdown date to allocate buyers into pre and post-policy enhancement periods may not be precise, given that a home purchase contract may have been signed much before the date of drawdown. For example, the loan drawdown date of 25th July, 2020 for buyer 'A' would suggest the allocation into post-policy enhancement period; however, buyer 'A' may have signed the contract on 20th July, 2020 making him truly a pre-policy enhancement buyer.

As a solution, we disregard observations with mortgage drawdowns in the first six months of the policy enhancement period (August to December 2020) and decide the post-policy enhancement period beginning from January 2021 after a six-month gap from the date of policy introduction, while the pre-policy enhancement period from January 2019 to July 2020. The rationale for dropping initial six months of data is based on the strict assumption that all mortgage drawdowns captured in our post-policy enhancement period (beginning January 2021) must have secured the house contract when the enhanced HTB was effective. Exclusion of the cases with mortgage drawdown date falling in the first six months of the policy change, allows us to address (in an extremely conservative fashion) the ambiguity associated with cases that may ascribe to the earlier version of the scheme. Hence, we deem all buyers with mortgage drawdowns in 2021 as correctly assigned to the enhanced HTB scheme, thus minimising any uncertainties associated with the qualification of buyers into the old versus the new HTB scheme.

Removing the mortgage sample for the first six months of the policy enhancement also addresses the issue of self-selection into the scheme. This may have arisen because although the prospect of a change in HTB was not particularly prominent in public news, it was not entirely unexpected. As a consequence, some buyers may have delayed their decision to sign the contract only after July 2020 allowing self-selection to avail the additional HTB benefit.

## 4.2 Descriptive statistics

In Table 3, we report descriptive statistics for key mortgage and borrower characteristics for treatment and control FTBs across the pre and post-policy enhancement periods. The mean values suggest a general increase in out of pocket downpayments, collateral value, loan size and total household income from pre to post-enhancement period. However, characteristics such as LTV, LTI, deposits used as gifts, and borrower age remain alike across the two periods with property size being the only exception, suggesting an average decline during the post-policy enhancement period.

The summary statistics for loan and borrower characteristics are further disaggregated across the treatment and control groups respectively, as shown in Table 4. In general, out of pocket downpayments and gifts used as deposits across the control group exceed in both pre and post-enhancement periods, with the differential being higher in magnitude in post-enhancement period. There are overall higher mean values noted for characteristics such as collateral value, loan size and LTV and LTI across the treatment group with similar differential in the pre and post-policy enhancement periods.

In terms of borrower characteristics such as age and total household income, we find that on average, FTBs in the control group are older and have lower total household income as

TABLE 3. Descriptive Statistics: Sample FTBs Pre and Post Periods (2019-2021)

Variables	Pre (Jan'19-July'20) N=29,092	Post (2021) N=21,378
Out of Pocket Downpayment (€)	50,026.8	51,664.8
Collateral Value (€)	273,429.2	288,910.4
Loan Size (€)	221,237.5	232,030.3
LTV	81.5	80.9
LTI	3.1	3.1
Deposit from Gifts (€)	15,863.4	15,271.5
Age of Primary Borrower	34.5	34.6
Total Household Gross Income (€)	72,787.8	74,841.7
Property Size (sq. feet)	1,515.7	1,396.3

**Source:** Monitoring Templates Data from Central Bank of Ireland

TABLE 4. Descriptive Statistics: Treatment and Control FTBs in Pre and Post Periods (2019-2021)

Variables	Control Pre N=20,091	Control Post N=14,630	Treatment Pre N=9,001	Treatment Post N=6,748
Out of Pocket Downpayment (€)	52,402.4	56,801.6	44,722.0	40,511.1
Collateral Value (€)	248,722.8	267,238.7	328,576.1	335,895.7
Loan Size (€)	196,332.5	210,452.7	276,827.8	278,811.8
LTV	80.2	79.8	84.4	83.1
LTI	3.0	3.1	3.3	3.3
Deposit from Gifts (€)	16,543.4	16,631.5	14,306.5	12,396.9
Age of Primary Borrower	34.8	34.9	33.8	34.0
Total Household Gross Income (€)	67,003.5	69,492.4	85,698.8	86,439.3
Property Size (sq. feet)	1,438.4	1,267.2	1,688.6	1,676.2

**Source:** Monitoring Templates Data from Central Bank of Ireland

compared to the treatment group; the magnitude of the differential being similar between the pre and post-enhancement periods. Finally, the statistics suggest that on average, property sizes are larger across the treatment group with the differential between the two groups being higher in post-enhancement periods.

With regards to the composition of FTBs in the treatment group pre and post the policy change, we find significant but economically very small differences across total income and age of primary borrower, while absence of any statistically significant differences across the LTI and property size.<sup>19</sup> This is suggestive that entry of households with very different characteristics (for example, income or age) was not a consequence of the change made in the scheme.

Our analysis also takes into account the variation across income groups in our sample. We divide our sample into income quintiles to conduct heterogeneous analysis across FTBs designated as control and treatment groups in the pre and post-enhancement period. Table 5 shows the distribution of the mean income across our sample of treatment and control FTBs. With average income of just under €115,000, income group five enjoys very high purchasing power.<sup>20</sup>

TABLE 5. Descriptive statistics across the Income distribution (2019-2021)

Income Groups	Sample Size (N)	Mean	Min.	Max.
Income Group 1	10,092	41,569	17,110	51,249
Income Group 2	10,092	57,655	51,250	63,882
Income Group 3	10,092	70,228	63,883	76,886
Income Group 4	10,092	84,691	76,888	93,844
Income Group 5	10,092	114,118	93,845	706,500

**Source:** Monitoring Templates Data from Central Bank of Ireland

Finally, we look at the distribution of the euro value of HTB claims across each income group in the pre and post-policy enhancement sample in Table 6.<sup>21</sup> Given that the HTB

<sup>19</sup>Difference of means t-test for total household gross income in the treatment group across the pre and post policy period is only €740 (significant at 10% level). The corresponding differences for LTI, age of primary borrower and property size are 0.012 percentage points (statistically insignificant), -0.21 years (significant at 1% level), and 12.4 sq.feet (statistically insignificant) respectively.

<sup>20</sup>Given that mortgage measures in Ireland prescribe LTI ratio of 3.5 in the period of analysis, the average size of credit for the fifth income group is over €400,000, which when combined with the LTV restrictions would allow them to buy a house of €440,000.

<sup>21</sup>The values in Table 6 include only the HTB claims available in the MTD and not the imputed values.

TABLE 6. HTB Claim distribution for the Treatment FTBs across Income Groups in Pre and Post Periods (2019-2021)

Income Groups	HTB Claim Pre-policy change	HTB Claim Post-policy change	Difference
Income Group 1	9,362	15,366	6,004
Income Group 2	10,401	19,118	8,717
Income Group 3	12,144	21,872	9,728
Income Group 4	14,080	25,606	11,526
Income Group 5	16,231	27,922	11,691

**Source:** Monitoring Templates Data from Central Bank of Ireland

benefit is conditional on the income tax and DIRT of the buyer as well as the house-price, it is reasonable that the value of HTB claims across the lower income FTBs is smaller by virtue of low tax-benefit accrued in previous four years of the house purchase as well as lower house purchase prices across income group one.<sup>22</sup> Further, we note that the enhancement leads to much larger increase in the total claims received by higher income groups- almost of the size of maximum policy allowance (€10,000); however, this is relatively smaller for lower income groups- again due to their lower income tax/DIRT contribution in previous years and lower house purchase price.

## 5 Methodology

We first describe the multiple (stochastic) imputation (MI) technique to impute values where the data on HTB status is not recorded in the MTD, despite the household being an eligible recipient. The MI technique, being stochastic in nature, addresses the issue of reduced variability associated with a linear deterministic imputation model that in turn depends upon the conditional means. The residual term, randomly drawn from a normal distribution (zero mean and constant variation equal to the residual variance), is added back to the scores that are predicted from the imputation regression model, thereby preserving the lost variation in imputed values.<sup>23</sup> Furthermore, attributing to the iterative approach behind MI, the uncertainty of the predicted values against the true value is also minimised by imputation of the values multiple times ([Eddings and Marchenko, 2012](#)).

<sup>22</sup>The average house price paid by income group one is €181,119 and €200,818 across the control and treatment group respectively. Compared to this, FTBs in income group five pay €367,022 and €397,150 across the control and treatment group respectively.

<sup>23</sup>Multiple Imputation on Stata. Retrieved from UCLA Advanced Research Computing Statistical Methods and Data Analytics

In order to carry out the MI technique, a regression model is set out to predict missing values of HTB amounts from the available values of HTB amounts observed on the MTD. We use a simple model (Equation 1) with ten replications to impute missing HTB values based on the total income and house price, given that these are the two most important predictors for the claims.<sup>24</sup> Furthermore, we control for time and county dummies to capture any seasonality or geographical variation in our model, as shown by  $\beta_4$  and  $\beta_5$  respectively.

$$HTB_i = \alpha_i + \beta_1(Income)_i + \beta_2(Income)_i^2 + \beta_3(HousePrice)_i + \beta_4 + \beta_5 + \epsilon_i \quad (1)$$

Since the distribution of HTB reliefs is not normally distributed and follows a bimodal pattern around the two peak values (€20,000 and €30,000 in the pre and post-enhancement respectively),<sup>25</sup> we follow the predictive mean matching (PMM) approach suggested by [Eddings and Marchenko \(2012\)](#). PMM approach integrates the nearest neighbour imputation approach with linear regression such that it first draws linear predictions based on regression and then uses these predictions as a distance measure to create a set of nearest neighbours ([Little, 1988](#); [Rubin, 1986](#); [StataCorp, 2021](#)). As a final step, PMM randomly draws values from this matched set such that the distribution of original values is preserved in the imputed data, providing this technique an added layer of robustness compared to a simple parametric linear regression approach. In our model, we specify five nearest neighbours as donors for imputations.

## 5.1 Estimation

The main analysis focussing on the three transmission channels uses difference-in-difference estimation, as shown in Equation 2. The dependent variable  $Y$  captures

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<sup>24</sup>The maximum relief from HTB is defined as 5% and 10% of the house price in pre and post-enhancement periods respectively. Moreover, the relief is determined by the refund of income tax and deposit interest retention tax (DIRT), which is captured by total income in the regression model in Equation 1.

<sup>25</sup>The average house prices paid by treatment group during the pre and post-policy enhancement are €328,576 and €335,895 respectively (see Table 4). Limiting the back-of-the-envelope calculation of HTB relief only on the house prices, the average HTB relief associated with 5% of the house-price in the pre-policy enhancement period equates to €16,428, while the 10% relief in the post-policy enhancement period equates to €33,589 (capped at €30,000), thus leading to bimodal pattern in HTB assistance around €20,000 and €30,000. Here, we base our back-of-the-envelope calculation for investigating the bimodal distribution of HTB reliefs only on the house price because we do not observe income tax information or DIRT for FTBs in MTD.

the variables associated with each of them (i) liquidity through out-of-pocket total downpayments (difference between total downpayment and HTB relief), (ii) equity through LTV ratio and loan size, and (iii) purchase prices through reported collateral values.

$$Y_i = \alpha_i + \beta_i(Post) + \gamma_i(Treatment) + \delta_i(Post * Treat) + (Controls)_i\theta + \epsilon_i \quad (2)$$

The right hand side variables include dummy variables ‘*Post*’ capturing the post-policy enhancement period and ‘*Treatment*’ capturing the treated FTBs. The key coefficient of interest is ‘ $\delta$ ’ capturing the difference-in-difference (‘*DiD*’ hereon) estimate that represents the change in ‘*Y*’ between the treatment and control FTBs across the post and pre-policy enhancement periods. The vector ‘*Controls*’ consists control variables across borrower and loan characteristics. These include borrower age, age squared, occupation, banking institution dummy, property size and LTI. All regressions also control for the loan size, barring the estimation where ‘*Y*’ on the left side of the equation is LTV and loan size itself, whereby the regression controls for house price instead. The regression also includes year dummy to control for the time trends as well as county dummies to capture geographical variation in collateral values for the estimation of transmission channel 3.

Finally, as discussed in the previous section, we conduct the main analysis on a region of common support derived from matching the treatment and control groups to alleviate any remaining concerns regarding the comparability of the control and treatment group. The matching is conducted on individual factors such as borrower age, occupation, total income, banking institution, interest rate type and sales channel using kernel type matching algorithm.<sup>26</sup>

## 6 Results

In the sub-sections below, we present results from the DiD estimation for each of the transmission channels in question. We also present findings for the HTB-eligible FTB response towards the use of gifts for downpayments post-policy enhancement. Lastly, in section 7, we also present heterogeneity in the response of HTB buyers across the five income groups for each of the transmission channels respectively.

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<sup>26</sup>Choice of matching variables (*X*) is made on the assumption that the conditional distribution of *X*, given  $b(X)$  (balancing scores being functions of relevant observed variables *X*), is independent of assignment into the treatment group.



## 6.1 Transmission Channel 1- Liquidity Response

Table 7 reports headline results for the liquidity transmission channel, where we model out of pocket downpayments, in line with Equation 2 presented in the methodological description.<sup>27</sup> Columns 1-3 show different regression specifications such that the model is iteratively controlled for borrower characteristics and bank level dummies in specifications 2 and 3 respectively.

TABLE 7. Transmission Channel 1- Liquidity Response of FTBs to HTB enhancement

Variables	(1) OOP Downpayment	(2) OOP Downpayment	(3) OOP Downpayment
Post	4,145.41*** (588.22)	4,528.86*** (588.39)	3,989.22*** (597.17)
Treatment	-14,232.27*** (475.93)	-14,021.01*** (475.98)	-13,818.56*** (474.02)
DiD	-10,259.17*** (711.03)	-10,183.95*** (710.72)	-9,515.01*** (707.55)
Constant	53,323.93*** (1,571.15)	18,294.15*** (6,475.41)	20,930.56*** (6,432.81)
Observations	50,362	50,362	50,362
Year Dummy	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes
Borr. Characteristics	No	Yes	Yes
Bank Dummies	No	No	Yes

Multiple Imputation regressions with robust SE in parenthesis \*\*\* p<0.01 \*\* p<0.05\* p<0.1. Post indicates all loans originating after 31st December, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

The positive and significant coefficients on 'Post' suggest that on average, out of pocket downpayments were higher in the post policy-enhancement period as compared to the pre-policy enhancement period, having controlled for time-trends in the regression model. These are consistent with the decade-long increase in house prices in Ireland that began in 2013 and continued through the pandemic period. With regards to the coefficient on 'Treatment', the negative coefficient suggesting lower out of pocket downpayments for the HTB eligible FTBs is also intuitive, given that eligible FTBs in the treatment group receive HTB claims in the form of housing assistance grant in both periods, thus reducing the required out of pocket downpayments.

<sup>27</sup>The results for liquidity transmission channel are estimated using Multiple (stochastic) Imputation technique, as discussed in Section 5 earlier. The dependent variable 'out of pocket downpayment' is derived as the difference between total downpayment and HTB claims- both original values available in the data-set and imputed. Since the dependent variable relies on an imputed value, the model is run iteratively using the MI method.

In terms of the main result, the ‘*DiD*’ estimates suggest a significant fall in the out of pocket downpayment in the range of €9,400–€10,300. Interestingly, this decline is almost equal to the €10,000 difference in the maximum allowable benefit between the pre-enhancement HTB scheme (capped at €20,000) versus the post-enhancement HTB scheme (capped at €30,000). This result confirms the existence of transmission channel 1.

## 6.2 Transmission Channel 2- Equity and Debt

Table 8 presents headline results for the equity transmission channel. We first model the LTV ratio to capture FTB equity position as a response to HTB enhancement. Once again, we vary regression specifications in columns 1-3 such that borrower characteristics and bank level dummies are added to specifications 2 and 3 respectively.

TABLE 8. Transmission Channel 2- Equity Response of FTBs to HTB enhancement (LTV Ratios)

Variables	(1) LTV Ratio	(2) LTV Ratio	(3) LTV Ratio
Post	-1.05*** (0.16)	-1.12*** (0.16)	-0.94*** (0.16)
Treatment	-0.04 (0.12)	-0.11 (0.12)	-0.16 (0.12)
DiD	-0.21 (0.18)	-0.24 (0.18)	-0.39** (0.18)
Constant	68.12*** (0.45)	73.26*** (1.85)	72.47*** (1.84)
Observations	50,373	50,373	50,373
R-squared	0.12	0.13	0.14
Year Dummy	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes
Borr. Characteristics	No	Yes	Yes
Bank Dummies	No	No	Yes

Robust SE in parenthesis \*\*\* p<0.01 \*\* p<0.05\* p<0.1. Post indicates all loans originating after 31st December, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include property price, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

The coefficient on ‘*Post*’ is statistically significant; however, it suggests a fall of around 1 percentage point in the LTV ratio from the pre to post-policy enhancement period, having controlled for time-trends in the regression. However, we do not find any significant differential in the LTV ratios between the HTB-eligible ‘*Treatment*’ cohort versus the non-HTB eligible buyers. With respect to the key result, the coefficient on ‘*DiD*’ in the fully controlled regression model is statistically significant with a negative differential of around 0.4 percentage point. This suggests that on average, the equity position of HTB-eligible treatment buyers slightly improves relative to the non-eligible control group as a result of the policy enhancement. Although the ‘*DiD*’ coefficient is significant, it is sensitive to

different specifications; therefore, we rely on heterogeneous analysis to decipher fully the prevalence of this channel.

Next, we look at the debt-response of FTBs across the HTB-eligible and non-eligible cohort in the two policy periods. Similar to the previous empirical setup, we model the loan size across the three specifications adding borrower characteristics and bank level dummies, as shown in Table 9. The coefficient on ‘*Post*’ suggests absence of any significant differential in the FTB loan amounts between the pre and post-policy enhancement periods. Further, we find a positive and significant coefficient on ‘*Treatment*’, which suggests that on average, the loan amount drawn by HTB-eligible treatment FTBs is circa. €20,000 more as compared to the non-eligible control group.

TABLE 9. Transmission Channel 2- Indebtedness Response of FTBs to HTB enhancement (Loan Size)

Variables	(1) Loan Size	(2) Loan Size	(3) Loan Size
Post	-113.78 (480.15)	-264.82 (481.08)	319.44 (487.11)
Treatment	20,043.51*** (496.34)	19,904.64*** (495.71)	19,825.91*** (493.80)
DiD	-2,606.47*** (624.56)	-2,820.74*** (623.63)	-2,963.52*** (619.21)
Constant	-20,837.98*** (1,071.29)	-66,455.35*** (4,934.95)	-68,271.27*** (4,902.58)
Observations	50,373	50,373	50,373
R-squared	0.80	0.80	0.80
Year Dummy	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes
Borr. Characteristics	No	Yes	Yes
Bank Dummies	No	No	Yes

Robust SE in parenthesis \*\*\* p<0.01 \*\* p<0.05\* p<0.1. Post indicates all loans originating after 31st December, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include property price, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

Our ‘*DiD*’ has a negative coefficient of €2,800. This smaller effect size suggests that a modest equity effect co-exists with a larger liquidity transmission channel.

### 6.3 Transmission Channel 3- House Purchase Price

Table 10 presents headline results for transmission channel 3- change in purchase prices of FTBs. Once again, we vary regression specifications in columns 1-4 to include borrower characteristics, bank level dummies and collateral counties in specifications 2, 3 and 4 respectively. We find a positive and significant coefficient on ‘*Post*’ indicating increase in house purchase price by circa. €7,300 in the post-policy enhancement period, having controlled for time-trends in the regression. With regards to the differential across the

treatment and control groups, the positive and significant coefficient on ‘*Treatment*’ in the fully controlled model (specification 4) suggests that on average, HTB-eligible FTBs paid higher house price relative to non-HTB eligible FTBs, consistent with aggregate evidence on the higher value of newly built properties in Ireland.<sup>28</sup> However, the estimates on ‘*Treatment*’ are not robust and are sensitive to the inclusion of control variables.<sup>29</sup>

TABLE 10. Transmission Channel 3- Change in House Purchase Price of FTBs as a response to HTB enhancement

Variables	(1) House Price	(2) House Price	(3) House Price	(4) House Price
Post	4,204.83*** (588.31)	4,582.59*** (588.50)	3,995.61*** (597.22)	7,615.28*** (577.36)
Treatment	-1,618.44*** (479.44)	-1,397.24*** (479.48)	-1,208.16** (477.60)	5,688.71*** (498.30)
DiD	758.98 (713.78)	832.20 (713.24)	1,482.56** (710.23)	1,413.89** (700.49)
Constant	52,421.52*** (1,571.98)	15,757.29** (6,476.54)	18,468.57*** (6,433.28)	28,641.27*** (6,239.74)
Observations	50,373	50,373	50,373	50,373
R-squared	0.78	0.78	0.78	0.80
Year Dummy	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes
Borr. Characteristics	No	Yes	Yes	Yes
Bank Dummies	No	No	Yes	Yes
Collateral County	No	No	No	Yes

Robust SE in parenthesis \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Post indicates all loans originating after 31st December, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower. Collateral County controls for the county where the house is located.

In terms of the main results, estimates on ‘*DiD*’ in the fully controlled specification (specification 4) in Table 10 suggest a positive and significant impact of HTB enhancement, indicating that HTB-eligible FTBs, on average, pay an additional €1,500 as compared to the non-HTB eligible FTBs between the post and pre-policy enhancement periods. However, this result is again sensitive to the inclusion of control variables in different specifications.

<sup>28</sup>Source: CSO Table HPA03- Market-based Household Purchases of Residential Dwellings. Available here: <https://data.cso.ie/table/HPA03>. Accessed on: 25th May, 2023.

<sup>29</sup>Inclusion of collateral county dummy leads to reversal of sign on ‘*Treatment*’. This is intuitively correct and confirmed by descriptive statistics in Table 4, where the average collateral value is significantly higher across the treatment group as compared to the control (in both pre and post-policy enhancement periods). However, this direction of relationship remains uncaptured in regression specification 1-3 on account of not controlling for county specific dummies, thus failing to capture house-price variation by geography.

## 6.4 Change in Gifts used as deposits by FTBs as a response to HTB enhancement

Finally, we look at source of downpayments. Here, we focus on the change in gifts sought in the form of informal borrowings/transfers by FTBs to meet the downpayment requirements for mortgage.

In some cases, FTBs may try to meet the downpayment constraint by borrowing from family and friends towards the required minimum downpayment. Intuitively, the enhancement in HTB would enable cash-constrained FTBs to reduce their need for downpayment gifts. We confirm this by modelling gifts used as downpayments in Table 11.

TABLE 11. Change in Gifts used towards downpayments as a response to HTB enhancement

Variables	(1) Downpayment-Gift	(2) Downpayment-Gift	(3) Downpayment-Gift
Post	59.74 (439.20)	-283.30 (443.01)	4.10 (449.27)
Treatment	-979.66** (386.94)	-998.58*** (385.54)	-1,341.37*** (380.24)
DiD	-1,894.56*** (567.54)	-2,050.78*** (565.69)	-2,097.52*** (558.68)
Constant	2,689.86*** (957.49)	771.26 (3,891.86)	1,732.50 (3,864.85)
Observations	43,879	43,879	43,879
R-squared	0.02	0.03	0.04
Year Dummy	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes
Borr. Characteristics	No	Yes	Yes
Bank Dummies	No	No	Yes

Robust SE in parenthesis \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Post indicates all loans originating after 31st December, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

The coefficient on '*Treatment*' suggests that the HTB-eligible FTBs borrow circa. €1,364 less than the non-HTB eligible FTBs. In terms of the main results, the coefficient on '*DiD*' suggests that HTB-eligible FTBs reduce their use of gifts by around €2,000 relative to the non-HTB buyers in the post-policy enhancement period.

## 7 Heterogeneity across income

In this section, we explore the main-results by conducting heterogeneous analysis at the different levels of income. In sub-sections 7.1 to 7.4, we present findings for each transmission channel as well as response of FTBs using gifts as part of their downpayments.

## 7.1 Transmission Channel 1- Liquidity response across income quintiles

Here, we explore heterogeneity in incidence of the liquidity channel across the five income quintiles, summarised earlier in Table 5. The negative DiD estimates in Table 12 (significant at 1% level) suggests a fall in the out of pocket downpayments for HTB eligible FTBs across all income groups (relative to the control group between the post and pre-policy enhancement period). We observe the strongest liquidity effect across the second and the third income groups, followed by the fourth and the first, with the lowest effect noted in the fifth income group.

TABLE 12. Transmission Channel 1- Liquidity Response of FTBs to HTB enhancement (Heterogeneous Response)

Variables	(1)	(2)	(3)	(4)	(5)
	OOP Downpayment	OOP Downpayment	OOP Downpayment	OOP Downpayment	OOP Downpayment
Post	2,603.02* (1,384.47)	6,322.40*** (1,250.56)	4,084.70*** (1,246.86)	2,971.72** (1,289.44)	595.77 (1,330.62)
Treatment	-18,097.29*** (1,504.28)	-12,824.01*** (1,055.24)	-12,281.52*** (968.83)	-15,177.72*** (924.53)	-16,720.43*** (1,044.92)
DiD	-7,622.53*** (2,212.02)	-9,594.08*** (1,574.22)	-9,494.86*** (1,461.47)	-8,833.85*** (1,466.07)	-6,739.34*** (1,520.87)
Constant	-107.09 (12,109.04)	-5,922.57 (13,445.10)	6,625.47 (12,799.55)	44,194.32*** (16,669.35)	81,392.40*** (17,996.02)
Observations	10,078	10,075	10,066	10,071	10,072
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Multiple Imputation regressions with robust SE in parenthesis \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st December, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

The lowest decline in out of pocket downpayment within the fifth income group suggests potential existence of other transmission channels, whereby the HTB eligible FTBs in this group may have used only a small part of the HTB enhancement towards reduction in their out of pocket downpayment, while using the remainder to adjust their loan size or house purchase price. However, the same may not be true for the lowest income group despite a similar smaller reduction in out of pocket downpayments. Most likely, this small liquidity enhancement in the first income quintile is by virtue of low house-prices paid as well as likely low income tax amount accrued in the last four years (due to low gross total household income). We confirm this from the summary statistics shown in Table 6, such that the decline in the out of pocket downpayments across the first income quintile, as shown in Table 12, is similar to the change in the value of HTB claims, recorded as circa. €6,000. This reflects that there is full absorption of the HTB enhancement also within this group, but that the size of the change in maximum grant available is smaller due to the policy design

that limits HTB relief to house-price and income-tax paid in the last four years- *both being lower in income group one.*

## 7.2 Transmission Channel 2- Equity and Debt Response across income quintiles

In order to compare the relative heterogeneity in equity and debt response across different income groups, we run the fully controlled regression specification for LTV and loan size across the five income groups, as shown in Table 13 and Table 14 respectively.

TABLE 13. Transmission Channel 2- Net Equity Position of FTBs (LTV) as a response to HTB enhancement (Heterogeneous Response)

Variables	(1) LTV	(2) LTV	(3) LTV	(4) LTV	(5) LTV
Post	-0.73* (0.41)	-1.62*** (0.33)	-0.91*** (0.31)	-0.62** (0.30)	-0.25 (0.29)
Treatment	0.38 (0.53)	-0.60** (0.29)	-0.59** (0.24)	0.13 (0.21)	0.33 (0.21)
DiD	-0.16 (0.80)	-0.19 (0.45)	-0.40 (0.37)	-0.76** (0.34)	-1.03*** (0.32)
Constant	74.76*** (4.00)	82.31*** (3.91)	80.06*** (3.56)	73.18*** (3.80)	65.56*** (4.03)
Observations	10,080	10,077	10,069	10,072	10,075
R-squared	0.08	0.05	0.07	0.11	0.26
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st December 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include property price, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

Important heterogeneity is uncovered, with LTV reductions only estimated to be statistically significant in the top two income quintiles, and largest in the top quintile at minus one per cent.<sup>30</sup> The fall in LTV ratio for income group five could ensue from change in both the numerator- reduction in loan amount as well as the denominator- increase in the house price, leading to a reduction in their overall leverage position.

We explore this further by assessing the debt-response across income quintiles, as shown in Table 14. The largest negative coefficient in quintile five implies that FTBs in this top income group not only use some part of the surplus HTB benefit to improve their liquidity position (by reducing their out of pocket downpayments as seen in Table 12) but also use

<sup>30</sup>The results show a marginal improvement in the equity position of fourth income group as well, whereby the LTV ratio falls by 0.8 percentage points (Table 13).

some of the benefit to build positive equity in the house by reducing their loan amount (as seen in Table 14).

TABLE 14. Transmission Channel 2- Debt Response of FTBs to HTB enhancement (Heterogeneous Response)

Variables	(1) Loan Size	(2) Loan Size	(3) Loan Size	(4) Loan Size	(5) Loan Size
Post	700.57 (480.71)	-46.89 (287.40)	401.27 (311.11)	635.35 (443.67)	1,890.11* (985.70)
Treatment	12,363.61*** (962.55)	3,560.33*** (386.11)	2,782.93*** (366.90)	2,196.17*** (432.28)	5,985.28*** (847.16)
DiD	345.85 (1,340.59)	-40.03 (582.78)	-296.10 (522.32)	-1,217.11* (621.12)	-5,617.22*** (1,198.51)
Constant	-45,921.16*** (4,348.18)	-4,087.08 (2,740.96)	-1,222.09 (3,175.86)	-14,763.43*** (4,748.35)	-53,965.00*** (12,057.56)
Observations	10,080	10,077	10,069	10,072	10,075
R-squared	0.65	0.91	0.93	0.92	0.81
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st December 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include property price, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

The non-effects among lower-income borrowers can be explained by the relatively higher absorption through a greater reduction in their out of pocket downpayments (see Table 12), thus leaving little or no room for improvement in their equity position. Contrary to this, because the absorption of additional HTB claim within the fifth income group is relatively less, as reflected by a smaller reduction in the out of pocket downpayment (see Table 12), it is natural to expect that these FTBs used some of the additional HTB benefit to reduce their loan and build more housing equity in the process. Together with the previous findings on liquidity channel, the heterogeneous results now confirm a rebalancing of additional HTB benefit within the highest income group such that there exists a mix of both liquidity and equity channels.

### 7.3 Transmission channel 3- House Purchase Price

In Table 15, the coefficients on 'DiD' suggest again that the mix of transmission channels varies across the income distribution. The top quintile increases purchased prices by €4,200, with smaller but still significant effects in the fourth quintile.

The lack of an effect in the bottom three quintiles may be explained by the LTI constraint, which is more likely to impede lower income borrowers from engaging in accelerator-like behaviour. Further, more-binding downpayment constraints among lower-income



borrowers are likely to bias the response of these groups towards complete absorption of the enhanced subsidy through the liquidity channel.

TABLE 15. Transmission Channel 3- House Purchase Price of FTBs as a response to HTB enhancement (Heterogeneous Response)

Variables	(1) House Price	(2) House Price	(3) House Price	(4) House Price	(5) House Price
Post	7,276.93*** (1,256.93)	9,980.53*** (1,207.98)	6,989.34*** (1,228.95)	5,552.71*** (1,266.81)	3,677.57*** (1,309.71)
Treatment	5,772.82*** (1,639.78)	6,839.10*** (1,131.57)	6,032.37*** (1,031.73)	2,650.15*** (952.88)	2,104.14** (1,045.20)
DiD	-3,241.58 (2,453.06)	-444.76 (1,561.50)	686.44 (1,444.47)	2,784.58* (1,440.90)	4,214.38*** (1,496.64)
Constant	30,587.54*** (10,814.28)	267.51 (13,158.04)	6,035.76 (12,625.26)	50,188.39*** (16,668.51)	70,467.05*** (18,280.54)
Observations	10,080	10,077	10,069	10,072	10,075
R-squared	0.42	0.50	0.59	0.69	0.73
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes
Collateral Counties	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\*  $p < 0.01$  \*\*  $p < 0.05$  \*  $p < 0.1$ . Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st December 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\* Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower. Collateral County controls for the county where the house is located.

TABLE 16. Change in Gifts used towards downpayments as a response to HTB enhancement (Heterogeneous Response)

Variables	(1) Downpayment Gift	(2) Downpayment Gift	(3) Downpayment Gift	(4) Downpayment Gift	(5) Downpayment Gift
Post	39.86 (1,071.68)	648.13 (866.28)	550.73 (925.55)	-1,340.45 (1,006.66)	-1,709.85* (925.48)
Treatment	-6,490.64*** (1,318.30)	-589.80 (875.78)	-1,584.77** (788.92)	-2,109.70*** (774.88)	-99.90 (804.11)
DiD	-899.83 (1,905.41)	-3,026.70** (1,315.12)	-1,951.07 (1,196.70)	-817.68 (1,167.40)	-1,097.94 (1,076.93)
Constant	-14,383.59* (8,438.11)	-11,614.10 (7,243.97)	8,327.53 (8,414.64)	14,377.63 (8,877.66)	17,083.75** (8,425.29)
Observations	9,433	9,036	8,690	8,558	8,162
R-squared	0.05	0.04	0.03	0.03	0.04
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\*  $p < 0.01$  \*\*  $p < 0.05$  \*  $p < 0.1$ . Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st December 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\* Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

Together, with the findings on liquidity and equity (as discussed in Table 12, Table 13 and Table 14 respectively), we can now conclude that HTB enhancement translated into a mix of liquidity, equity and asset enhancement for FTBs in the fifth income quintile (and to a

lesser extent, the fourth). On the other hand, for income group one, two, and three, the HTB enhancement was primarily reflected towards only an increase in the liquidity position demonstrated by reduction in out of pocket downpayments only.

#### **7.4 Change in Gifts used as deposits across income quintiles**

Exploring the change in gifts used as part of downpayments across income quintiles (see Table 16), we find that the response is primarily within the second income group, suggesting a fall in gifts by circa. €2,900. This result indicates an additional improvement in the leverage position of low income FTBs such that the HTB enhancement enables them to avoid additional informal debt burdens (in cases where downpayment assistance is borrowed from, rather than received as a gift from, family members or friends) to meet the downpayment requirement.

### **8 Robustness Checks**

In the sub-sections below, we present robustness checks conducted to validate our main findings. Primarily, we conduct two robustness checks; first, using the original MTD identifier for HTB eligibility; and second, time analysis varying the choice of the post-policy enhancement period. Our main findings are robust to each of these robustness checks and the results are presented in Appendix C. For brevity, we present robustness checks for the heterogeneous analysis only, as our main findings on the transmission of HTB enhancement are sensitive to the income distribution.

#### **8.1 Using original MTD identifier for HTB eligibility**

As mentioned in sub-section 3.3 on empirical challenges, one of the core limitations that we face in the MTD is unavailability of an accurate HTB identifier. The original HTB identifier in the MTD captures only 54% of the actual HTB recipients reported by the Revenue statistics, as shown in Table 2. As a solution, we construct our own HTB flag for the main analysis by enforcing the pre-requisites on the house value, loan amount, buyer status-FTB or SSB and the nature of the house- PDH or Buy-to-let as conditions to trace the eligibility criteria for the scheme. Furthermore, we use multiple imputation for deducing HTB claims for FTBs that remain unidentified in MTD, despite their eligibility into the scheme.

In this robustness check, we re-run the regression models by using original HTB status and claims from the MTD. This robustness check addresses any uncertainties associated with our constructed identifier of HTB as well as the imputed values of HTB claims respectively. Additionally, we disregard the sample of FTBs, who despite being eligible (observed in the data on house value, loan amount, buyer status and the nature of the

house) are recorded as a non-HTB buyer in the MTD, since we suspect that inclusion of these FTBs in the analysis would impose a downward bias to our results.

The regression estimates from the heterogeneous analysis in Table C.1.1-Table C.1.5 in Appendix C.1 confirm our main findings for the three transmission channels and the impact on gifts used as downpayments post HTB enhancement. As before, we find existence of liquidity channel across all income groups, with the extent of the reduction in out of pocket downpayments being the least within the fifth income group (Table C.1.1). Furthermore, we also confirm the positive equity (Table C.1.2 and Table C.1.3) and asset position impact (Table C.1.4) within the fifth income group and a reduction in the use of gifts towards downpayments within the lower income group (Table C.1.5).<sup>31</sup> Finally, we also infer robustness in our main results from the similarity in the magnitude of the coefficients that we obtain using this smaller original MTD sample.

## **8.2 Time analysis varying the choice of the post-policy enhancement period**

As discussed earlier, we decide the post-policy enhancement period for mortgage drawdowns beginning in 2021 despite the actual policy enhancement introduced in July 2020. We decide this threshold to minimise the uncertainty around the qualification of HTB eligible FTBs into the pre or post-enhancement scheme as well as to address the self-selection issues concerning mortgage drawdowns recorded between August-December 2020. However, as a robustness we relax the decision on the post-policy enhancement period and expand our sample by including FTBs with mortgage drawdown between (i) September-December 2020, (ii) October-December, 2020, and (iii) November-December 2020, in addition of mortgage drawdowns in 2021. The results for each of the transmission channels as well as gifts used as downpayments are presented in Appendix C.2.1-C.2.4 across the three aforesaid periods.

The time analysis suggests consistency of 'DiD' estimates with our main results across the three transmission channels in each period respectively. We confirm reduction in out of pocket downpayments across HTB eligible FTBs in all income groups in post-policy enhancement periods (Table C.2.1.1-Table C.2.1.3). Further, similar to the main results, we find income group five opting for the least absorption of additional HTB benefit towards their immediate liquidity to make way for positive equity and net asset position. We

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<sup>31</sup>The effect for reduction in gift towards downpayment appears for the third income group in this robustness. In other robustness checks, we conform to the main findings of the decline in the second income group only.

confirm this from the time analysis on LTV ratios (Table C.2.2.1-Table C.2.2.3), loan size (Table C.2.2.4-Table C.2.2.6) and house price regression models (Table C.2.3.1-Table C.2.3.3), suggesting reduction loan amount and increase in house value, such that that there is an overall reduction in the LTV ratio (Table C.2.2.1-Table C.2.2.3). Finally, we also confirm our main finding on reduction in gifts used as downpayments within the HTB eligible second income group in the post-policy enhancement period across the three time analysis models (Table C.2.4.1-Table C.2.4.3).

## 9 Conclusion and Policy Implications

In this paper, we examine borrower level effects of an enhancement in the subsidy size in the Irish housing assistance scheme ‘Help to Buy’. We exploit the exogenous policy change to infer the impact on the liquidity, equity and purchase prices of first time buyers amidst economic uncertainty posed by the COVID-19 pandemic. In particular, we evaluate how larger grants as part of this enhancement allowed FTBs to ease their downpayment constraint that binds as a result of banks’ lending standards and the macroprudential mortgage measures in place for LTI and LTV ratios in Ireland. We study how participating borrowers change their posted out-of-pocket downpayments, loan sizes, and property purchase prices after the introduction of more generous fiscal support.

Primarily, we find that on average, HTB enhancement had a strong liquidity impact: there was a fall in the out-of-pocket downpayments across eligible FTBs, which was equivalent to the enhancement in the housing assistance. Furthermore, we find a small positive equity effect (driven by reduction in the mortgage amount) as well as positive asset position (reflected by increase in house purchase price). Contrary to the current policy debate that housing subsidies are inflationary in the housing market, our results do not find a strong house price increase for eligible FTBs as a result of the HTB enhancement, although the analysis - by design - is not general-equilibrium in nature.

Overall, the improvement in liquidity position of eligible FTBs confirms how housing assistance schemes can offset the costs imposed by the binding downpayment constraint that results for many potential borrowers. By complementing part of their downpayment with public subsidies such as the HTB, borrowers are able to maintain their stock of liquid assets or precautionary savings that is otherwise converted into illiquid housing stock. This in turn may either allow them to increase consumption of goods complementary to housing, or to boost their resilience against unanticipated idiosyncratic shocks.

Our results provide a link between two important strands of the literature on the housing and mortgage markets. A large body of work has studied the effects of macroprudential policies over the past decade, concluding that their benefits are substantial, in improving

borrower resilience and mitigating cyclical growth in lending and property prices. A smaller but growing body of work also concludes that these policies also entail costs, that need to be understood and balanced by policymakers. We believe we are the first to formally assess whether housing assistance schemes act to offset some of the downpayment constraint costs, particularly as they relate to the erosion of borrowers' liquidity position. A thorough assessment of whether the bolstering of mortgage borrowers' liquidity positions represents an optimal use of scarce public funds is beyond the scope of our study, but represents a promising avenue for future research.

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# Appendices

## A Variable Description

1. Help to Buy Claim: The approved subsidy under the Help to Buy housing assistance scheme. This is based on the income tax and deposit interest retention tax paid by the FTB in last four years of house purchase.
2. Out of Pocket Downpayment: For HTB eligible buyers, this is the difference between total house price and mortgage amount as well as the help to buy claim ( $OODP = \text{House Price} - \text{Mortgage} - \text{HTB Claim}$ ), whereas for non-HTB buyers, this the difference between house price and mortgage amount ( $OODP = \text{House Price} - \text{Mortgage}$ ).
3. House-price: The collateral value reported in the MTD.
4. Loan-size: The approved mortgage amount.
5. Total Household Gross Income: Annual income of all members of the household listed as joint-borrowers on approved mortgage.

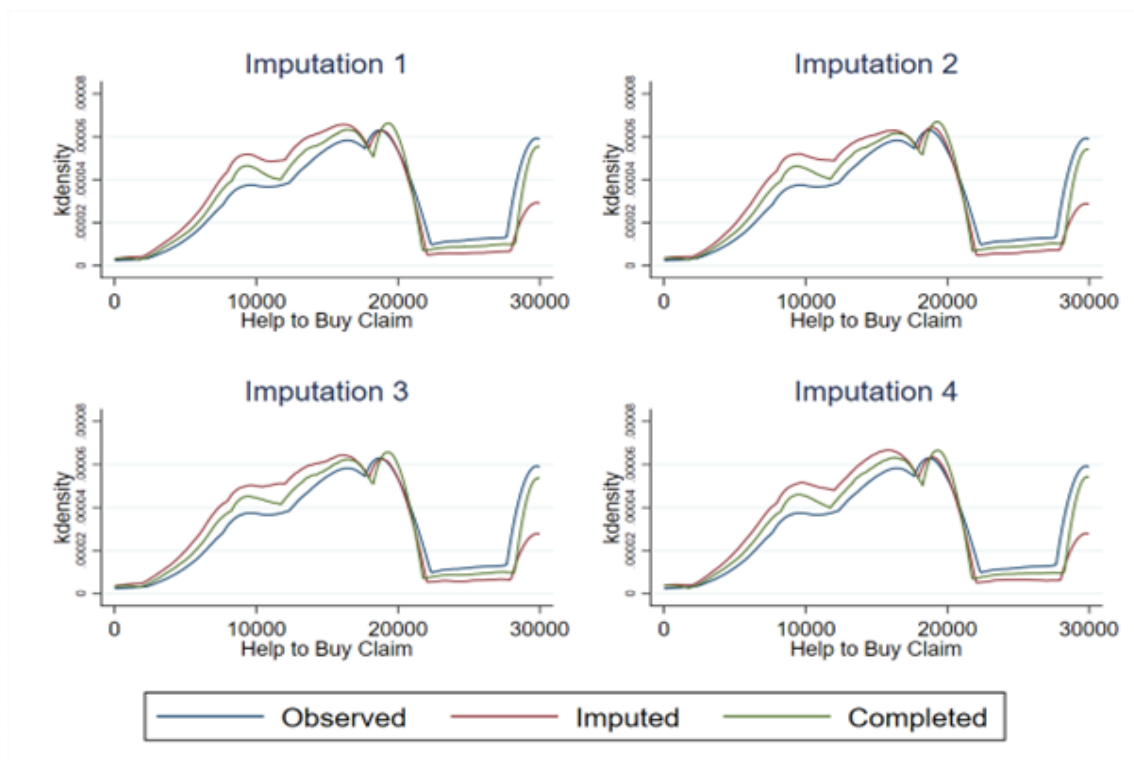


- 6. LTV: The ratio of loan-size and house-price.
- 7. LTI: The ratio of loan-size and total household gross income.
- 8. Deposit from Gifts: Total downpayment sourced from family or friends in the form of gift or informal borrowing.

## B Multiple (Stochastic) Imputation Diagnostic Check

The distribution shown in Figure B.1 presents the comparison of the distribution of observed (original) HTB claims from MTD, the imputed values for HTB using multiple imputation technique (imputed) and distribution of observed as well as imputed (completed). Here, we present the distributions from four imputation replications, although we undertake ten replications to generate imputed HTB claim values. As the graph suggests, the similarity between the distribution of imputed and observed values provides strength to our approach because existence of any significant differences in the distributions are generally associated with issues in the underlying imputation model (Eddings and Marchenko, 2012).

FIGURE B.1. Distribution of Imputed HTB claims based on original MTD HTB claim values



The distribution of the original HTB claims suggests a non-normal bi-modal distribution. This is due to the two HTB policy regimes observed in the data such that the density of

plot increases at €20,000 and €30,000. We make adjustment to our multiple imputation model to take this into account by using the predictive mean matching (PMM) approach as suggested by [Eddings and Marchenko \(2012\)](#). PMM approach integrates the nearest neighbour imputation approach with linear regression such that it first draws linear predictions based on regression and then uses these predictions as a distance measure to create a set of nearest neighbours ([Little, 1988](#); [Rubin, 1986](#); [StataCorp, 2021](#)). The visual inspection of imputed value distribution suggests that the PMM approach sits well with context to our missing data problem, generating distribution that closely follows the original.

## C Robustness Results

### C.1 Robustness 1- Original HTB identifier

TABLE C.1.1. Transmission Channel 1- Liquidity Response of FTBs to HTB enhancement (Heterogeneous Response- MTD Identifier)

Variables	(1) OOP Downpayment	(2) OOP Downpayment	(3) OOP Downpayment	(4) OOP Downpayment	(5) OOP Downpayment
Post	2,327.32 (1,460.43)	6,641.40*** (1,327.21)	4,462.98*** (1,241.13)	2,511.63** (1,276.94)	594.46 (1,304.54)
Treatment	-13,283.55*** (3,072.00)	-12,765.92*** (1,536.65)	-13,406.69*** (1,130.16)	-16,502.75*** (983.66)	-17,770.05*** (1,083.06)
DiD	-7,842.26** (3,803.20)	-7,459.70*** (2,101.00)	-9,341.30*** (1,633.30)	-8,374.94*** (1,531.27)	-6,160.68*** (1,553.20)
Constant	1,019.19 (13,004.94)	-13,633.55 (14,208.66)	9,754.61 (13,812.81)	50,321.00*** (17,103.57)	77,938.55*** (18,916.69)
Observations	8,927	8,609	8,812	8,620	8,743
R-squared	0.04	0.05	0.06	0.09	0.17
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st December, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

TABLE C.1.2. Transmission Channel 2- Net Equity Position of FTBs (LTV) as a response to HTB enhancement (Heterogeneous Response- MTD Identifier)

Variables	(1) LTV	(2) LTV	(3) LTV	(4) LTV	(5) LTV
Post	-0.68 (0.43)	-1.72*** (0.36)	-0.98*** (0.31)	-0.53* (0.30)	-0.28 (0.28)
Treatment	-1.87* (1.04)	-0.68 (0.43)	-0.37 (0.29)	0.25 (0.23)	0.32 (0.22)
DiD	0.60 (1.34)	-0.69 (0.60)	-0.27 (0.42)	-0.65* (0.36)	-1.09*** (0.33)
Constant	74.19*** (4.29)	83.90*** (4.16)	78.52*** (3.90)	72.06*** (3.85)	66.15*** (4.25)
Observations	8,929	8,612	8,817	8,630	8,750
R-squared	0.08	0.05	0.07	0.11	0.27
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st December 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include property price, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

TABLE C.1.3. Transmission Channel 2- Debt Response of FTBs to HTB enhancement (Heterogeneous Response- MTD Identifier)

Variables	(1) Loan Size	(2) Loan Size	(3) Loan Size	(4) Loan Size	(5) Loan Size
Post	628.29 (484.49)	-528.12* (282.73)	226.15 (305.49)	268.23 (433.34)	1,964.46** (961.48)
Treatment	14,414.57*** (1,819.44)	3,892.90*** (576.18)	3,465.31*** (483.23)	3,602.02*** (503.20)	6,821.36*** (920.54)
DiD	1,184.41 (2,181.78)	93.42 (810.83)	-1,012.33 (654.90)	-1,773.52*** (687.03)	-6,092.68*** (1,272.64)
Constant	-45,643.31*** (4,403.63)	-7,846.41*** (2,701.42)	-1,858.40 (3,263.37)	-15,020.32*** (4,725.77)	-53,592.79*** (12,434.40)
Observations	8,929	8,612	8,817	8,630	8,750
R-squared	0.65	0.92	0.93	0.93	0.82
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st December 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include property price, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

TABLE C.1.4. Transmission Channel 3- House Purchase Price of FTBs as a response to HTB enhancement (Heterogeneous Response- MTD Identifier)

Variables	(1) House Price	(2) House Price	(3) House Price	(4) House Price	(5) House Price
Post	7,445.42*** (1,322.10)	10,473.21*** (1,277.96)	7,590.16*** (1,225.97)	5,622.98*** (1,249.49)	3,861.70*** (1,281.33)
Treatment	9,140.39*** (3,105.20)	6,869.67*** (1,614.63)	4,343.00*** (1,211.71)	306.64 (1,030.28)	176.14 (1,098.66)
DiD	1,232.52 (3,933.14)	1,588.85 (2,132.42)	1,344.63 (1,618.17)	3,939.06*** (1,519.92)	5,656.66*** (1,536.62)
Constant	32,149.91*** (11,584.62)	-4,082.27 (13,827.12)	8,118.15 (13,550.20)	54,347.84*** (17,047.76)	67,383.89*** (19,164.21)
Observations	8,929	8,612	8,817	8,630	8,750
R-squared	0.42	0.48	0.58	0.68	0.73
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes
Collateral Counties	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st December 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower. Collateral County controls for the county where the house is located.

TABLE C.1.5. Change in Gifts used towards downpayments as a response to HTB enhancement  
(Heterogeneous Response- MTD Identifier)

Variables	(1) Downpayment Gift	(2) Downpayment Gift	(3) Downpayment Gift	(4) Downpayment Gift	(5) Downpayment Gift
Post	-459.24 (1,142.68)	1,508.70* (916.96)	620.30 (897.31)	-1,379.69 (980.81)	-2,022.29** (937.47)
Treatment	-8,847.66*** (2,520.53)	-2,976.23** (1,202.16)	-3,377.09*** (891.08)	-5,066.67*** (776.14)	-2,169.48*** (835.66)
DiD	2,601.32 (3,201.23)	-1,911.77 (1,702.51)	-2,638.73** (1,265.39)	-231.84 (1,154.17)	-448.44 (1,112.05)
Constant	-16,517.58* (9,104.88)	-12,769.35* (7,718.96)	6,822.04 (9,180.84)	15,349.04* (9,035.54)	14,378.51* (8,587.82)
Observations	8,364	7,786	7,664	7,456	7,213
R-squared	0.04	0.04	0.03	0.02	0.03
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st December 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

## C.2 Robustness 2- Time analysis differing the choice of the post-policy enhancement period

### C.2.1: Transmission Channel 1- Liquidity Response- Out of pocket downpayments (Heterogeneous Analysis)

TABLE C.2.1.1. Out of pocket downpayments- Pre-policy enhancement (2019 and July 2020) and Post-policy enhancement (Sep-Dec, 2020 and 2021) (Heterogeneous Response)

Variables	(1) OOP Downpayment	(2) OOP Downpayment	(3) OOP Downpayment	(4) OOP Downpayment	(5) OOP Downpayment
Post	342.52 (1,859.09)	2,862.87* (1,628.76)	3,524.51** (1,629.46)	4,913.81*** (1,594.94)	355.17 (1,525.84)
Treatment	-18,769.42*** (1,478.10)	-13,546.07*** (1,038.07)	-12,391.69*** (969.06)	-16,664.11*** (940.72)	-16,898.62*** (1,065.00)
DiD	-5,509.73*** (2,046.04)	-6,776.22*** (1,420.04)	-7,981.13*** (1,340.06)	-6,791.52*** (1,350.78)	-5,130.52*** (1,413.40)
Constant	-487.88 (11,070.17)	-9,110.35 (12,466.89)	-2,938.12 (11,499.57)	49,800.00*** (15,565.14)	81,687.09*** (16,215.25)
Observations	11,667	11,681	11,652	11,654	11,670
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Multiple Imputation regressions with robust SE in parenthesis \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st August, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

TABLE C.2.1.2. Out of pocket downpayments- Pre-policy enhancement (2019 and July 2020) and Post-policy enhancement (Oct-Dec, 2020 and 2021) (Heterogeneous Response)

Variables	(1)	(2)	(3)	(4)	(5)
	OOP Downpayment	OOP Downpayment	OOP Downpayment	OOP Downpayment	OOP Downpayment
Post	1,145.07 (1,996.17)	2,027.59 (1,708.90)	4,003.35** (1,704.05)	4,626.72*** (1,651.73)	194.31 (1,558.87)
Treatment	-18,718.88*** (1,481.92)	-13,528.61*** (1,039.18)	-12,345.34*** (967.74)	-16,552.15*** (938.85)	-16,888.08*** (1,063.10)
DiD	-6,041.15*** (2,071.56)	-6,809.85*** (1,441.42)	-8,460.81*** (1,358.00)	-7,144.00*** (1,365.99)	-5,449.66*** (1,427.15)
Constant	1,130.31 (11,258.59)	-7,441.46 (12,634.06)	697.06 (11,635.16)	51,698.00*** (15,887.24)	82,711.24*** (16,409.80)
Observations	11,367	11,402	11,335	11,350	11,330
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Multiple Imputation regressions with robust SE in parenthesis \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 30th September, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

TABLE C.2.1.3. Out of pocket downpayments- Pre-policy enhancement (2019 and July 2020) and Post-policy enhancement (Nov-Dec, 2020 and 2021) (Heterogeneous Response)

Variables	(1)	(2)	(3)	(4)	(5)
	OOP Downpayment	OOP Downpayment	OOP Downpayment	OOP Downpayment	OOP Downpayment
Post	1,098.87 (2,240.08)	2,718.16 (1,928.80)	4,307.23** (1,877.95)	4,017.59** (1,763.74)	120.28 (1,628.50)
Treatment	-18,571.40*** (1,487.23)	-13,511.48*** (1,040.91)	-12,283.86*** (965.30)	-16,438.25*** (936.80)	-16,845.00*** (1,059.88)
DiD	-6,419.10*** (2,121.12)	-7,164.81*** (1,470.78)	-8,992.82*** (1,387.03)	-7,247.08*** (1,393.41)	-6,094.42*** (1,450.38)
Constant	2,850.39 (11,546.34)	-6,331.29 (12,853.79)	4,248.43 (11,897.64)	52,704.11*** (16,239.71)	84,970.59*** (16,702.94)
Observations	10,988	11,046	10,951	10,945	10,884
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Multiple Imputation regressions with robust SE in parenthesis \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st October, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

## C.2.2: Transmission Channel 2- Equity Effect- LTV Ratio and Loan Size (Heterogeneous)

TABLE C.2.2.1. LTV- Pre-policy enhancement (2019 and July 2020) and Post-policy enhancement (Sep-Dec, 2020 and 2021) (Heterogeneous Response)

Variables	(1) LTV	(2) LTV	(3) LTV	(4) LTV	(5) LTV
Post	0.10 (0.57)	-0.59 (0.44)	-0.30 (0.41)	-0.17 (0.37)	0.51 (0.33)
Treatment	0.50 (0.52)	-0.48* (0.29)	-0.61** (0.24)	0.42* (0.22)	0.31 (0.21)
DiD	-0.16 (0.74)	-0.56 (0.40)	-0.29 (0.34)	-0.84*** (0.31)	-0.93*** (0.29)
Constant	75.17*** (3.69)	83.70*** (3.63)	81.69*** (3.26)	72.38*** (3.51)	64.90*** (3.82)
Observations	11,670	11,684	11,655	11,655	11,673
R-squared	0.08	0.05	0.07	0.10	0.25
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st August, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include property price, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

TABLE C.2.2.2. LTV- Pre-policy enhancement (2019 and July 2020) and Post-policy enhancement (Oct-Dec, 2020 and 2021) (Heterogeneous Response)

Variables	(1) LTV	(2) LTV	(3) LTV	(4) LTV	(5) LTV
Post	-0.12 (0.61)	-0.34 (0.47)	-0.52 (0.43)	-0.12 (0.38)	0.53 (0.34)
Treatment	0.48 (0.52)	-0.49* (0.29)	-0.64*** (0.24)	0.39* (0.22)	0.31 (0.21)
DiD	-0.03 (0.75)	-0.62 (0.41)	-0.24 (0.34)	-0.84*** (0.32)	-0.94*** (0.30)
Constant	74.67*** (3.74)	83.11*** (3.67)	80.73*** (3.30)	72.04*** (3.58)	64.76*** (3.86)
Observations	11,370	11,405	11,338	11,351	11,333
R-squared	0.08	0.05	0.07	0.10	0.25
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 30th September, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include property price, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

TABLE C.2.2.3. LTV- Pre-policy enhancement (2019 and July 2020) and Post-policy enhancement (Nov-Dec, 2020 and 2021) (Heterogeneous Response)

Variables	(1) LTV	(2) LTV	(3) LTV	(4) LTV	(5) LTV
Post	-0.06 (0.68)	-0.49 (0.52)	-0.65 (0.48)	-0.02 (0.41)	0.50 (0.36)
Treatment	0.44 (0.53)	-0.50* (0.29)	-0.66*** (0.24)	0.36* (0.22)	0.29 (0.21)
DiD	-0.16 (0.77)	-0.62 (0.42)	-0.20 (0.35)	-0.88*** (0.32)	-0.91*** (0.30)
Constant	74.29*** (3.82)	82.76*** (3.73)	79.57*** (3.36)	71.77*** (3.67)	64.18*** (3.93)
Observations	10,991	11,048	10,954	10,946	10,887
R-squared	0.08	0.05	0.07	0.10	0.26
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st October, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include property price, property size and LTI. Borrower Characteristics include occupation and, age and age square of 1st borrower.

TABLE C.2.2.4. Loan Size- Pre-policy enhancement (2019 and July 2020) and Post-policy enhancement (Sep-Dec, 2020 and 2021) (Heterogeneous Response)

Variables	(1) Loan Size	(2) Loan Size	(3) Loan Size	(4) Loan Size	(5) Loan Size
Post	800.19 (701.24)	713.45* (414.61)	-64.66 (460.28)	392.30 (613.51)	5,161.67*** (1,189.23)
Treatment	12,668.63*** (950.98)	3,624.46*** (384.11)	2,687.49*** (365.90)	2,265.45*** (432.07)	5,748.44*** (859.17)
DiD	-1,414.67 (1,289.51)	-203.35 (538.75)	-637.56 (488.85)	-897.94 (571.52)	-5,567.02*** (1,118.44)
Constant	-48,337.19*** (4,032.57)	-807.72 (2,599.13)	2,047.70 (2,991.05)	-19,374.53*** (4,446.99)	-51,281.62*** (11,201.54)
Observations	11,670	11,684	11,655	11,655	11,673
R-squared	0.64	0.90	0.93	0.92	0.81
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st August, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include property price, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

TABLE C.2.2.5. Loan Size- Pre-policy enhancement (2019 and July 2020) and Post-policy enhancement (Oct-Dec, 2020 and 2021) (Heterogeneous Response)

Variables	(1) Loan Size	(2) Loan Size	(3) Loan Size	(4) Loan Size	(5) Loan Size
Post	596.54 (743.19)	807.78* (436.23)	-83.90 (483.48)	540.67 (637.64)	5,559.13*** (1,220.71)
Treatment	12,648.94*** (951.25)	3,624.72*** (384.37)	2,681.01*** (366.20)	2,247.50*** (432.45)	5,761.18*** (858.70)
DiD	-1,370.91 (1,294.01)	-184.34 (544.91)	-563.72 (491.82)	-952.10 (579.18)	-5,703.95*** (1,129.51)
Constant	-48,106.53*** (4,087.41)	-674.03 (2,630.80)	1,248.62 (3,020.65)	-19,326.04*** (4,542.06)	-52,338.63*** (11,347.35)
Observations	11,370	11,405	11,338	11,351	11,333
R-squared	0.64	0.90	0.93	0.92	0.81
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 30th September, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include property price, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

TABLE C.2.2.6. Loan Size- Pre-policy enhancement (2019 and July 2020) and Post-policy enhancement (Nov-Dec, 2020 and 2021) (Heterogeneous Response)

Variables	(1) Loan Size	(2) Loan Size	(3) Loan Size	(4) Loan Size	(5) Loan Size
Post	1,144.51 (839.51)	861.11* (492.04)	-231.19 (540.48)	737.74 (691.86)	5,859.05*** (1,293.38)
Treatment	12,646.76*** (952.80)	3,619.52*** (384.66)	2,687.09*** (366.79)	2,223.72*** (432.84)	5,739.08*** (857.81)
DiD	-886.91 (1,315.70)	-100.75 (552.94)	-498.12 (501.85)	-1,013.22* (590.76)	-5,636.86*** (1,146.13)
Constant	-46,851.37*** (4,174.03)	-607.39 (2,669.76)	1,104.21 (3,069.23)	-18,975.38*** (4,629.18)	-55,002.86*** (11,550.95)
Observations	10,991	11,048	10,954	10,946	10,887
R-squared	0.64	0.90	0.93	0.92	0.81
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st October, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include property price, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

### C.2.3: Transmission Channel 3- House Purchase Price (Heterogeneous Analysis)

TABLE C.2.3.1. House Price- Pre-policy enhancement (2019 and July 2020) and Post-policy enhancement (Sep-Dec, 2020 and 2021) (Heterogeneous Response)

Variables	(1) House Price	(2) House Price	(3) House Price	(4) House Price	(5) House Price
Post	975.95 (1,676.22)	2,342.72 (1,562.88)	2,177.49 (1,577.23)	1,414.29 (1,562.31)	-2,365.38 (1,484.80)
Treatment	5,570.40*** (1,591.66)	6,447.26*** (1,095.37)	6,428.48*** (1,022.04)	1,541.71 (959.78)	2,087.47** (1,058.23)
DiD	-1,941.52 (2,219.36)	885.35 (1,407.85)	496.48 (1,317.25)	2,723.52** (1,326.36)	3,916.54*** (1,389.42)
Constant	29,250.82*** (9,875.40)	-4,734.51 (12,179.35)	-3,615.77 (11,333.26)	53,281.27*** (15,496.55)	72,140.86*** (16,485.92)
Observations	11,670	11,684	11,655	11,655	11,673
R-squared	0.43	0.51	0.60	0.68	0.74
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes
Collateral Counties	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st August, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower. Collateral County controls for the county where the house is located.

TABLE C.2.3.2. House Price- Pre-policy enhancement (2019 and July 2020) and Post-policy enhancement (Oct-Dec, 2020 and 2021) (Heterogeneous Response)

Variables	(1) House Price	(2) House Price	(3) House Price	(4) House Price	(5) House Price
Post = 1	1,508.47 (1,792.18)	1,794.29 (1,638.26)	2,596.32 (1,648.44)	1,112.49 (1,617.00)	-2,425.48 (1,519.01)
treatCBI = 1	5,593.07*** (1,597.78)	6,442.67*** (1,098.08)	6,422.48*** (1,022.96)	1,649.96* (958.79)	2,111.45** (1,057.05)
DiD = 1	-2,414.51 (2,243.97)	1,124.82 (1,431.33)	386.48 (1,334.82)	2,763.97** (1,341.06)	3,947.01*** (1,402.83)
Constant	30,483.65*** (10,037.25)	-2,820.02 (12,341.70)	-405.33 (11,480.19)	55,732.24*** (15,836.59)	72,931.90*** (16,682.99)
Observations	11,370	11,405	11,338	11,351	11,333
R-squared	0.43	0.51	0.60	0.68	0.74
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes
Collateral Counties	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 30th September, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower. Collateral County controls for the county where the house is located.



TABLE C.2.3.3. House Price- Pre-policy enhancement (2019 and July 2020) and Post-policy enhancement (Nov-Dec, 2020 and 2021) (Heterogeneous Response)

Variables	(1) House Price	(2) House Price	(3) House Price	(4) House Price	(5) House Price
Post	2,246.13 (2,010.84)	2,471.04 (1,842.76)	3,138.02* (1,801.20)	559.46 (1,731.17)	-2,485.20 (1,589.73)
Treatment	5,759.94*** (1,607.41)	6,532.36*** (1,102.34)	6,506.02*** (1,026.21)	1,684.32* (957.74)	2,140.59** (1,055.29)
DiD	-2,269.13 (2,305.21)	1,103.28 (1,460.18)	161.42 (1,363.19)	3,037.80** (1,368.45)	3,773.53*** (1,427.45)
Constant	31,962.31*** (10,285.10)	-1,544.74 (12,546.83)	3,205.77 (11,727.16)	57,662.58*** (16,212.20)	75,068.48*** (16,987.08)
Observations	10,991	11,048	10,954	10,946	10,887
R-squared	0.43	0.51	0.60	0.68	0.74
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes
Collateral Counties	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st October, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower. Collateral County controls for the county where the house is located.

C.2.4: Gifts Used as Downpayment (Heterogeneous Analysis)

TABLE C.2.4.1. Gifts as Downpayments- Pre-policy enhancement (2019 and July 2020) and Post-policy enhancement (Sep-Dec, 2020 and 2021) (Heterogeneous Response)

Variables	(1) Downpayment Gift	(2) Downpayment Gift	(3) Downpayment Gift	(4) Downpayment Gift	(5) Downpayment Gift
Post	-646.11 (1,446.37)	1,306.29 (1,128.32)	-1,240.83 (1,141.23)	116.01 (1,199.04)	-1,316.70 (1,043.83)
Treatment	-6,872.71*** (1,292.23)	-656.30 (864.27)	-1,286.68* (775.53)	-2,765.93*** (782.73)	55.68 (815.38)
DiD	-526.26 (1,744.52)	-2,390.04** (1,216.69)	-2,113.18** (1,061.28)	-1,026.62 (1,080.88)	-1,613.64 (1,004.45)
Constant	-14,444.91* (7,721.17)	-13,577.13** (6,608.25)	4,721.77 (7,580.32)	16,585.43** (8,396.11)	16,017.99** (7,703.96)
Observations	10,933	10,510	10,079	9,923	9,482
R-squared	0.05	0.04	0.03	0.03	0.04
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st August, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

TABLE C.2.4.2. Gifts as Downpayments- Pre-policy enhancement (2019 and July 2020) and Post-policy enhancement (Oct-Dec, 2020 and 2021) (Heterogeneous Response)

Variables	(1) Downpayment Gift	(2) Downpayment Gift	(3) Downpayment Gift	(4) Downpayment Gift	(5) Downpayment Gift
Post	-1,129.54 (1,514.57)	1,049.71 (1,217.91)	-1,461.50 (1,180.77)	-438.43 (1,229.08)	-1,934.46* (1,048.14)
Treatment	-6,885.39*** (1,293.64)	-656.83 (865.31)	-1,305.18* (775.80)	-2,698.97*** (781.77)	-21.02 (813.63)
DiD	-514.98 (1,755.15)	-2,672.87** (1,227.80)	-2,125.04** (1,076.85)	-1,121.22 (1,092.05)	-1,602.04 (1,007.87)
Constant	-12,734.95 (7,826.30)	-13,266.04** (6,732.07)	5,161.43 (7,706.18)	17,090.17** (8,533.71)	14,786.29* (7,802.25)
Observations	10,649	10,256	9,801	9,655	9,201
R-squared	0.05	0.04	0.03	0.03	0.04
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 30th September, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

TABLE C.2.4.3. Gifts as Downpayments- Pre-policy enhancement (2019 and July 2020) and Post-policy enhancement (Nov-Dec, 2020 and 2021) (Heterogeneous Response)

Variables	(1) Downpayment Gift	(2) Downpayment Gift	(3) Downpayment Gift	(4) Downpayment Gift	(5) Downpayment Gift
Post	-1,206.40 (1,685.12)	1,800.96 (1,433.43)	-1,800.74 (1,279.67)	-482.01 (1,371.12)	-2,271.14** (1,127.34)
Treatment	-6,882.62*** (1,295.62)	-641.59 (866.89)	-1,259.04 (776.86)	-2,566.00*** (781.25)	-19.77 (813.84)
DiD	-603.16 (1,803.14)	-2,660.84** (1,256.75)	-2,414.49** (1,097.83)	-1,209.20 (1,118.72)	-1,484.44 (1,028.56)
Constant	-13,081.62 (8,024.06)	-12,864.81* (6,852.46)	4,751.30 (7,900.53)	19,797.65** (8,710.21)	17,541.66** (8,007.84)
Observations	10,287	9,926	9,460	9,317	8,829
R-squared	0.05	0.04	0.03	0.03	0.04
Year Dummy	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes
Borr. Characteristics	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes

Robust SE in parenthesis. \*\*\* p<0.01 \*\* p<0.05 \* p<0.1. Income quintiles presented in ascending order in columns 1-5. Post indicates all loans originating after 31st October, 2020. Treatment indicates HTB recipients. DiD indicates the interaction of Post and Treatment (Post\*Treatment). Loan Characteristics include loan size, property size and LTI. Borrower Characteristics include occupation, age and age square of 1st borrower.

