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Abstract
We estimate the effect of the UK Stamp Duty Land Tax on household mobility using micro data. Exploiting a discontinuity in the tax schedule as a quasi-experimental setting, we isolate the impact of the stamp duty from other determinants of mobility. Our empirical strategy essentially compares similar households with self-assessed house values on either sides of a cut-off value where the tax rate increases from 1 to 3 percent. We find that a higher stamp duty strongly negatively affects a household's propensity to move: the 2 percentage-point increase in the stamp duty may reduce mobility of homeowners by around 40 percent. This adverse effect is mainly confined to short-distance and non-job related moves.

JEL Classifications: D23, H21, H27, J61, R21, R31, R38
Keywords: Stamp duty, real estate transfer tax, transaction costs, household mobility

1. Introduction

Most developed countries impose a tax – often labeled 'stamp duty' – on real estate transactions. The stamp duty increases the transaction costs associated with the sale of a property and therefore increases the costs of moving for homeowners. This cost increase can be expected to negatively affect the propensity to move of homeowners. To the extent that the stamp duty does prevent both housing- and job-related relocation, it is prone to have significant adverse effects on housing- and labor markets. Households may not live in the type of dwelling and the location that most closely match their preferences. Similarly, individuals may be less willing to accept new jobs that are not within commuting distance or they may decide to hold on to a current job that is a less good match than another available job further away. Given these potential adverse effects caused by mismatch in housing- and labor markets, the question of whether, and to what extent, the stamp duty reduces housing- and job-related household mobility is highly policy relevant.

The UK stamp duty – since 2003 termed Stamp Duty Land Tax (SDLT) but commonly referred to as 'stamp duty' – has long been criticized by economists as being inefficient. The Mirrlees Review (2011) highlights the fact that the British stamp duty system "creates a disincentive for people to move house" (p. 403) and the adverse consequences of this on the functioning of housing- and labor markets. To date, however, little is known about the *magnitude* of this disincentive effect on actual household mobility or the *nature of the affected moves* (housing- vs. job-related). The present study sheds light on these questions.

The revenues from the UK stamp duty on real estate transactions are substantial and have increased considerably over the years. Due to rising housing prices and the increases in tax rates, residential stamp duty revenue has increased from roughly £2 billion in fiscal year 2000-2001 to over £8 billion in 2008-2009. As the economic significance of the stamp duty increases it becomes ever more important to understand its incentive effects and its impact on the functioning of housing- and labor markets.

The UK provides an ideal setting to explore the impact of real estate transfer taxes on mobility decisions. This is partly because the stamp duty liability is quite substantial, at least for more expensive housing, and partly because the stamp duty liabilities jump sharply at various cut-off values, providing various 'discontinuities' that can be exploited empirically. Our analysis focuses on a discontinuity where the stamp duty jumps particularly strongly. This discontinuity allows us to isolate the impact of the stamp duty from other determinants of mobility. Specifically, we compare households with self-assessed house values on either side of the cut-off, while controlling for flexible but smooth functions of house values. We find that the stamp duty has a significant negative effect on household mobility and that this effect is confined to short-distance moves that are typically housing- rather than job-related.

Real estate transfer taxes are an important part of moving costs and they are the most important component directly determined by policy makers. Despite this, little is known about their effect on mobility. In a related study, Dachis *et al.* (2012) utilize the introduction of transfer taxes in Toronto to estimate their effect on the housing transaction volume and prices with a Differences–in-Differences approach. They find that a 1.1 percent real estate

transfer tax led to a 15 percent decrease in transactions in the first eight months after the introduction of the tax. The impact of the stamp duty on mobility may, however, differ from the impact on the transaction volume. This is because some transactions are carried out by investors rather than homeowners and because some homeowners may avoid transfer taxes by renting out their previous dwelling when they move.

Van Ommeren and van Leuvensteijn (2005) provide indirect evidence on the mobility effects of the stamp duty using individual panel data for the Netherlands. They estimate a competing risks hazard model of moving to renting or owning with house values as an explanatory variable and use a theoretical model to infer the effect of transaction costs. Their results suggest that a 1 percentage-point increase in the value of transaction costs—as a percentage of the value of the residence—decreases residential mobility rates by at least 8 percent.

In contrast to these previous empirical studies, our analysis focuses on identifying the *long term effect* on *actual household mobility* and on the *nature of the affected moves (housing- vs. job-related)*. This paper is to our knowledge the first quasi-experimental study that directly evaluates the effect of a real estate transfer tax on actual household mobility.

On the theoretical side, Nordvik (2001) analyzes the mobility effects of the stamp duty in a theoretical dynamic life-cycle model of housing demand. He finds that a 2.5 percent stamp duty decreases the number of moves by the model household over the life cycle from three to one. The dead-weight loss of the stamp duty is somewhere between 17 and 34 percent of the tax revenue.

Two strands of the economics literature motivate our analysis. Firstly, we draw on literature analyzing the effects of various housing market policies on residential mobility and the match between different kinds of dwellings and households with different housing needs. For example Glaeser and Luttmer (2003) argue that rent control may lead to wasteful mismatch of dwellings and households by locking-in households to suboptimal dwellings.[1]

Secondly, there is a long line of research starting from Oswald (1996) that explores whether high moving costs related to owner-occupied housing may have negative effects on owner-occupiers' labor market outcomes. Oswald (1996) argued that homeownership, by reducing mobility, may increase unemployment. He also provided cross-country evidence that is consistent with this conjecture.

Subsequent studies (e.g., van Leuvensteijn and Koning, 2004; Battu *et al.*, 2008; Munch *et al.*, 2006 and 2008) that use individual-level panel data and more rigorous estimating techniques, by and large, confirm Oswald's conjecture that homeowners are less mobile, however, they rebut Oswald's hypothesis that homeowners are more likely to become unemployed or have longer unemployment spells. Munch *et al.* (2006) point out that homeowners may set lower reservation wages for accepting jobs in the local labor market.

[1] In related studies, Munch and Svarer (2002) find that the tenancy mobility in Denmark is severely reduced by rent control. Svarer *et al.* (2005), also using Danish data, document that the propensity of finding a local job increases with rent control intensity but the probability of finding a job outside the local labor market decreases.

Hence, they are more likely to find jobs locally than renters. Munch *et al.* (2008) have argued, from a search theoretic perspective, that homeowners should have a lower transition rate into new non-local jobs and therefore should stay longer in their jobs. Battu *et al.* (2008) suggest that there are differential effects across tenure types and that it matters whether the starting point is employment or unemployment. Their findings imply that homeownership is a constraint for the employed and public renting is more of a constraint for the unemployed.

Coulson and Fisher (2009) explore a number of theoretical mechanisms that may affect the link between homeownership on the one hand and mobility and labor market outcomes on the other hand. They point out that different theoretical models can have very different predictions about the labor market at both micro and aggregate level. Their findings suggest that homeowners are less likely to be unemployed but they also have lower wages than renters. At the aggregate level, higher regional homeownership rates are associated with a greater probability of individual worker unemployment and higher wages. Stamp duty is one of the potential reasons why owner-occupiers are less mobile than renters.

The general lesson to be learned from these two strands of the literature is that policies that make households less mobile may harmfully affect the performance of housing- and labor markets.

Our study makes a contribution to this literature by looking deeper into one of the mechanisms that may explain differences in mobility by tenure status. A series of recent papers (Ferreira *et al.*, 2010 and 2011; Schulhofer-Wohl, 2011; Coulson and Grieco, 2012) examines the effect of negative equity on homeowners' mobility but there are few studies that explore the impact of property transfer taxes.

2. The UK stamp duty system and theoretical considerations

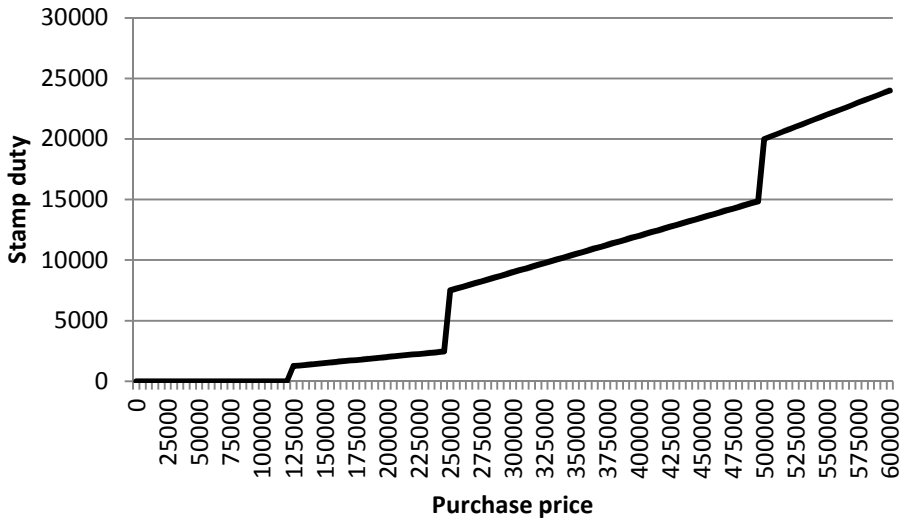
The stamp duty on real estate transactions was introduced in the UK during the 1950s. We focus on the current system of stamp duty on residential real estate transactions.[2] The stamp duty is paid by the buyer and is a percentage share of the purchase price of the house.[3] The defining feature of the UK stamp duty system is a progressive schedule where the tax rate for the whole purchase price goes up at certain thresholds. Table 1 reports the tax schedule that applies during our sample period: Houses sold for up to 125,000 are exempt from stamp duty, but from £125,000 upwards the tax rate rises in a stepwise manner from 1 to 5 percent.[4]

Figure 1 illustrates the relationship between the purchase price and stamp duty liabilities. Our empirical analysis focuses on the second of four cut-offs at £250,000 where the tax rate increases from 1 to 3 percent. We do so for two reasons. Firstly, stamp duty payable increases significantly at this cut-off (from £2,500 to £7,500). Secondly, our data is reasonably dense

[2] The stamp duty also applies to other types of property transactions.
[3] The economic incidence, however, can be mainly expected to fall on the seller: In a setting with a uniform stamp duty for all properties and relatively inelastic supply, the stamp duty will be nearly fully (negatively) capitalized into prices and the tax will be mainly borne by the seller.
[4] A new higher "mansion" tax rate was introduced for properties over £2 million on 22 March 2012.

around the £250k cut-off. Significant variation in stamp duty liabilities and large sample size together make it possible to detect the effects of the stamp duty on mobility.

FIGURE 1
Purchase price and stamp duty

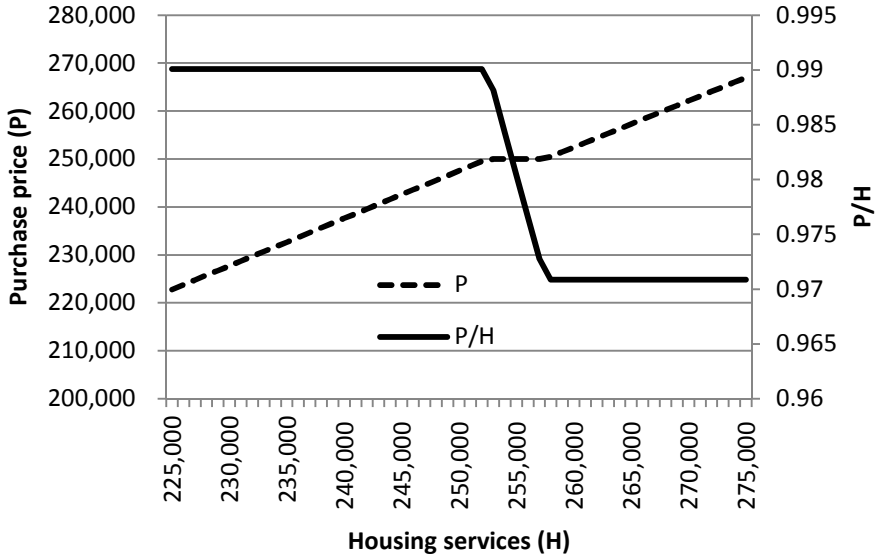


We focus on the current stamp duty system – the Stamp Duty Land Tax (SDLT), which replaced the old system in 2003. The SDLT was designed to crack down on tax evasion. In the old system it was possible to evade taxes by selling "fixtures and fittings" separately at excessive prices. In the current system, the sale of fixtures and fittings is declared together with the property and the Land Registry compares purchase prices with typical prices paid in the area to detect evasion.

We use the following theoretical reasoning to analyze the effect of the stamp duty schedule on incentives to move. Assume that dwellings produce a homogenous flow of housing services H. Denote the purchase price of the unit by P and the stamp duty rate by t. Further, assume that the buyers' willingness to pay for a unit of H is one pound. In this setting, the stamp duty is capitalized into the purchase price, and hence, P is given by $P = H/(1 + t)$. We assume that, other things equal, households' propensity to move depends negatively on the price per unit of housing services they receive upon sale (P/H).

Figure 2 illustrates the relationship between housing services provided by the unit (horizontal axis), price of the whole unit before tax (left vertical axis) and price per unit of housing services before tax (right vertical axis) in a UK type stepwise tax schedule with $t = 0.01$ up to P=250k and $t = 0.03$ for P>250k. With this tax schedule, a house with H just above the cut-off will sell for £250k because charging slightly above £250k would imply that the buyer is better off buying a house with slightly lower H and price £250k. As shown by the dashed line, a seller will only be able to charge above £250k if the value of the services above the cut-off exceeds the additional stamp duty liabilities (£5,000).

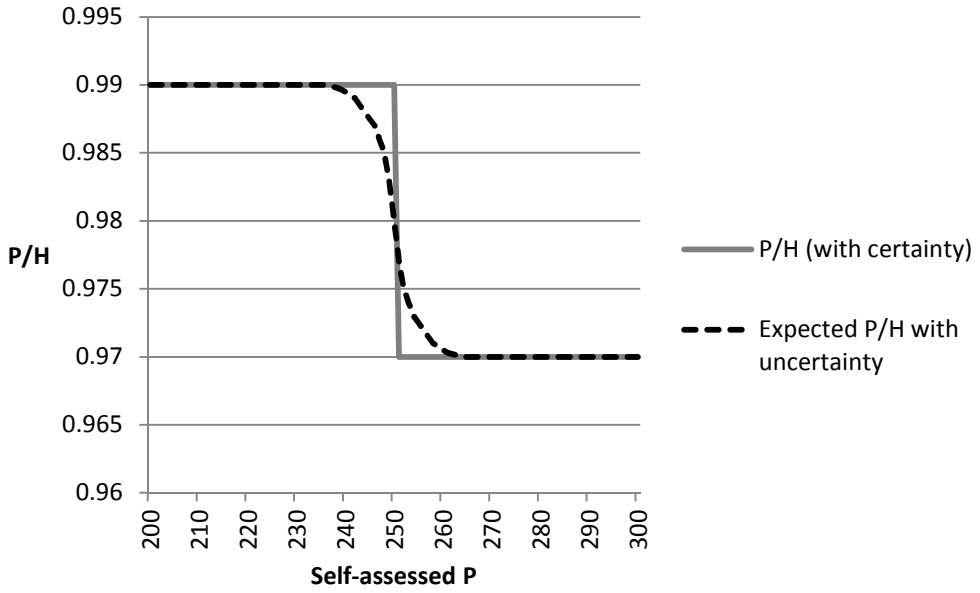
FIGURE 2
Housing services, purchase price and price per unit for the seller



Our empirical analysis is based on *self-assessed* house values and essentially compares those reporting house values above the 250k cut-off with households below the cut-off. Now we consider the relationship between the self-assessed house value and the price per unit of *H* obtained by the sellers. As a starting point, we assume that households think they know their house value with certainty. In this simplified case, sellers with house values below £250k face a market price of £0.99 per unit of *H* and households reporting above £250k face a price of £0.97. Households reporting exactly £250k include those who would sell for £250k even in the absence of the tax rate notch and those who would sell for £250k < $P \leq$ £255k in the absence of the notch but are unable to do so because of the notch. The latter group now receives £0.97$\leq P/H \leq$ £0.99. We argue that the decrease in the price per unit of housing services at the cut-off reduces the utility of moving compared with the utility of staying. Hence, we expect to see a drop in household mobility, when the perceived value of the house exceeds £250k.

Figure 3 illustrates that, with full certainty, *P/H* drops sharply at £250k. In practice, however, households are likely to be uncertain about the value of their house. We argue that uncertainty will smooth out the relationship between the self-assessed price and *P/H* as illustrated by the dashed line in Figure 3. Uncertainty implies that, strictly speaking, there is no sharp discontinuity in the *P/H* at the £250k cut-off. We argue, however, that at the scale we use in the empirical analysis, the discontinuity is sharp enough for regression discontinuity type empirical analysis to be informative of the causal effect of the stamp duty increase at the cut-off. Due to data limitations, and the fact that household mobility is difficult to model, we have to use data relatively far from the cut-off to get reasonably precise estimates. In our base specification, we use a sample where self-assessed house values vary between £175k and £325k (i.e., a 30 percent band around the £250k cut-off).

FIGURE 3
Self-assessed price and price per unit of housing services

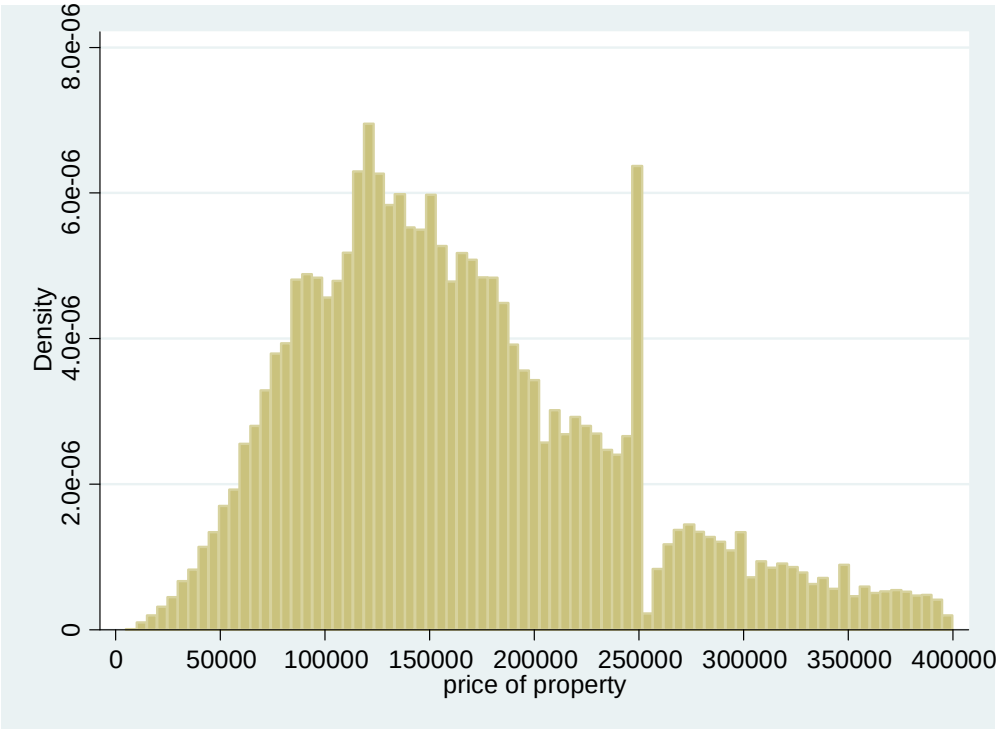


Our theoretical analysis suggests that we should observe a pile-up in the transaction price distribution at £250k because houses that would sell for up to £255k absent of the tax rate notch (i.e., the jump from 1 to 3 percent) will sell for £250k. This is indeed what is seen in Figure 4, which illustrates the distribution of actual transaction prices in the UK in 2005 from an auxiliary data set obtained from the Land Registry. Our simplified theoretical analysis also suggests that the price distribution right of the cut-off should move left and the distribution should continue smoothly after the cut-off. However, Figure 4 shows a dip in the distribution immediately right of the cut-off. Very few properties sell at £251k – £255k. The possibility to avoid taxes by selling fixtures and fittings separately at excessive prices is a likely explanation for this dip. Even though the SDLT system introduced in 2003 made such tax avoidance harder, it is likely that close to the cut-off people are more prone to engage in tax avoidance, even by unlawful means, because just above the cut-off expected benefits of trying to bring down the declared purchase price are larger compared with the risk of getting caught.[5]

[5] Our theoretical considerations thus far have abstracted from the fact that sellers may not only care about the sales price but also about the property's expected time on the market, which signifies an opportunity cost to them. Properties that offer housing services close to H=257,500 but can only be sold for £250k can be expected to have a shorter time on the market than properties that offer housing services H only slightly above 252,500 and that can also be sold for £250k. This effect may thus in principle further reduce the sharpness of the discontinuity in the P/H at the £250k cut-off. During our sample period, however, the median time on the market was quite short (see: http://www.hometrack.co.uk/our-insight/monthly-national-house-price-survey/time-to-sell-over-three-months-across-a-third-of-the-country; last accessed on 29/5/2012). Moreover, property sales in the UK are time-consuming mainly due to a complicated legal procedure that takes roughly 12 weeks irrespective of the 'attractiveness' of the asking price (see e.g., http://www.home.co.uk/guides/buying/; last accessed on 29/5/2012). Hence, the discontinuity in the P/H at the cut-off can be expected to persist even when endogenous time on the market is taken into account.

The Land Registry transaction price data used for Figure 4 does not include information about the owners and can't be used to analyze household mobility. The British Household Panel Survey (BHPS) data we use for that purpose is described in the next section. In this data, the key variable we use to determine the treatment status of households is their *self-assessed* house values. It is not clear whether respondents include the amount charged for fixture and fittings and possible illegal side payments in their house value estimates. If avoidance components are not included in the self-assessed value, households reporting a house value slightly above £250k will in fact face a P/H above £0.97, which would further smooth out the downward shift in P/H at the £250k cut-off in Figure 3.

FIGURE 4
Housing transaction prices in the UK in 2005



3. Empirical analysis

3.1. British Household Panel Survey data

The data used in this study is derived from the British Household Panel Survey (BHPS). The BHPS follows roughly 10,000 households over time. The survey began in 1991 and the most recent year available is 2008. The surveys for each wave are conducted between September and March. We define our 'year' variable as the year when data collection started.

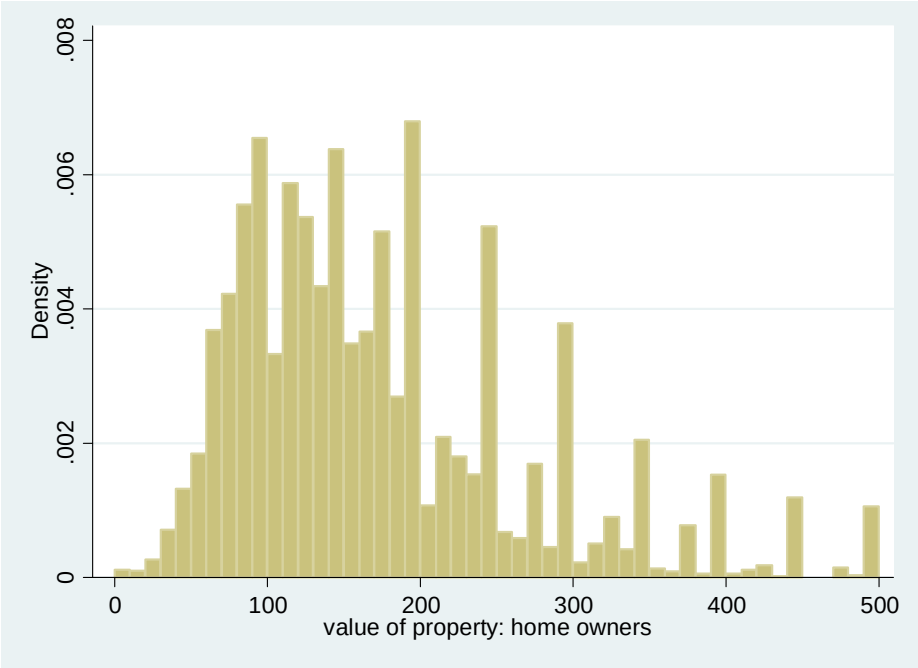
The data includes a rich set of household characteristics. The main variables used in the empirical analysis are the owner-occupiers' assessments of the value of their homes, and information on whether the household moved in the subsequent year. The exact question on which the self-assessed house value is based is: "About how much would you expect to get

for your home if you sold it today?" If the household gives a range, the interviewer will report the lowest figure in that range.

We limit the sample to the post 2002 period when the SDLT system with stricter control on tax avoidance came into effect. In the estimations, we further limit the sample to owner-occupiers with self-assessed house values within 20 to 40 percent bands around the £250k cut-off where the stamp duty tax rate jumps from 1 to 3 percent. Finally, we are concerned that recent movers may bias our results. Because many houses sell at and just below £250k, recent movers are disproportionately represented just below the cut-off. To the extent that the *recent mover* status affects mobility, this may bias our estimates. Moreover, recent movers may be problematic for our research design in the sense that they can precisely choose the value of their house. Their ability to "precisely manipulate" the assignment variable can invalidate the Regression Discontinuity (RD) design. Due to these issues, we exclude households that moved into their current dwelling between year *t-1* and *t*.

Figure 5 shows the distribution of self-assessed house values. Overall, people tend to report round values divisible by £50k. There is a clear spike at £250k, but this spike does not stand out from the other round values. The spike is clearly much more pronounced in the transaction price distribution in Figure 4. The fact that there is no abnormal pile-up at the cut-off supports the validity of the RD design.

FIGURE 5
Distribution of self-assessed house values (excluding recent movers)



Treatment variable

Our treatment variable is a dummy variable that equals one if the self-assessed house value of household *i* in year *t*-1 exceeds £250k, $Treat_{it\text{-}1}$ = D(*House value*$_{it\text{-}1}$ > 250k). Based on the

discussion in Section 2, we argue that the likelihood of being affected by the 3 percent tax rate rather than the 1 percent rate increases drastically at, or in the vicinity, of this point. The self-assessed value may not be an accurate measure of the actual value when a house is sold. However, the self-assessed value is arguably more relevant for our purposes as households' expectations regarding stamp duty payable upon sale are probably based on the self-assessed house value.

Outcome variable

Our outcome variable measures actual moves between the interview date and the subsequent interview. The variable move gets the value one if the BHPS records classify the household as a mover household in *t*. We lose some observations due to attrition from the panel between *t*-1 and *t* but we were able to recover the value of the moving indicator for some non-respondent households by utilizing information in the sample record files of the BHPS. In addition to the overall mobility, we study different types of mobility separately by using information on the distance of move and main reasons of moving.

We argue that a direct measure of household mobility is preferable to measures of housing transactions, used in Dachis *et al.* (2012), when the interest is on the potential adverse impact of the stamp duty on the functioning of housing- and labor markets. As already noted in the introduction, the effect of the stamp duty on transactions may differ from the effect on mobility for two reasons: (i) some housing transactions are carried out by investors rather than owner-occupiers, and (ii) some mover households can circumvent the stamp duty by renting out their previous house rather than selling it. In the latter case, the stamp duty leads to a distortion in a household's investment portfolio but may affect mobility to a lesser extent. In our data about 20 percent of owner-occupiers who moved appear to have rented out their previous unit.[6]

Control variables

Exploring the data suggests that households that report round house values divisible by £50k (£100k, £150k etc.) have a lower propensity to move. One might be concerned that households intending to stay do not follow the market as closely and give rough rounded estimates of the value of their house. The round value effect might bias our estimates if disproportionately many round values are in the treatment or the control group. To address this issue, we include a dummy variable for round house values divisible by £50k in the model as a control variable. In addition, we control for year specific effects that affect the whole economy by including year dummies.

Table 2 shows summary statistics for the variables used in our empirical analysis for the largest regression sample (40 percent band around the cut-off). The average house value in the sample is £220,000 and 4.7 percent of households moved within a year.

[6] Housing transactions are not recorded directly in our data. The estimate was calculated by checking whether owner-occupiers who had no additional property when they moved have an additional property two years later.

3.2. Empirical model

We use regression analysis to estimate the impact of an increase in the stamp duty rate on the propensity to move of owner-occupier households. The estimation of the effect of the stamp duty is challenging because stamp duty liabilities are likely to be correlated with other factors affecting mobility. However, the fact that the stamp duty rate for the whole property jumps at certain cut-off points can be used to identify the impact of the stamp duty. More specifically, we use the RD method discussed in Lee and Lemieux (2010). The idea of the empirical strategy is to compare mobility rates below the £250k cut-off point, where the stamp duty amount increases sharply, with the moving probability of households above the cut-off point. We estimate a regression model of a mobility dummy on a dummy for being above the cut-off point and include a flexible but smooth function of house values in the set of control variables. The house value variables pick up the impact of all determinants of mobility correlated with house values, apart from the stamp duty. Hence, we will obtain a reliable estimate of the effect of the stamp duty on mobility clean from confounding factors that might otherwise bias our estimates.

We estimate a reduced form model evaluating the mobility effect of being above the £250k threshold compared with being below the cut-off. We estimate by OLS the following model

$$Move_{it} = \beta_t + \beta_1 Treat_{it-1} + f(House\ Value_{it-1}) + u_{it}, \quad (1)$$

where the dependent variable $Move_{it}$ is the mobility indicator that gets the value one if household i moved between $t-1$ and t. The treatment variable takes the value one if the household's self-assessed house value exceeds £250k. The function $f(House\ Value_{it-1})$ is a 1^{st} – 4^{th} order polynomial of self-assessed house values. To facilitate comparability of the treatment and control groups, we limit the data to 20, 30 or 40 percent bands around the cut-off.

Our empirical model can be interpreted as a reduced form of a fuzzy RD design. Arguably, the discontinuity we exploit is likely to be fuzzy because we can't be sure whether all households reporting house values above the limit are affected by the 3 percent tax rate. Standard fuzzy RD analysis uses a discontinuity in the likelihood of obtaining the treatment as an instrument for the actual treatment status in a Two-Stage-Least-Squares regression. This approach is not feasible with the BHPS data because there is no way to identify the compliers. We argue that the reduced form of the fuzzy RD likely produces downward biased estimates of the actual treatment effect, because the treatment group as defined in (1) likely includes non-compliers and the control group includes compliers.

The identifying assumption of the model is that other determinants of mobility develop smoothly with respect to house values and are therefore captured by the f function. The ability of households to precisely manipulate whether they are to the right or to the left of the cut-off would invalidate the design. Manipulation of the self-assessed value is naturally possible but households do not have incentives to misreport in the BHPS survey. Manipulation of the actual value of the house may be possible too by, for example, neglecting

renovation. However, local demand and supply conditions are the main drivers of house prices and therefore precise manipulation is impossible.

If all households respond similarly to the stamp duty, our results for the £250k cut-off can be generalized to apply for the whole population in the UK, and possibly tell us something about the effects of similar taxes in other countries as well. With heterogeneous responses, the results may apply to a smaller sub-population. Drawing on Lee and Lemieux (2010), our estimates can be interpreted as a weighted average of treatment effects of the British owner-occupier households in the BHPS data. The weight of each household is the probability that their self-assessed house value falls within the band around the cut-off used in each specification we estimate.

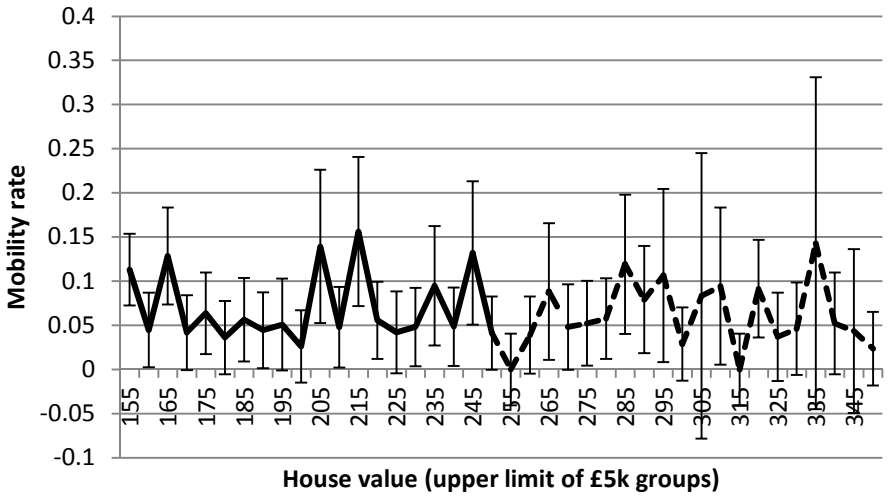
The panel property of the data and the lumpiness of the distribution of self-assessed house values have potential implications for statistical inference. Firstly, since the households in our sample are observed in multiple years, we have to account for within household correlation of the error terms. Hence, we cluster the error terms at the household level in our base specification. Another potential issue regarding statistical inference was pointed out by Lee and Card (2008), who discuss RD analysis with a discrete assignment variable. They argue that specification errors in the fitted regression line imply that at each discrete value there is an error component positively correlated within observations at that particular point, which means that standard errors are downward biased. They show that clustering standard errors by the values of the discrete assignment variable solves the problem. In principle, the self-assessed house value is a continuous variable and in the BHPS data there are observations at 147 different self-reported values within the broadest house value band we use (£150k – £350k). However, 97.7 percent of the observations are concentrated at values divisible by £5k. We construct a new house value variable by rounding house values up to the closest value divisible by £5k and use it as an alternative assignment variable in a robustness check where we cluster standard errors at the house value group level in addition to the household level. Clustering at all of the 147 discrete values is not feasible because of very few observations at several non-round values. Clustering at the house value group level may be problematic with the samples using the 20 percent and 30 percent bands around the £250k cut-off because the number of clusters is limited. With the 40 percent band, however, the number of house value clusters is reasonably large (40 clusters). This robustness check indicates to what extent standard errors clustered only at the household level are likely to be downward biased.

3.3. Results

We start with a descriptive analysis of mobility, in which we do not restrict the functional form of the relationship between the house value and mobility. Figure 6 shows predicted mobility for £5k wide house value groups from a regression of the mobility indicator on house value group dummies. The line in Figure 6 is highly volatile, but seems to suggest that there is a downward shift in moving probability when the self-assessed house value exceeds

£250k. Next we test for the statistical significance of this downward shift and attempt to quantify it with our RD type method.

FIGURE 6
Mobility and self-assessed house values



Notes: Predicted mobility from a regression of a move dummy on house value group dummies. Solid line indicates house values with 1 percent stamp duty rate and dashed line indicates house values with 3 percent stamp duty rate.

Table 3 reports the regression results on observed mobility. In the first column, we show the naïve regression where we do not control for house values. Columns 2 – 5 show the results with 1st – 4th order polynomials of house values and rows 1 – 3 use 20, 30 and 40 percent bands around the £250k cut-off. The Akaike Information Criterion (AIC) is shown in italics to assist specification selection.

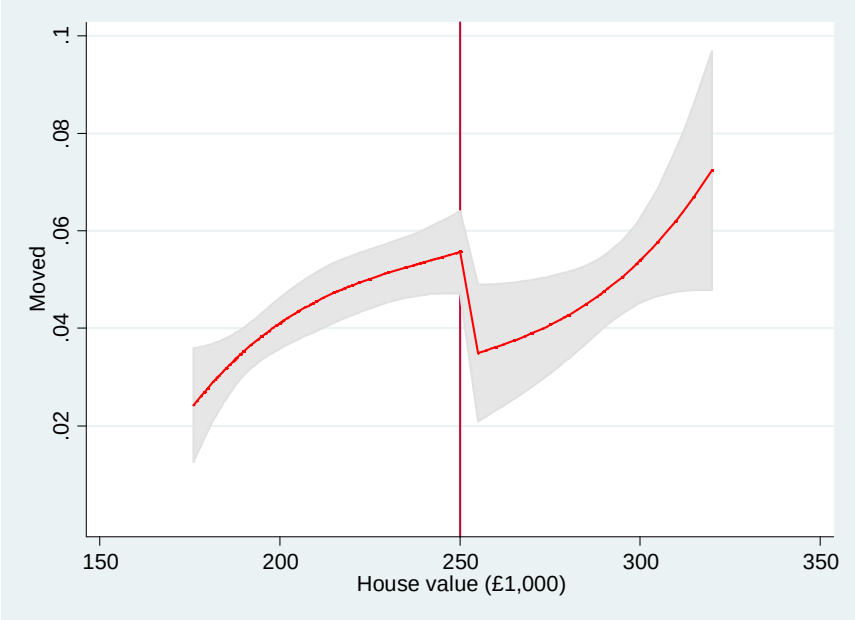
In the first column, the coefficient on the treatment indicator is close to zero and insignificant, but becomes negative and significant when the house value controls are added. With the +/-20 percent band, the estimates vary from -0.02 and insignificant to -0.055 and significant. Using a wider band makes the estimates more stable and decreases the standard errors. With the 30 percent band, the estimate is -0.025 and highly significant in the second column and stays virtually unchanged in the 3rd column. In the fourth column the coefficient is 0.22 and significant at the 5 percent level. We take this specification with the 30 percent band and the 3rd order polynomial of house values as our preferred specification. The band is wide enough for reasonably precise estimation and the 3rd order polynomial is chosen because adding further polynomials increases the AIC score. Taken at face value, the point estimate of our preferred specification implies that the 2 percentage-point increase in the stamp duty rate reduces the propensity to move by about 2.2 percent. A comparison with the average propensity to move (4.7 percent) reveals that this point estimate corresponds to a 38

percent decrease in the probability of moving.[7] In row 3, using a 40 percent band around the cut-off, the coefficient is insignificant with the 1st order polynomial but becomes significant with the 2nd order polynomial (or higher). Our various point estimates vary around our preferred estimate with the attached standard errors also varying around the standard error of the preferred estimate. Overall, our results provide strong evidence that an increase in the stamp duty has a significant negative effect on household mobility. They also suggest that naïve estimates may be quite misleading and that it is important to control for house values.

Standard errors in Table 3 are clustered at the household level to make them robust for correlation in the error term within household. As discussed in Section 3.2, the error terms may, in addition, be correlated within different self-assessed house values. In the Appendix Table A1 we show the results with the 40 percent band using £5k wide house value groups as the assignment variable and two-way clustering. The coefficients on the treatment indicator in Table A1 are almost identical to those in Table 3. A comparison of standard errors in Table A1 with the standard errors in Table 3 (40 percent band) suggests that the one-way clustered standard errors in Table 3 are only slightly downward biased. Two-way clustering increases standard errors by around 0.002 depending on the specification – the significance levels do not change.

Figure 7 illustrates the fitted regression line in our preferred specification, with the 30 percent band and 3rd order polynomial. The Figure shows the fitted regression line and the 95 percent confidence interval. There is a clear downward shift in the regression line at the cut-off.

FIGURE 7
Fitted regression line (30 percent band and 3rd order polynomial)



[7] The relative decrease in propensity to move was calculated by adding half of the absolute value of the treatment effect estimate to the mean of the mobility dummy and dividing the treatment effect estimate by this starting value (2.2/(4.7 +2.2/2) *100 = 38%).

Validity tests and robustness checks

A standard way of testing the validity of the RD design is to check if predetermined characteristics of households change significantly at the cut-off. If the flexible but smooth function of the assignment variable (self-assessed house values in our case) adequately captures other relevant factors, we should not observe changes in background characteristics of households at the cut-off. Specifically, we are concerned that households with a high underlying propensity to move and houses worth slightly above £250k (in the absence of the tax notch) may be better informed about the stamp duty and may therefore be more likely to report precisely £250k rather than slightly above £250k. To test this, we estimate model (1) using several observed determinants of mobility as the dependent variable. The variables used are: the age of the household head, dummy for kids, household income and two indicators of education (GCE A-levels or higher and bachelor degree or higher) as the dependent variable. If the sorting story was true we would expect to find significant coefficients in the balancing tests. The balancing tests for education are particularly important because in addition to being related with mobility, education may also be related with how well the household knows the stamp duty system.

Table 4 shows the results of the balancing tests with a 3rd order polynomial of house values in Panel A and 4th order polynomial in Panel B. Panel A, indicates that income, the likelihood of having children and education are not correlated with the treatment variable but, in the specification with the 40 percent band, age is statistically significantly higher in the treatment group. However, when we add the 4th order term of house values in Panel B, the coefficient becomes insignificant even with the 40 percent band.

In order to test whether our results might be driven by age and other confounding factors correlated with the treatment indicator we include age, dummy for kids, log of household income, dummy for GCE A-levels or higher, dummy for bachelor degree or higher and region dummies (19 regions) as control variables in model (1). Table 5 shows the results. The coefficients on age of household head, dummy for kids and log of household income are negative and significant and the dummy for bachelor degree is positive and significant (not shown in the tables). The coefficients on the treatment indicator are very similar to the specifications without the additional controls in Table 3, which increases our confidence in the finding that the stamp duty decreases mobility. The robustness of the results to observed determinants of mobility suggests that unobserved omitted variables are unlikely to bias our estimates significantly.

As a further test for whether households with a high underlying propensity to move sort into the self-assessed house value of £250k, we also re-estimated Table 3 dropping all households that self-report exactly £250k. The results reported in Appendix Table A2 are similar despite losing many observations. Our results survive even when we limit the sample to households who say they are willing to move. In this subsample, sorting on unobserved propensity to move should not be a problem. The results are shown in Appendix Table A3.

In our base specification, we fit the same polynomial over the whole range of house values and only allow the intercept to change at the cut-off. Restricting the polynomials to be the same on both sides of the cut-off can be considered intuitively unappealing, because it implies that we use data on the right of the cut-off to estimate the function on the left, and vice versa. We therefore estimate a more flexible specification in which we allow the slope of the regression line to differ by treatment status. That is, we estimate the coefficients on the n^{th} order polynomials of house values separately for the sample below the cut-off and above the cut-off. The drawback of this specification is less precise estimation because the number of parameters to be estimated doubles. We report results with 1^{st} – 4^{th} order polynomials of house values. The results are reported in Table 6. Again, all estimates are negative and seven out of twelve are statistically significant. As expected, the standard errors go up in some specifications, especially when estimating higher order polynomials.

Finally, we are concerned that our results might be driven by some irregularities related to the reporting of house values around round numbers. In order to test this possibility, we run placebo tests with artificial cut-offs set at £200k, £225k, £275k and £300k. We focus on our core specifications that use a 30 percent band around the cut-off and 3^{rd} and 4^{th} order polynomials of house values. The results are shown in Table 7. One of the eight placebo tests gives a positive and significant coefficient at the 10 percent-level, the rest are small and insignificant. The fact that our method does not give significant negative coefficients at artificial cut-offs increases our confidence in the finding that the decrease in mobility at £250k is indeed caused by the 2 percentage-point increase in the stamp duty at the cut-off.

Distance and type of moves

In Table 8, we study differential effects by distance of move. We divide moves into three groups based on the straight line distance of move: less than 10 kilometers, 10-30 kilometers, and over 30 kilometers. The shares of these groups in our sample are 56 percent, 17 percent and 27 percent. We use indicators for these categories as outcome variables in model (1). The results imply that the overall effect found in Table 3 is solely driven by short-distance mobility (less than 10km). Medium- and longer-distance mobility appear to be unaffected by the stamp duty. A likely explanation for this finding is that short-distance mobility is often related to adjustments of housing consumption. A 2 percentage point increase in the stamp duty may outweigh the benefits of typical housing consumption adjustments, such as buying one room more or less, but it may not outweigh the benefits associated with longer distance moves. The latter are typically related to other important decisions, such as changes in employment or family status.[8]

In Table 9, we show additional evidence that the reduction in mobility is mainly attributable to housing related mobility. We use information on the primary reason of moving to divide moves into three groups: 1) Job related mobility, 2) housing and area related mobility, and 3) reason of move 'other or unknown'. The share of moves mainly motivated by job related

[8] Consistent with this conjecture, Buck (2000) finds that job-related moves in the UK tend to be over longer distances (across rather than within Local Authority Districts).

reasons is only about 5 percent, which makes it difficult to identify a separate effect on job motivated moves. This issue notwithstanding, the results in Table 9 are in line with our interpretation of the distance-of-move results in Table 8. Coefficients for housing and area motivated moves are always negative and highly statistically significant in three of the six specifications while the coefficients for job related moves are close to zero and insignificant.[9] The results are less clear-cut for mobility for 'other and unknown' reasons. The negative and sometimes significant coefficients are indicative that part of the negative mobility effect of the stamp duty may be attributable to a reduction in this kind of moves.

4. Conclusions

The previous literature suggests two main channels through which the stamp duty may have detrimental effects on the functioning of the economy. Firstly, by increasing moving costs, the stamp duty may deter the unemployed from taking up jobs far from their residence or workers from switching to more productive jobs. Secondly, the stamp duty can make households tolerate larger discrepancies between the characteristics of their actual and the desired dwelling before moving. As a result, the match between dwellings and households is on average worse than in the absence of the tax. The increased mismatch on the housing market may lead to `waste' in the form of misallocation costs due to, for example, large households living in too small apartments and small households living in too large apartments simply because the stamp duty involved in moving outweighs the benefits of moving.

The stamp duty induced increase in moving costs will only have these adverse effects if it reduces mobility. Our findings suggest that the stamp duty indeed decreases household mobility substantially; a 2 percentage-point increase in the stamp duty reduces household mobility by around 40 percent. Our analysis of short- and longer-distance moves indicates that the effect is attributable to the stamp duty's adverse impact on short-distance moves, which are typically related to adjustments in housing consumption. This implies that the stamp duty leads to misallocation of dwellings in the housing market but its impact on the functioning of the labor market may be fairly limited.

Given the magnitude of the negative effect on (short-distance) mobility, we conclude that the stamp duty likely has very substantial detrimental effects on the functioning of the housing market. A further conclusion is that the stamp duty on residential properties may be an inefficient way of collecting tax revenue. Taxes on land (and housing) consumption that apply independently of whether a household moves also have real property as the basis of taxation but are more efficient from an optimal taxation theory point of view as such taxes are likely less distorting.

[9] This finding is consistent with a setting where the benefit derived from a job-related move has a low mean but a high variance. In such a setting we should observe few job-related moves and very few of them should be affected by the stamp duty.

In addition to the effect on the mobility of homeowners, the stamp duty may also affect the propensity that households choose to become homeowners. Households (especially those with a short expected duration) can be expected to become renters because the moving costs are high. The effect of the stamp duty on tenure choice is a question that should be explored in future work.

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Tables

TABLE 1
Stamp duty schedule (during sample period)

Purchase price	Stamp duty rate
Up to £125,000	0%
Over £125,000 to £250,000	1%
Over £250,000 to £500,000	3%
Over £500,000 to £1 million	4%
Over £1 million	5%

TABLE 2
Summary statistics (40 percent band around the £250k cut-off)

Variable	Obs.	Mean	Std. Dev.
Self-assessed house value	17997	221.8	47.9
Moved between t-1 and t	17997	0.047	0.211
Moved less than 10 km	17997	0.026	0.160
Moved 10 - 30 km	17997	0.008	0.087
Moved over 30 km	17997	0.013	0.113
Moved mainly for employment reasons	17997	0.003	0.052
Moved mainly for housing or area reasons	17997	0.021	0.143
Moved mainly for other or unknown reasons	17997	0.024	0.153
Round house value (divisible with £50k)	17997	0.344	0.475
Household has children	17997	0.340	0.474
Annual household income	17528	37787	24681
Age	17669	52.1	14.8
GCE A-levels or higher	17149	0.645	0.478
Bachelor degree or higher	17149	0.194	0.396

TABLE 3
Stamp duty and mobility

Dependent variable: household moved (0/1)						
Band around	Order of polynomial of house value					
£250k cut-off	NO	1st	2nd	3rd	4th	N
20 %	-0.001	-0.02	-0.037**	-0.055**	-0.044	6665
	[0.007]	[0.018]	[0.018]	[0.027]	[0.028]	
	-916	*-916*	*-926*	*-927*	*-929*	
30 %	0.006	-0.025***	-0.027***	-0.022**	-0.029**	14151
	[0.004]	[0.008]	[0.010]	[0.010]	[0.014]	
	-4742	*-4764*	*-4762*	*-4764*	*-4763*	
40 %	0.003	-0.011	-0.015*	-0.029***	-0.024**	17997
	[0.004]	[0.007]	[0.008]	[0.009]	[0.011]	
	-4946	*-4949*	*-4949*	*-4963*	*-4961*	

Notes: The table shows coefficients on the treatment indicator (house value>£250k). Additional control variables: year dummies, dummy for round house value. Standard errors clustered at household level brackets. * p<0.1, ** p<0.05, *** p<0.01. Akaike Information Criterion shown in italics.

TABLE 4
Balance of covariates tests

Panel A: 3rd order polynomial of house value					
Band around	Age	Kids (0/1)	Ln(HH income)	GCE A-levels or higher	Bachelor or higher
£250k cutoff					
30 %	0.66	-0.002	0.035	0.021	0.01
	[0.730]	[0.025]	[0.036]	[0.025]	[0.022]
40 %	1.926***	-0.021	0.008	-0.006	-0.017
	[0.658]	[0.022]	[0.032]	[0.022]	[0.020]
Panel B: 4th order polynomial of house value					
Band around	Age	Kids (0/1)	Ln(HH income)	GCE A-levels or higher	Bachelor or higher
£250k cutoff					
30 %	0.589	0.038	0.028	0.041	0.043
	[0.979]	[0.033]	[0.050]	[0.033]	[0.029]
40 %	0.442	0.016	0.034	0.017	0.018
	[0.798]	[0.027]	[0.040]	[0.027]	[0.024]

Notes: The table shows coefficients on the treatment indicator (house value>£250k). Additional control variables: year dummies, dummy for round house value. Standard errors clustered at household level in brackets. * p<0.1, ** p<0.05, *** p<0.01.

TABLE 5
Stamp duty and mobility – controls added

Dependent variable: household moved (0/1)						
Band around	Order of polynomial of house value					
£250k cutoff	NO	1st	2nd	3rd	4th	N
20 %	0.002	-0.025	-0.044**	-0.075***	-0.061**	6263
	[0.007]	[0.019]	[0.019]	[0.029]	[0.029]	
	-828	*-829*	*-841*	*-843*	*-849*	
30 %	0.005	-0.023***	-0.027***	-0.025**	-0.032**	13310
	[0.004]	[0.008]	[0.010]	[0.010]	[0.014]	
	-4414	*-4432*	*-4430*	*-4431*	*-4429*	
40 %	0.003	-0.01	-0.013	-0.027***	-0.026**	16983
	[0.004]	[0.007]	[0.008]	[0.009]	[0.011]	
	-4750	*-4753*	*-4751*	*-4765*	*-4763*	

Notes: The table shows coefficients on the treatment indicator (house value>£250k). Additional control variables: year dummies, dummy for round house value, age, dummy for kids, 18 region dummies, dummy for GCE A-levels or higher, dummy for bachelor degree or higher. Standard errors clustered at household level in brackets. * p<0.1, ** p<0.05, *** p<0.01. Akaike Information Criterion is shown in italics.

TABLE 6
Stamp duty and mobility – coefficients on n^{th} order polynomials allowed to vary on different sides of cut-off

Band around	Order of polynomial of house value			
£250k cut-off	1st	2nd	3rd	4th
20 %	-0.035*	-0.049	-0.150*	-0.173
	[0.018]	[0.035]	[0.077]	[0.130]
	-922	*-928*	*-926*	*-923*
30 %	-0.030***	-0.027	-0.070***	-0.043
	[0.011]	[0.017]	[0.026]	[0.059]
	-4762	*-4759*	*-4766*	*-4768*
40 %	-0.011	-0.041***	-0.042*	-0.059*
	[0.009]	[0.014]	[0.022]	[0.031]
	-4948	*-4957*	*-4959*	*-4974*

Notes: The table shows coefficients on the treatment indicator (house value>£250k). Additional control variables: year dummies and dummy for round house value. Standard errors clustered at household level in brackets. * p<0.1, ** p<0.05, *** p<0.01. Akaike Information Criterion is shown in italics.

TABLE 7
Placebo tests with artificial cut-offs

Dependent variable: household moved (0/1)			
Artificial	Order of polynomial of house value		
cut-off	3rd	4th	N
£200k	-0.012	0.000	15688
	[0.016]	[0.017]	
£225k	-0.003	0.006	14578
	[0.011]	[0.012]	
£275k	0.013	0.011	12149
	[0.013]	[0.013]	
£300k	0.005	0.039*	9409
	[0.013]	[0.022]	

Notes: The table shows coefficients on the placebo treatment indicator. Additional control variables: year dummies, dummy for round house value. Sample: +/- 30 percent band around the artificial cut-off. Standard errors clustered at household level in brackets. * p<0.1, ** p<0.05, *** p<0.01.

TABLE 8
Stamp duty and mobility – differential effects by distance of move

Distance of move:	Less than 10 kilometers		10 – 30 kilometers		Over 30 kilometers	
Band around	Order of polynomial of house value					
£250k cutoff	3rd	4th	3rd	4th	3rd	4th
20 %	-0.057***	-0.048***	0.013	0.013	-0.001	-0.002
	[0.018]	[0.018]	[0.011]	[0.012]	[0.014]	[0.014]
	-7559	*-7564*	*-12317*	*-12317*	*-9186*	*-9186*
30 %	-0.025***	-0.032***	0.002	0.009	0.007	0.000
	[0.006]	[0.008]	[0.005]	[0.007]	[0.005]	[0.008]
	-19372	*-19372*	*-30310*	*-30311*	*-22038*	*-22037*
40 %	-0.026***	-0.026***	-0.001	0.004	0.003	0.003
	[0.005]	[0.006]	[0.004]	[0.005]	[0.005]	[0.006]
	-23120	*-23118*	*-36730*	*-36733*	*-27561*	*-27559*

Notes: The table shows coefficients on the treatment indicator (house value>£250k). Additional control variables: year dummies and dummy for round house value. Standard errors clustered at household level in brackets. * p<0.1, ** p<0.05, *** p<0.01. Akaike Information Criterion is shown in italics.

TABLE 9

Stamp duty and mobility – differential effects by primary reason of move

Type of move:	Employment reasons		Housing and area related reasons		Other or unknown reasons	
Band around	Order of polynomial of house value					
£250k cutoff	3rd	4th	3rd	4th	3rd	4th
20 %	0.01	0.009	-0.027	-0.015	-0.032*	-0.03
	[0.007]	[0.008]	[0.019]	[0.021]	[0.019]	[0.018]
	-17833	*-17832*	*-6356*	*-6365*	*-5139*	*-5137*
30 %	0.005	0.007	-0.019***	-0.009	-0.004	-0.023**
	[0.003]	[0.005]	[0.007]	[0.010]	[0.007]	[0.009]
	-43659	*-43660*	*-16181*	*-16182*	*-13735*	*-13742*
40 %	0.002	0.007*	-0.020***	-0.017**	-0.01	-0.01
	[0.003]	[0.004]	[0.006]	[0.008]	[0.006]	[0.008]
	-55263	*-55271*	*-19077*	*-19075*	*-16601*	*-16599*

Notes: The table shows coefficients on the treatment indicator (house value>£250k). Additional control variables: year dummies and dummy for round house value. Standard errors clustered at household level in brackets. * p<0.1, ** p<0.05, *** p<0.01. Akaike Information Criterion is shown in italics.

Appendix

TABLE A1

Stamp duty and mobility – two-way clustering at house value group level and household level

	Dependent variable: household moved (0/1)					
Band around	Order of polynomial of house value (rounded up to closest £5,000)					
£250k cutoff	NO	1st	2nd	3rd	4th	N
40 %	0.003	-0.012	-0.016*	-0.028***	-0.026**	17997
	[0.005]	[0.010]	[0.009]	[0.010]	[0.013]	
	-4946	*-4951*	*-4950*	*-4961*	*-4960*	

Notes: The table shows coefficients on the treatment indicator (house value>£250k). Additional control variables: year dummies and dummy for round house value. Standard errors clustered at house value group level (£5,000 groups) and household level in brackets. * p<0.1, ** p<0.05, *** p<0.01. Akaike Information Criterion is shown in italics.

TABLE A2

Stamp duty and mobility – households reporting a self-assessed house value of £250,000 dropped

	Dependent variable: household moved (0/1)					
Band around	Order of polynomial of house value					
£250k cut-off	NO	1st	2nd	3rd	4th	N
20 %	-0.001	-0.02	-0.038**	-0.056**	-0.045	4706
	[0.007]	[0.018]	[0.018]	[0.027]	[0.028]	
	-204	-203	-213	-213	-215	
30 %	0.009**	-0.025**	-0.027**	-0.008	-0.014	12192
	[0.004]	[0.011]	[0.012]	[0.016]	[0.016]	
	-3947	-3960	-3958	-3961	-3962	
40 %	0.006	-0.002	-0.007	-0.035***	-0.031**	16038
	[0.004]	[0.009]	[0.010]	[0.013]	[0.014]	
	-4163	-4162	-4161	-4173	-4172	

Notes: The table shows coefficients on the treatment indicator (house value>£250k). Households reporting self-assessed house values of £250,000 were dropped. Additional control variables: year dummies, dummy for round house value. Standard errors clustered at household level brackets. * p<0.1, ** p<0.05, *** p<0.01. Akaike Information Criterion shown in italics.

TABLE A3

Stamp duty and mobility – sample includes only households saying they would like to move

Dependent variable: household moved (0/1)						
Band around	Order of polynomial of house value					
£250k cut-off	NO	1st	2nd	3rd	4th	N
20 %	0.001	-0.05	-0.071	-0.111	-0.111	1409
	[0.023]	[0.055]	[0.058]	[0.082]	[0.082]	
	1059	*1059*	*1060*	*1062*	*1062*	
30 %	0.014	-0.081***	-0.086**	-0.080**	-0.053	2808
	[0.015]	[0.027]	[0.036]	[0.037]	[0.045]	
	1619	*1602*	*1604*	*1605*	*1604*	
40 %	0.018	-0.046*	-0.071**	-0.106***	-0.062	3774
	[0.014]	[0.024]	[0.029]	[0.032]	[0.041]	
	2280	*2271*	*2271*	*2266*	*2262*	

Notes: The table shows coefficients on the treatment indicator (house value>£250k). Sample includes only households saying they are willing to move. Additional control variables: year dummies, dummy for round house value. Standard errors clustered at household level brackets. * p<0.1, ** p<0.05, *** p<0.01. Akaike Information Criterion shown in italics.

BIS Department for Business Innovation & Skills

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