The Direct and Spillover Effects of Taxation: Evidence from a Property Tax Break for First-Time Buyers

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Abstract

This paper identifies both the direct and indirect (spillover) effects of a property tax break made available to first-time buyers. By exempting properties below a defined threshold from transaction taxes, Irish law generated a notch that strongly discouraged first-time ('targeted') buyers from bidding above that threshold. However, this policy created a spillover effect on non-targeted individuals, by incentivizing them to bid just above that threshold. A theoretical analysis predicts excess mass on both sides of the notch, delineated by tax status. The empirical strategy reveals this double-bunching, highlighting sophisticated bidding strategies by both targeted and non-targeted groups.

1 Introduction

Public economics typically analyzes only the direct effects of taxation; this paper identifies both the direct and indirect (spillover) effects of a property tax break that was available to first-time buyers in Ireland. For many years tax law granted house-buyers a once-off exemption from the "stamp duty" property transaction tax, conditional on the sale price not exceeding €317,500.[1] Exceeding this threshold, for example by purchasing a house for €318,000, triggered the 3% stamp duty on the *total* price. Purchasers eligible for this exemption thus faced a discontinuous cost in the after-tax price of a house at this threshold, as the tax owed increased from nil to over €9,000. Policies where crossing thresholds triggers discrete increases in tax liabilities are typically called *notches*. These tax notches are surprisingly common, and a large literature has investigated their effects in both property and non-property domains, cf. Slemrod et al. (2016), Besley et al. (2014), Best and Kleven (2016),

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[1]The peculiar €317,500 threshold was the €-conversion of £250,000.

Kopczuk and Munroe (2015), Bradley (2016), Kleven and Waseem (2013). By penalizing crossing thresholds, empirical analyses of notches use measures of excess mass just below thresholds to estimate parameters of interest, e.g. the elasticity of taxable income.

The stamp duty exemption was a once-per-lifetime exemption. This implies many categories of potential buyers, such as down-sizing empty nesters, or middle-aged couples moving up the property ladder, were ineligible for the exemption. The exemption, and thus the notch, applied only to first-time buyers. The direct effect of this notch was to disincentivize these buyers from bidding above €317,500 for a house. This generates an excess mass of bidding below the threshold, and the extent of this bunching can reveal structural parameters about the affected taxpayers (Kleven and Waseem, 2013; Chetty et al., 2011; Sallee and Slemrod, 2012). The public finance story typically ends here, as we can generally assume that tax affairs of one person do not affect the decisions of another.

This is not the case when individuals with distinct tax statuses are competing over the purchase of the same property. In this case, the tax notch is more comparable to a subsidy to a single firm in an industry. If the direct effect of the policy was to incentivize bunching below a well-defined threshold for exempt buyers, the indirect (or spillover) effect was to incentivize non-exempt buyers to bid just above the threshold. Somewhat counter-intuitively, the tax exemption created a competitive disadvantage for targeted individuals near the notch threshold. For these non-exempt buyers like down-sizing empty nesters, increasing the bid marginally above the notch threshold had negligible tax consequences. However, bidding just above this threshold would likely out-muscle any first-time buyers. This is an unintended consequence of the notched component of the tax being targeted at first-time buyers. By imposing no discontinuities on them, second-time buyers were granted a slight competitive advantage in the bidding.

This paper analyzes this tax policy. First, the equilibrium bidding strategies are modeled theoretically. The discontinuities in payoff functions mean we cannot rely on the usual first-order conditions of standard auction theory. To work with this problem, I model the 'auction' for the house is as making the discrete choice of bidding on the property or not and, conditional on submitting a bid, making an offer just above or just below the notch threshold. The equilibrium is for first-time buyers to disproportionately bid ('bunch') just below the threshold, and for second-time buyers to bid ('bunch') just above the threshold. An implication of this is allocative inefficiency: desirable houses tend to be sold to second-time buyers, even if first-time buyers value them more.

Administrative data on mortgage issuances permit empirical analysis of this policy. The paper is novel not just as the first measurement of the effects of a property tax notch in Ireland. This paper is of more general interest because of the targeted nature of this specific

policy. Unlike existing notch estimation papers which rely on discontinuities in price or time, this paper has the additional wrinkle of targeted vs. non-targeted buyers. Consequently the empirical strategy permits identifying the direct effects of the policy (on targeted buyers), but also the indirect spillover effects on non-targeted buyers.

The €317,500 threshold is striking in the data, with the number of houses sold for this price being an order of magnitude higher than comparable thresholds such as €327,500. Consistent with the predictions of the model, there is clear excess bunching on *both* sides of the notch. Further, this double-hump is delineated by tax status: first-time buyers bunch below the threshold; second-time buyers above. This is indicative of sophisticated bidding strategies on the part of both groups. This evidence of tax-influenced optimizing behaviour (not just by the targeted group but also the non-targeted group) challenges an increasing line of work emphasizing deviations from optimality by taxpayers (Bradley, 2016; Chetty et al., 2009).

Identification of the effects of this policy is furthered by a reform of stamp duty in mid-2007. These unexpected reforms abolished the notch elements and ultimately introduced a flat 1% rate on all houses below €1m (Donegan et al., 2009). This permits confirmation that the bunching behaviour was contingent on the tax incentives. As expected, the excess mass of houses sold near €317,500 disappeared when the notch was removed. A difference-in-difference analysis confirms the ratio of targeted to non-targeted buyers returned to approximately unity when the policy was reformed.

2 Theoretical Analysis

Consider the case of players i and j contemplating bidding on the property valued near the tax threshold T. Each player has a valuation V_i of the property, and we will assume $V_1 = V_2$. This assumption is purely for clarity. The results are more interesting with independent values, but the exposition is considerably less clear. Player i may choose from three bidding actions, $\{T - \epsilon, T + \epsilon, Dropout\}$ where the final element is to place no bid, avoid any costs of submitting a bid (such as time costs), and exit the game with some outside option value $u_i > 0$. The highest bid wins, pays their bid plus any relevant taxes, and in the case of a tie a coin is tossed to decide the winner.

The unusual component of this model is the nature of the tax payment, namely the notch on some first-time buyers. The tax notch N takes the form:

$$\text{Tax} = \begin{cases} 0 \text{ if } i = 1 \text{ and } b < T \\ N \text{ otherwise} \end{cases}$$

which is a formalization of the statement that first-time buyers bidding below the threshold T are exempt from the tax. The bidding space is confined to the neighborhood of T to focus on where the notch is relevant. To match the data in the subsequent empirical analysis, the bidding space is discrete and avoids any concerns about weak inequalities just at the threshold T. The payoffs are outlined below.

		Player 2		
		$T-\epsilon$	$T+\epsilon$	Dropout
Player 1	$T-\epsilon$	$\frac{1}{2}(V-T+\epsilon+u_1)$, $\frac{1}{2}(V-T+\epsilon-N+u_2)$	u_1, $V-T-\epsilon-N$	$V-T+\epsilon$, u_2+c
	$T+\epsilon$	$V-T-\epsilon-N$, u_2	$\frac{1}{2}(V-T-\epsilon-N+u_1)$, $\frac{1}{2}(V-T-\epsilon-N+u_2)$	$V-T-\epsilon-N$, u_2+c
	Dropout	u_1+c, $V-T+\epsilon-N$	u_1+c, $V-T-\epsilon-N$	u_1+c, u_2+c

To operationalize this game, I make two restrictions on magnitudes. Firstly, that $V-T-N-3\epsilon > u_2$ (a minor increase in bid that wins for sure is better than risking), and secondly that $u_2+c < V-T+\epsilon-N$, which is to say Player 2 prefers a 50-50 chance of victory at a high price than dropping out. If valuations were coming from a known distribution, these restrictions would be true for a subset of that distribution.

Player 2 — the second-time buyers — will face the notch regardless of the price at which they purchase. Under most sensible circumstances, Player 2 would rather make an ϵ higher bid that secures victory than take a risky gamble to save ϵ. Thus I assume Player 2 will only strictly prefer to bid $T-\epsilon$ if that bid will win for sure, i.e. if Player 1 drops out.

Conversely, an ϵ-increase in bid triggers a large discontinuous tax for Player 1. Therefore I impose that Player 1 — the first-time buyer — prefers the risky gamble of avoiding the notch and winning than triggering the tax and winning for sure. Mathematically, these conditions imply $-(\epsilon+N) < u-(V-T) < \epsilon-c$, which is that the notch is sufficiently large and the costs of submitting a bid are relatively small.

Given these strategies, there is no pure strategy Nash Equilibrium. For example, suppose Player 1 would bid $T-\epsilon$ with certainty. Knowing this, Player 2 would increase the bid slightly and win for sure. However, given even an infinitesimal cost of bidding, Player 1 would then be better off not bidding at all than losing with certainty. This is not an equilibrium, as facing no opposition Player 2 could then lower their bid, potentially inviting Player 1 back into bidding, and so on. The only Nash Equilibrium can be where it is not obvious how much the other player will bid, and thus players mix between the various strategies.

The process of finding a mixed strategy Nash equilibrium is simplified by the elimination of dominated strategies. Under the parameter restrictions above, which loosely translate to the notch being sufficiently large and the costs of submitting a bid being sufficiently small, then Player 2 will always submit some strictly positive bid. This in turn makes it rational for Player 1 to prefer to drop out than bidding above the notch. What remains is a more familiar 2×2 game-form.

		Player 2	
		$T-\epsilon$	$T+\epsilon$
Player 1	Dropout	$u_1 + c$, $V - T + \epsilon - N$	$u_1 + c$, $V - T - \epsilon - N$
	$T-\epsilon$	$\frac{1}{2}(V - T + \epsilon + u_1)$, $\frac{1}{2}(V - T + \epsilon - N + u_2)$	u_1 $V - T - \epsilon - N$

Let us define α as the probability that Player 2 chooses $T - \epsilon$, and β as the probability that Player 1 chooses to Dropout. The complementary probabilities are of course $(1 - \alpha)$ and $(1 - \beta)$. In a mixed strategy equilibrium all options occur with positive probability and, given these strategy probabilities, players are indifferent between choosing different strategies. Thus, given α, the payoff to Player 1 of dropping out ($\pi_1(D)$) must equal her payoff to bidding $T - \epsilon$, namely $\pi_1(T - \epsilon)$. This generates two expressions that must be equal in equilibrium:

$$\pi_1(D) = \alpha(u_1 + c) + (1 - \alpha)(u_1 + c)$$
$$\pi_1(T - \epsilon) = \frac{\alpha}{2}(V - T + \epsilon) + \frac{\alpha}{2}u_1 + (1 - \alpha)u_1$$

Asserting $\pi_1(D) \stackrel{!}{=} \pi_1(T - \epsilon)$, we solve that

$$\alpha = \frac{2c}{V - T + \epsilon - u_1}$$

By a similar logic, taking the two payoff functions for Player 2 and equating them derives:

$$\pi_2(T - \epsilon) = \beta(V - T - \epsilon - N) + (1 - \beta)\left(\frac{1}{2}\right)(V - T + \epsilon - N + u_2)$$
$$\pi_2(T + \epsilon) = \beta(V - T - \epsilon - N) + (1 - \beta)(V - T - \epsilon - N)$$

$$\beta = \frac{V - T - N - 3\epsilon - u_2}{V - T - N + \epsilon - u_2}$$

The predictions of this model are two-fold. First, when we see first-time buyers entering

the auction, they will bid $T - \epsilon$. This implies we expect to see an excess mass of first-time buyers bidding just below the notch threshold. Secondly, so long as the cost of submitting a bid is relatively inconsequential, second-time buyers will be more likely to bid above the notch threshold than below. If the cost of submitting a bid infinitesimal, the probability that second-time buyers bid $T + \epsilon$ approaches one. Given that behaviour, we have our prediction of an excess mass of second-time buyers bidding just above the notch thresholds.

At this point it is worth recapping the preliminaries of the model. Likely the most controversial component of the model is the assumption of equivalent values of the property. As we have seen, this assumption still permits differential bidding strategies by bidders, where first-time buyers are more likely to be out-bid by second-time buyers, despite equivalent valuations and holding an *ex ante* tax advantage. While the case of $V_1 \lesseqgtr V_2$ is certainly interesting, it is my contention that the analysis is most convincing with equal valuations.

There are some results here in terms of productive and allocative efficiency. Firstly, we see from the (admittedly sparse) model that first-time buyers never purchase houses valued more than the notch threshold. In the model, this is true in the strict case where first-time buyers and second-time buyers value houses equally. It remains true where first-time buyers value these properties slightly more than second-time buyers. In this case, the properties are not allocated to the people who value them most, even though these individuals are tax-preferred. In fact, it is precisely because these bidders are tax-preferred in such a discontinuous way that generates the perverse incentive to seek alternatives.

There are likely further inefficiencies on the supply-side, such as construction plans restricting themselves to houses that will be profitable at prices below the notch threshold. Allocation of resources to comply with arbitrary thresholds of little social value, like the vehicle efficiency standards discussed in Sallee and Slemrod (2012) is a wasteful use of talent. Although these inefficiencies likely exist, this paper focuses on demand-side behaviour, and further work is left for future research.

3 Empirical Analysis

3.1 Institutional Setting and Data Description

Stamp Duty refers to the fee paid for the execution of a transfer of ownership of property. As notarization is a legal requirement, Stamp Duty is a form of financial transaction tax. In the Irish context, transfers of property are conducted by the National Stamp Duty Office, which is a division of the Revenue Commissioners. Mechanically, the payment is typically remitted through a solicitor's office, but statutory incidence falls on the buyer.

Prior to 2007, Stamp Duty followed a notched schedule. Of particular relevance is a notch at €317,500, where first-time buyers' tax liability switches from exempt to owing 3% of the value of the property. In a departure from the stylized theoretical model above, second-time buyers also face a notch at the threshold of €317,500 as the tax due jumped from 5% to 6%. This is, of course, a not inconsiderable 1% increase in the after-tax price of the house. However, the increase is one-third the size of the increase first-time buyers face.

Multiple reforms were enacted to the scheme in 2007. Initially, beginning March 31, first-time buyers were exempted from all Stamp Duty charges. Then, beginning November 5, the distinction between first- and second-time buyers was abolished and for the final seven weeks of the year a large notch (7% Stamp Duty) existed at €125,000. Of most immediate relevance is that 2007 was a year of change for the tax structure, and that the €317,500 notch was abolished before 2008 began. This will be relevant when I later analyze the effects of this abolition in a pre- and post-2007 setup.

Data on mortgage draw-downs were helpfully provided by the Central Statistics Office's Residential Property division. In particular, the data are the number of mortgages (rounded to the nearest ten to ensure anonymity) issued by the major mortgage providers in Ireland, in €1,000-increments, annually from 2005–2009, for both first-time buyers and second-time buyers.[2] At my request, mortgages on properties sold for exactly €317,500 (and other €*,500 thresholds) are rounded down rather than up.

3.2 Cross-sectional Analysis

Recall the stylized model above. Two main predictions were generated, namely that first-time buyers will disproportionately bid just below the notch threshold and that second-time buyers will disproportionately bid just above. The purpose of this section is to test these two predictions.

Figure 1 provides some preliminary evidence of the impact of the policy. In the figure, I

[2] I use "second-time buyers" loosely. The legal classification is Former Owner Occupiers.

plot the number of mortgages issued for houses that were valued at the maximum amount permitted before triggering the tax, along with six control groups. The control groups are the solid lines clustered towards the bottom of the plot. The treatment group is the dashed line in the middle. It is immediately apparent that an order of magnitude more houses are sold just at the threshold than at comparable prices nearby. People are aware of the tax implications of the notch, and are bunching just below it.

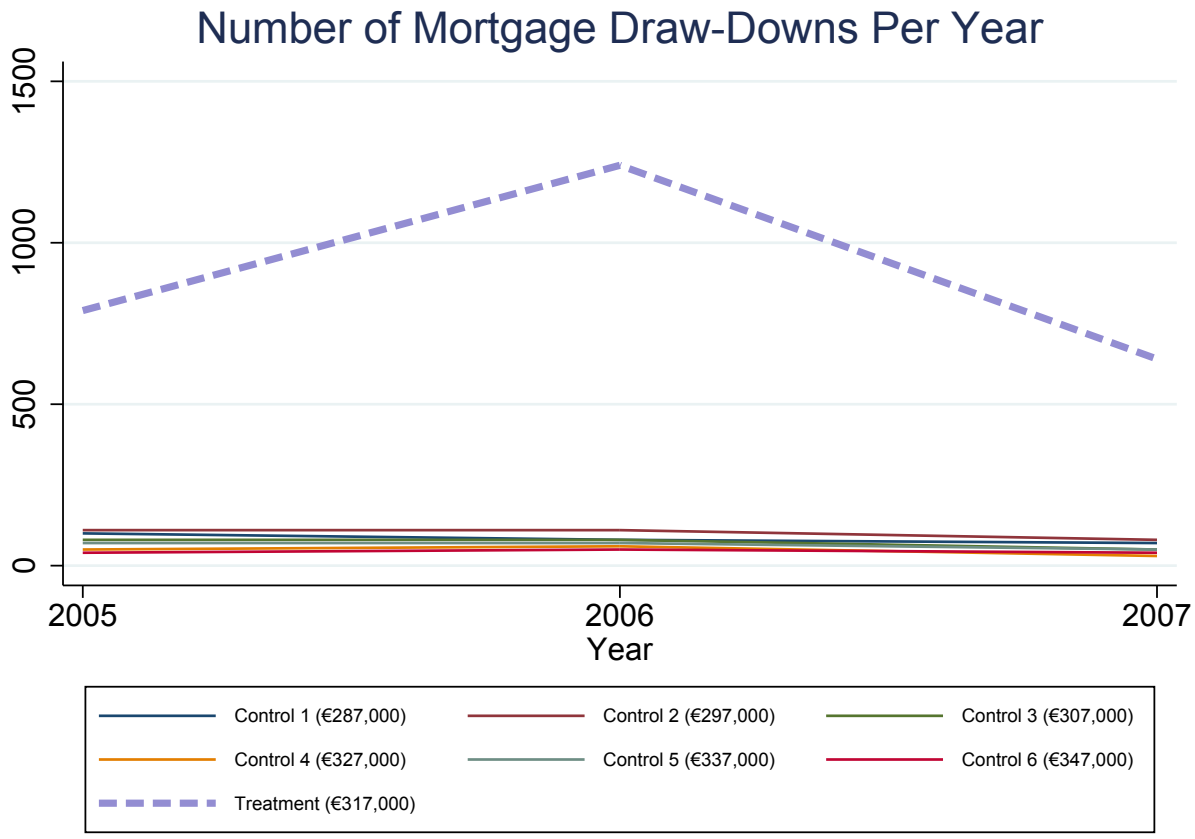

Figure 1: We notice a large excess number of mortgages issued just below the notch threshold relative to all control groups.

Given this initial depiction of the data, the question arises whether the specific predictions of the model — excess bunching of first-time buyers below the threshold and excess bunching of second-time buyers above the threshold — are confirmed. Figure 2 speaks to this.

Figure 2 plots the difference in the number of first-time ('targeted') buyers and second-time ('non-targeted') buyers either side of the notch threshold. Several features are noticeable, primary among them the large positive spike immediately below the notch threshold. This indicates that approximately 400 more first-time buyers purchased homes just below €317,500 than second-time buyers did at this price. That spike is very clear, and shows strategic

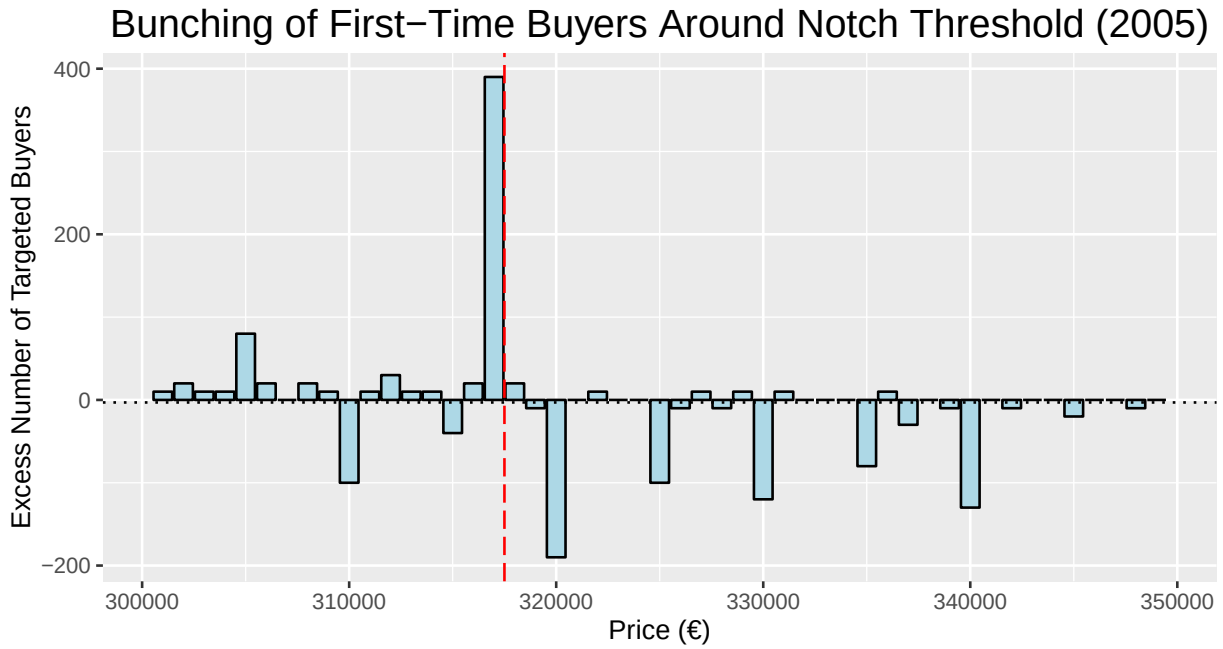

Figure 2: The spike just below the notch threshold at €317,500 shows the excess mass of targeted buyers. The excess number of non-targeted buyers at prices above the threshold is also visible. The dotted line near zero is the average value of the y-variable, i.e. there are approximately as many targeted as non-targeted buyers in the €300,000–€350,000 price range.

decision-making by first-time buyers.

The second prediction of the model is an excess number of second-time buyers just above the notch threshold. The evidence of this is shown in the negative spike at €320,000. This evidence is slightly complicated by two features. Firstly, strictly speaking it would be optimal for second-time buyers to bid €317,501 to out-muscle those concerned crossing the threshold. However, a round-number effect seems to bind here as they are clustering at the next multiple of 10,000, namely at €320,000. It is unclear why this taste for round numbers is so prominent but, conditional on bids above the threshold being round numbers, there is an excess mass of second-time buyers at the next round number.

Secondly, and more subtly, the evidence of bunching here is muted relatively to the particularly striking bunching immediately below the notch. Notice that approximately 200 more second-time buyers purchase houses for €320,000 than first-time buyers. Using the other negative spikes as a counterfactual, we see that this is approximately twice as many as we would expect absent the notch. In other words, we see roughly 400 excess first-time buyers bunching below the notch and roughly 100 excess second-time buyers bunching above the notch. Given that the tax incentives were about three-times as strong for first-time buyers,

these magnitudes seem reasonable.

Let us consider the implications of this evidence. Firstly, the bidding behaviour is consistent with those predicted by relatively conventional auction theory. Facing the notch, first-time buyers are hesitant to bid above the threshold and we see clear bunching just below the threshold. Secondly, second-time buyers facing higher costs above the threshold but counter-balanced with an increased likelihood of securing the property, are more likely to bid just above the threshold than would be predicted if there were no competitive advantage. This is perhaps best explained by imagining the auction as sequential: first-time buyers are unwilling to bid above the notch threshold and, facing this, second-time buyers accept the additional costs to place a higher bid. This outcome, where a comparatively smaller increase in after-tax price is available to second-time buyers, is only possible because the structure of the exemption for first-time buyers discontinues so abruptly. A phase-out region would mitigate against this incentive.

The excess mass of second-time buyers above the notch threshold is indicative of allocative inefficiency. Of course the data do not include measures of buyers' true valuations of the properties, but the relatively diminished after-tax cost faced by second-time buyers at the threshold facilitates allocation of the property to people with lower valuations. Of course this must be considered in the second-best world where the government has decided to exempt certain first-time buyers from the tax. Given this policy, it is reasonable to assume this reveals a social preference for first-time buyers obtaining the property relative to second-time buyers of equivalent valuations. The notch/exemption certainly aids in the delivery of this outcome at prices substantially below the €317,5000 threshold, but is unintentionally preferential to second-time buyers in the neighbourhood of that threshold.

Finally, it is worth noting that this policy likely leads to inefficiencies on the supply side too. Facing these discontinuous consumer taxes near this threshold, the basic theory of tax incidence suggests property developers have an incentive to price houses just below the threshold too. This is almost certainly factored into the designing of the properties, with planners e.g. restricting area size to remain profitable below the threshold. Introducing this discontinuous tax cost for a marginal increase in the size of a property is an inefficient restriction on market participants. The large number of mortgages issued precisely at €317,500 indicates this pricing-to-tax incentives phenomenon likely occurred.

3.3 Inter-temporal Analysis

The credibility of this paper's identification strategy is aided by the unexpected (and back-dated) abolition of this policy in 2007. This creates a further exogenous change in addition to the two discontinuities previously discussed off which to estimate the effects of this policy. The abolition of this policy removed the incentives to bunch near the notch threshold and, as indicated by Figure 3, little evidence of excess mass exists the year after its removal.

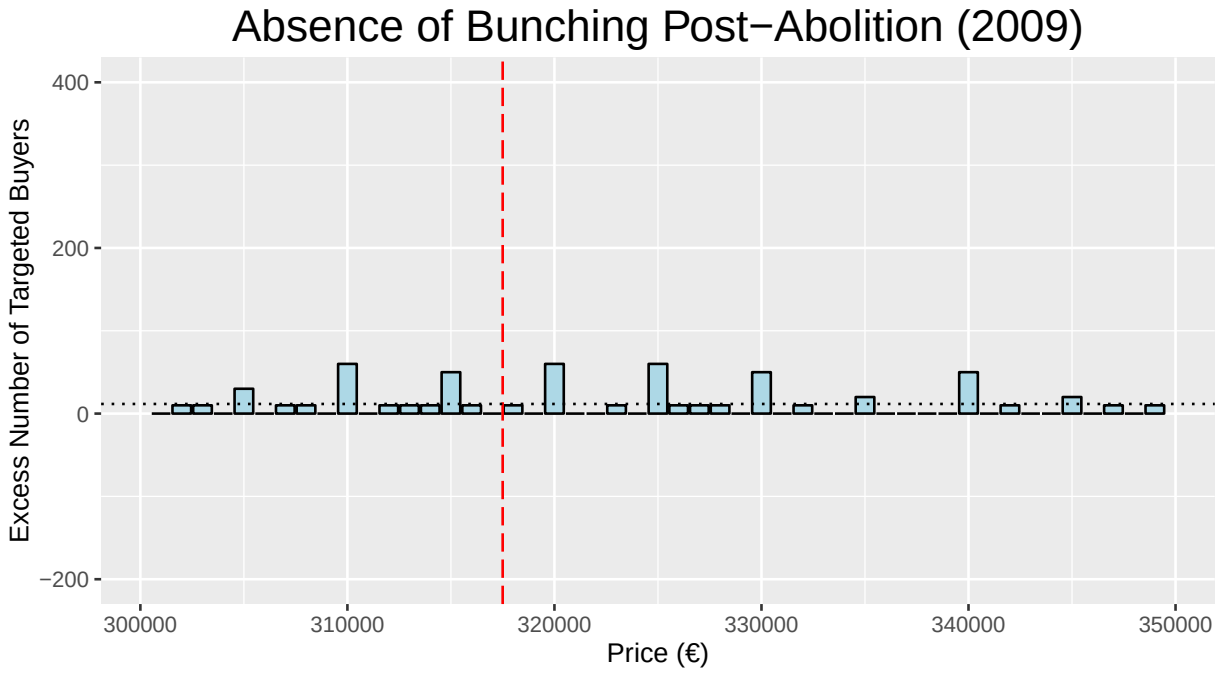

Figure 3: Drawn to the same scale as Figure 2 above, this figure shows the absence of bunching near the notch threshold after the policy was abolished.

In terms of levels, it is reasonably apparent that the abolition of the policy caused the notch-incentivised behaviour to dissipate. This is clear from both the histogram of the differences in sales by group (Figure 3), and the number of mortgages issued just below the threshold (Figure 4).

However, this policy was abolished during 2007, immediately before the Great Financial Crisis caused a sharp contraction in the housing market. One could argue that this secular decline in the market could spuriously generate the convergence in mortgage numbers by type, and indeed there is some evidence of a decline in tax avoidance during the recession (**?**). This argument can be counteracted with a difference-in-differences analysis. This approach looks not at the absolute levels of treatment and control groups, but instead identifies effects off a parallel trends assumption. If one believes the secular decline would affect treatment

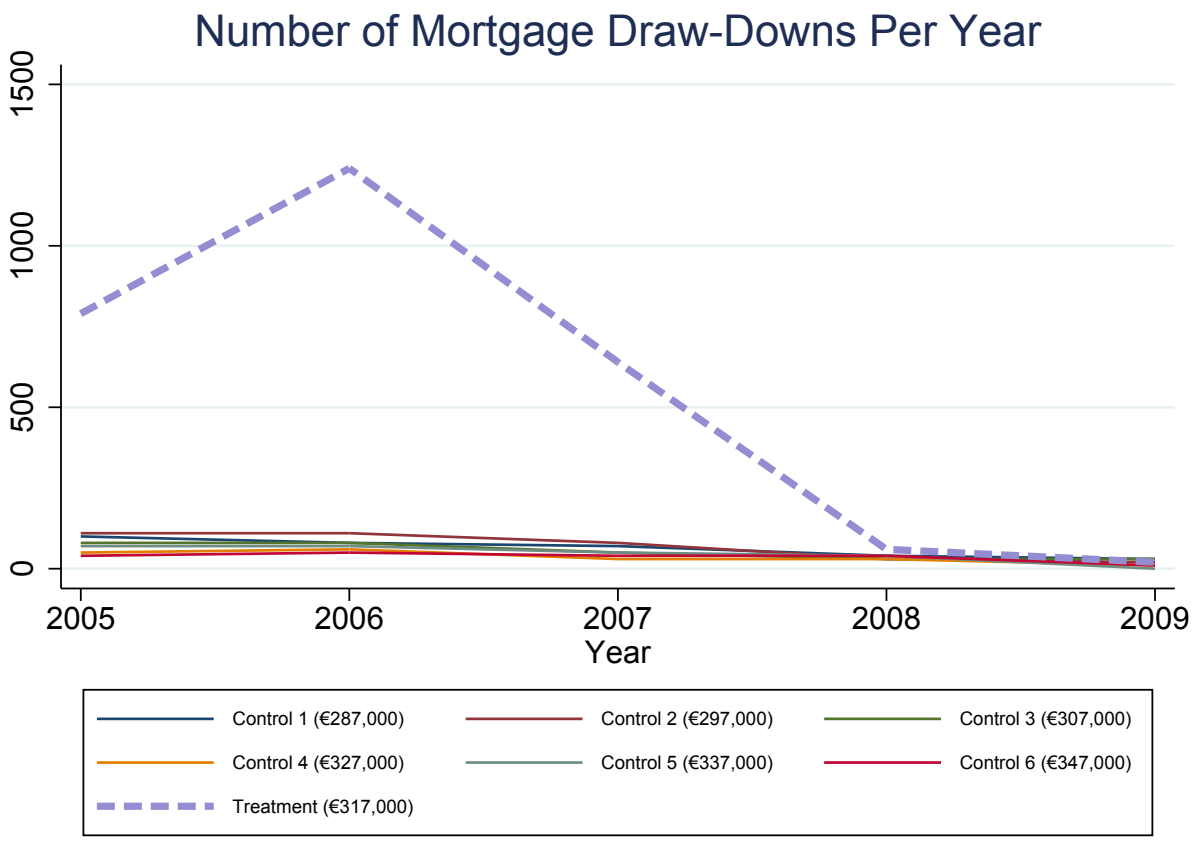

Figure 4: After the abolition, the excess number of mortgages issued at €317,000 substantially decreased relative to control groups.

and control groups in a consistent manner, this approach recovers the true effect of abolition on sales.

This is a difference-in-differences with two treatment groups. We expect the below-threshold treatment group will see a decline in the ratio of first- to second-time buyers, and we expect the above-threshold treatment group will see an increase. The difference-in-differences result shown in Table 1 confirm statistically what is suggested by the graphical depictions in Figure 5 at the end of this document.

With the outcome variable being the number of first-time buyers divided by the number of second-time buyers in a particular price bin, we see the intercept is about 1.7. From that base, being just below the €317,500 threshold increases this ratio by 1.447, and the coefficient on just above the threshold indicates the ratio is about 1 unit lower above the threshold. The treatment effect on the just below DD is -1.988, suggesting a decrease in the ratio from e.g. 3 to approx 1.012. The treatment effect on the just above DD is 0.655, implying an increase in the ratio from e.g. 0.5 to 1.155. As suggested by the figures above, there is no exceptional

Table 1: Diff-in-diff estimates of ratio of buyers

	(1) First- to Second-Time Buyers Ratio
Just below threshold	1.447***
	(0.080)
Just above threshold	-0.991***
	(0.080)
Post-reform dummy	0.376**
	(0.14)
Just below × post-reform	-1.988***
	(0.14)
Just above × post-reform	0.655***
	(0.14)
Constant	1.666***
	(0.080)
Observations	215
Adjusted R^2	0.058

bunching around the notch threshold post-abolition.

4 Conclusion

This paper investigated how property buyers reacted to a tax that treated first- and second-time buyers differentially. This tax policy created a notch that would increase the after tax price for first-time buyers by over €9,000. In the context of the public finance literature, the unique feature of the differential treatment of different category of buyers is the endogeneity of their bidding strategies and consequent spillover of the policy onto non-targeted individuals. The incentive for first-time buyers to not cross the notch threshold unintentionally created an opportunity for second-time buyers to purchase the property with a relatively small increase in cost. This indirect effect of the tax gave second-time buyers a competitive advantage in the property market, likely the opposite of the legislative intent.

I modeled the house purchase as an auction with a continuation value of non-participation.

As long as there is even an infinitesimal cost of submitting a bid and losing, it will be optimal for many first-time buyers to never bid above the notch threshold. With the knowledge of this fact, second-time buyers are more likely to bid just above the threshold, generally being allocated the property and securing the consumer surplus. This result is true even if both types of buyers' valuations are equal. The model predicts the notch drives allocative inefficiency.

With the predictions of bunching on both sides of the notch generated from the model, I turned to administrative data on mortgages to see if the Nash equilibrium was borne out by actual bidding strategies. There was clear evidence of excess mass near the threshold, and a double-hump delineated by tax status. Identification of these effects were strengthened by investigating the response of bidding strategies to a large reform of the policy in 2007. Almost all evidence of manipulation around the threshold disappeared when the notch was abolished, reinforcing the cross-sectional results described above.

On the face of it, the abolition of the notched elements of Stamp Duty in 2007 settled the policy implications of this research. Reform was a wise move, and one which Ireland should keep. However, the lesson remains relevant for other countries. For example, *Die Welt* reports Germany's ruling CDU party have recently floated the idea of an exemption of €100,000 (Chase, 2016). Exempting low-income people from taxes is a legitimate political objective. However, a policy with a phase-in of the tax liability would be more efficient.

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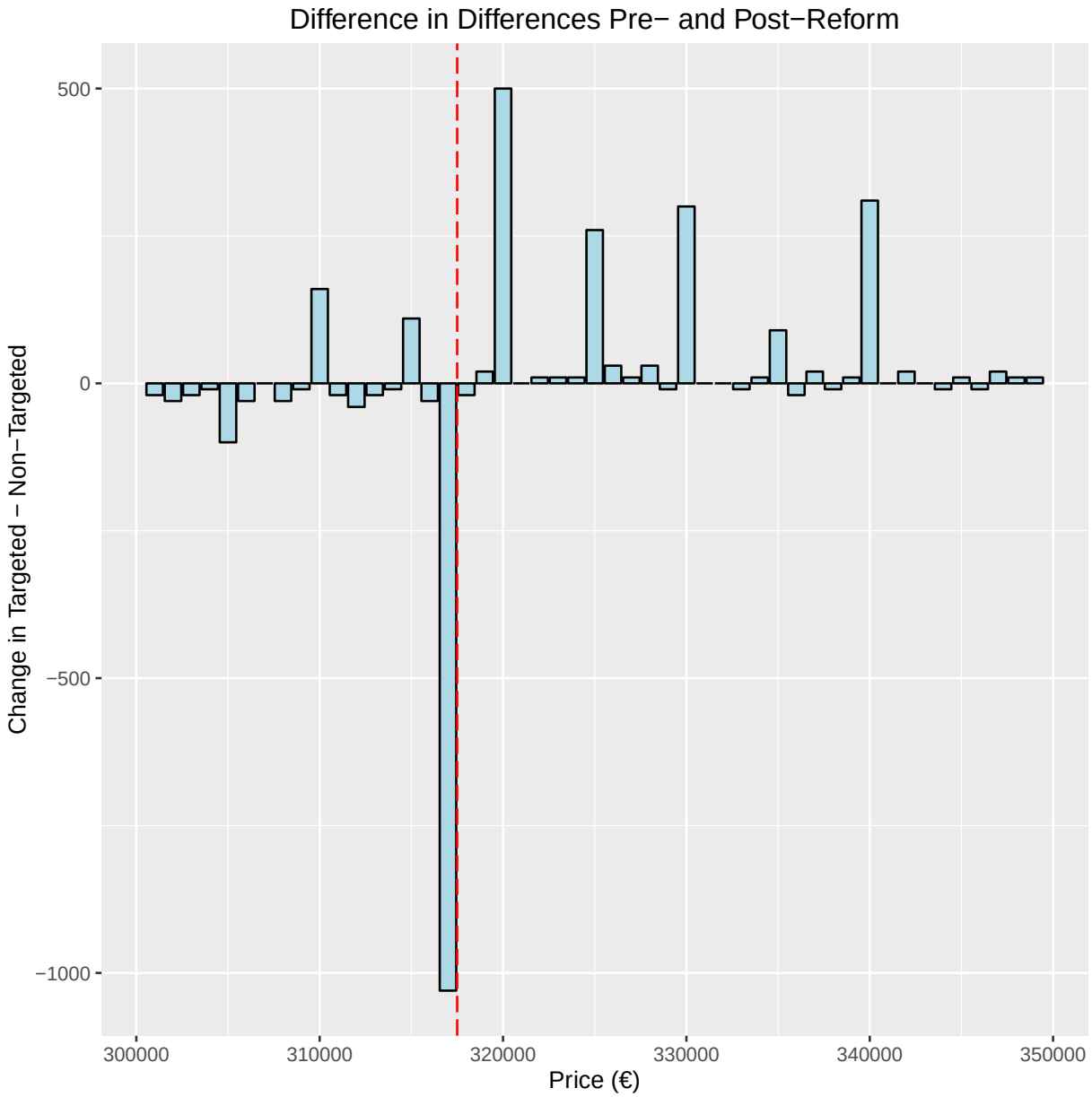

Figure 5: Graphical depiction of the diff-in-diff analysis.