Mortgage affordability and entrepreneurship: Evidence from spatial discontinuity in Help-to-Buy equity loans

Nikodem Szumilo* Enrico Vanino†

Abstract

We exploit a policy change in the UK Help-to-Buy (HTB) equity loan scheme in order to identify the causal link between mortgage affordability and entrepreneurship activity at the local level. We contribute to the literature on the relationship between housing finance and entrepreneurship by demonstrating the impact of government equity loans on entrepreneurship through the release of trapped liquidity. When less equity is required to buy a house, households could use the 'additional' liquidity to start a business. We use a spatial discontinuity in treatment methodology to take advantage of the reform of the Help-to-Buy scheme in 2016, which increased the limit of equity loans provided in London. By using data on business population at the postcode sector level, we are able to measure the impact of the new policy by comparing similar areas on the opposite sides of the Greater London Authority boundary. Our results show that an increase in mortgage affordability fosters entrepreneurial activity in affected areas by 20%, resulting in 1 more start-up on average per postcode per year. The new businesses are mainly single-plant micro enterprises in capital intensive sectors with low income volatility.

Keywords: entrepreneurship; home-ownership; help-to-buy; home equity; trapped liquidity

JEL codes: L26, D14, G21, R21, R38

*Bartlett School of Construction and Project Management – University College London.

†Department of Economics - University of Sheffield. Corresponding author: e.vanino@sheffield.ac.uk .

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1 Introduction

Theoretical and empirical research shows that the decision to start a business is a function of wealth (Hurst and Lusardi, 2004; Fairlie and Krashinsky, 2012). However, recent research also suggests that borrowing constrains can restrict this decision if the wealth is not liquid (Kerr and Nanda, 2009; Robb and Robinson, 2014). Several studies used exogenous variations in housing values to argue that their increase can alleviate borrowing constraints. However, it is notoriously difficult to disentangle the impact of increasing wealth from the impact of an increase in the value of collateral on the decision to start a company. We add to this literature by exploiting a policy change that increased mortgage affordability (lowering liquidity constraints) but did not affect the wealth of buyers at the time of the purchase. We argue that households who prioritize home ownership above entrepreneurship use the extra liquidity (savings released by lower mortgage constraints) to start companies in addition to owning houses. As both home ownership and the propensity to start a company are functions of wealth and liquidity, households with limited liquidity are forced to choose between allocating liquidity to home ownership or entrepreneurship. Our results demonstrate that high mortgage constraints are detrimental to entrepreneurship. This has important implications for policy making in both credit and housing markets. It also implies that rising house prices can negatively affect entrepreneurial activity if households are forced to allocate a larger share of their liquidity to mortgages.

Debates and discussions around home ownership and entrepreneurship have recently become increasingly important in many developed countries, given their policy-relevant implications for economic growth and households' income (Lee, 2018). After the financial crisis of 2008/09 numerous policies and initiatives have tried to encourage growth in housing and labour markets, recognising their strong relationship with general economic performance (OECD, 2003; Acs and Szerb, 2007; Decker et al., 2014; Mocking et al., 2017). For instance, entrepreneurship has been encouraged in many OECD countries by establishing entrepreneurship hubs and stat-ups centres (Stokan et al., 2015), promoting bank lending and alternative sources of finance (Bruton et al., 2015), and introducing tax breaks and new labour regulations (Hansson, 2012) in order to foster innovation[1] and create new jobs. At the same time, home ownership has also been a topic of interest for policy-makers. Through tax reliefs, moderated interest rates and subsidies policy makers have attempted to stimulate a sector badly affected by the credit crunch, and to help households enter the housing market, especially in countries where affordability issues are particularly severe (Andrews and Sanchez, 2011; Coulson and Li, 2013; Hilber and Turner, 2014; Pero et al., 2016; Fingleton et al., 2019; Szumilo and Vanino, 2018). However, many of these policies are very controversial due to their cost to tax payers, debatable efficiency and potential

[1]Note that this literature shows that entrepreneurship fosters innovation even if it is not targeted at high growth sectors.

externalities (Mole et al., 2009; Engelhardt et al., 2010; Winkler, 2011; Minniti, 2008)[2]. Thus, it is particularly important in the current policy debate to understand if policies promoting home ownership also influence entrepreneurial activities. In this study we exploit an exogenous policy change in the UK Help-to-Buy (HTB) scheme in order to identify the causal link between higher mortgage affordability and the rate of entrepreneurship activity at the local level.

Specifically, we contribute to the existing literature by analysing the impact of an increase in the limit of direct equity loans provided by the UK government to finance mortgage deposits on the rate of entrepreneurship activity at the local level. Our analysis uses spatial discontinuity in treatment assignment methodology taking advantage of this natural experiment which occurred at the beginning of 2016. At that time, the UK government has reformed the Help-to-Buy scheme only for the Greater London Authority, increasing the upper limit of equity loans from 20% to 40% of the purchased house value. The scheme aimed to help households with limited resources to qualify for mortgages increasing the transactions limit allowed with a lower debt exposure. It provides an ideal setting to study the impact of additional liquidity in the house purchase process on entrepreneurship.

Previous research has shown how the government's decision to provide larger equity loans has increased mortgage borrowing at the postcode level, while having no impact on the average number and value of housing transactions (Szumilo and Vanino, 2018). By using data on the population of businesses in the UK from the ONS Business Structure Database (ONS, 2017), we are able to compare postcode sectors on the opposite sides of the Greater London Authority boundary, measuring the impact of the policy reform on very similar local markets sharing parallel economic conditions. The natural experiment allows us to identify the local impact of higher government lending on entrepreneurship in very small areas, providing a suitable control group used to disentangle this effect. In particular, in our spatial discontinuity methodology the treatment is assigned to selected geographical locations within the Greater London Authority after the reform of HTB scheme for these areas. We can identify the treatment effect by comparing their entrepreneurship rates with similar postcode sectors immediately outside of the administrative boundary before and after the implementation of the reform (a difference-in-difference at boundary approach).

Our results show that the policy intended to promote home ownership has a positive indirect effect on entrepreneurial activity increasing it by more than 20%, creating new micro enterprises and thus

[2]Policies promoting entrepreneurship or home ownership have attracted an increasing attention also in the public and policy debate, see for instance newspapers articles on home ownership support in the UK (https://www.telegraph.co.uk/politics/2018/09/29/help-buy-scheme-not-working-should-housing-minister-admits/) and on public support to high-tech start-ups (http://uk.businessinsider.com/uk-government-investing-21-million-into-tech-city-uk-2017-11).

further employment in the local area. The positive effect on the growth of entrepreneurial activity is net of the exiting rate, suggesting that new firms created as a consequence of the HTB scheme reform do not crowd out existing businesses in the area. The mechanism we advocate is simple: since the decision to start a company is a function of liquidity, unexpected shocks to liquidity should affect entrepreneurship rates. In our case the shock is assigned to a specific house so that its buyer faces lower mortgage requirements. Notably, we are not able to track characteristics of households due to data limitations, meaning that we cannot distinguish between the impact of the treatment on individual local residents and on sorting. The fact that we cannot rule out sorting means that we do not know if the effect comes from households with savings who choose not to use them to repay a larger mortgage or from households with no savings who would otherwise not be able to buy[3]. However, in both cases the effect on local entrepreneurship is causal.

Our identification assumption is that the affected (new) firms are owned by people who live nearby[4] while entrepreneurship rates of non-local residents are not expected to vary across the treatment boundary. To support this assumption we 1) demonstrate parallel pre-trends, 2) show that business conditions and supporting policies do not change at the boundary at the same time as the policy is amended, and 3) replicate our main results using only business started at home. Further robustness checks show that the growth in entrepreneurship rates is particularly relevant in manufacturing industries, while it is not related to housing-market related sectors such as finance, real estate and constructions, and it is not driven by multi-plant companies. To further support our hypothesis, we follow previous studies that considered the impact of liquidity shocks on entrepreneurship to show that the positive relationship is statistically significant in particular for entrepreneurship entry in relatively capital-intensive sectors with lower level of profit volatility and risks.

The rest of the study is structured as follows. Section 2 provides an overview of the Help-To-Buy scheme, outlying its key features and the main points of the 2016 reform for London. Section 3 reviews the relevant literature and uses it to form predictions about the impact of HTB on area-level entrepreneurship rates. Section 4 describes the data, presents some summary statistics and explains our methodology. Results are discussed in section 5 and section 6 concludes by offering final remarks and policy implications.

[3]We also are unable to observe location decisions of households, so it is not possible to know if in the absence of the treatment the entrepreneurs would move into the same areas but not start a business or if they would choose to live somewhere else.

[4]Note that we do not distinguish between residents of the area before the policy was implemented and ones who moved in due to the policy.

2 The Help-to-Buy Scheme

In this study we focus on the Help-to-Buy Equity Loan scheme (HTB), introduced in 2013 by the UK government in order to promote home ownership by helping mortgage buyers. The key limitation on mortgage access in the UK is the loan to annual income ratio (LTI), which in most cases is limited to 4.5. The equity loan scheme promotes home ownership by offering equity loans that are not included in the LTI ratio by mortgage lenders. While theoretically this makes mortgages more accessible to borrowers with lower savings or with lower income, in practice low income households in London find it difficult to use the scheme. This is mainly because even after taking an equity loan, the LTI limit would require an income in the top half of the national distribution to purchase an average house in London[5]. In addition, the HTB scheme imposed debt to income limits which further restricted the ability of low income households to use the scheme.

Initially, the government offered 20% of the value of a new house and required a minimum own deposit of 5%, with up to 75% of the price being financed by a bank mortgage. The equity loan was free from interest (except for monthly £1 service charges) for the first five years after which the cost increased to 1.75% and raised with inflation (the increase is calculated as the retail price index plus 1%). Only new houses up to £600,000 were eligible in England. HTB equity loans were available to first-time buyers as well as house movers, but the purchased home had to be a borrower's only residence after the purchase. The loans were not available to assist buy-to-let investors or those who will own any property other than their HTB property after completing their purchase. Because the government had an equity claim on the market value of the house, the repayment amount was not fixed but a fraction of the market value of the property (40% in London after the change).

The loan could be repaid at any time (at the sale of the property if the house was sold before the loan was repaid) without additional charges. In default, the bank had the first claim to the asset and the government would only recover its funds after the mortgage principle was repaid. Critically, if the value of the property changed and the owner chose to sell it before the equity loan was fully repaid, the principal owed to the government was a share of the new price based on the initial equity loan. This was intended to reduce speculation amongst the scheme's participants by limiting the possible short-term gain. However, this also had consequences for limiting the risk to the borrowers who used HTB. With a 5% deposit a buyer is exposed to high risk of the housing market. With a traditional UK (full recourse) mortgage the exposure is not limited to the deposit. However, with a HTB loan the

[5] An average house in London of £500,000 with an equity loan of 40% (£200,000) and a deposit of 5% (25,000) requires an income of £61,000. In 2014 this was above the 93^{rd} percentile of individual income distribution while the average income was around £29,000 according to ONS.

buyer is only liable for a proportion of the negative equity if the value drops below 95% of the initial purchase price.

The participation rate in the scheme was relatively high across the country with around 20% of all new homes being purchased using HTB in the first year of its operation and the figure increasing to 33% if only properties outside of London were considered. The overwhelming majority of those loans chose the maximum equity loan of 20% of the purchase price. The biggest political concern of the scheme was the fact that only 6% of new houses in London were bought using the scheme, significantly below the national average. The key difference was that London's buyers faced much higher price-to-income ratios than the rest of the country, which meant that fewer borrowers qualified for mortgages. To address this issue in November 2015 the government announced that, starting from February 2016, the maximum level of the purchase price offered as the equity loan would be changed to 40%. Controversially, the increase would only apply to properties within the boundary of the Greater London Authority. Although average house prices in central London and their ratio to the income of local workers (including inward commuters) are much higher than in the rest of the UK, house prices do not change significantly at the border of the GLA as shown in Table 1.

Thanks to the change in the scheme, the HTB became significantly more popular in London. Before the change in policy, HTB loans constituted less than 10% of all new housing lending. However, out of around £345m of net new lending at the end of 2016 as much as £58m (16.8%) were HTB loans. However, it is difficult to assess if the popularity of the new London scheme is due to the city's high price to income ratios or the overall attractiveness of the higher loan. For instance, the increase in popularity of the scheme could have been driven by higher equity loans rather than removing an obstacle to use HTB in unaffordable areas. Indeed, Szumilo and Vanino (2018) have estimated how the government's decision to provide larger equity loans has increased mortgage borrowing at the postcode sector level, with little impact on average number and value of transactions[6]. This means that households using HTB are probably a combination of those who would be able to take mortgages without the scheme but chose to use it to optimize their finances, and those who rely on the scheme to buy their first house. Naturally, the first group is expected to have a larger impact on local entrepreneurship rates.

[6]Other studies of the scheme considered its impact on prices of new houses and the number of transactions (Carozzi et al., 2020), as well as characteristics of home buyers (Benetton et al., 2019).

3 Theoretical Framework

To form expectations on how HTB should affect local entrepreneurship we review the relevant literature. Importantly, we are limited by the fact that our unit of analysis is a postcode sector. We keep houses and locations constant but allow for sorting of people, so our expectations are place-based.

Our study is related to several strands of the literature on the relation between home equity and entrepreneurship as well as their spatial distribution. Since several papers have focused on developing theoretical models of entrepreneurship with liquidity constrains we do not attempt to model the process and focus our work on an empirical analysis.

The most natural starting point for this paper is the literature on financing constraints. Several papers have examined the financial structure of start-ups finding that new firms extensively rely on personal credit. Entrepreneurs receive personal loans from banks as well as friends and relatives (Kerr and Nanda, 2009; Robb and Robinson, 2014). Connecting entrepreneurial credit constraints to housing collateral, Corradin and Popov (2015) use US individual-level data to show that housing wealth helps alleviate credit constraints for potential entrepreneurs by enabling home owners to extract equity from their property and invest it in their business. Similarly, Schmalz et al. (2017), using cross-sectional administrative data on the variation of local house-price appreciation in France, demonstrate that collateral constraints restrict firm entry, affecting both the extensive (number of start-ups) and the intensive margin (post-entry performance). In this light, it is natural to expect that since entrepreneurs are heavily restricted by credit constraints, relaxing the constraint on the most important source of household credit (mortgages) would help those who aspire to both own a house and start a business. In the context of HTB this means that those who have enough assets to buy a house without the scheme may choose to use it and use their remaining savings to start a business. To test if this is true, we will show that the new firms started due to HTB are more likely to be in capital intensive industries which are difficult to start without external financing.

However, other contributions have challenged this interpretation mainly because of the potential omitted variable bias and the presence of alternative channels of transmission. For instance, Kerr et al. (2015) have investigated the relationship between house prices and entrepreneurship using US micro-level data. The authors find a modest effect of home prices increase on the rate of entrepreneurship, and while housing collateral plays a role, it does not seem to be a major barrier to entrepreneurship entry. Chetty et al. (2017) have stressed the importance of distinguishing between the effects of home equity and mortgage debt on household choice of risky financial activities. The predictions of their

model, tested empirically using US data, suggest that an increase in property value (holding home equity constant) reduces households' propensity towards risky financial activities such as stock-holding, while increases in home equity wealth (holding property value constant) raise the exposure of households' portfolio. Following these predictions, Bracke et al. (2018) study the link between mortgage debt and entrepreneurship using UK household-level data. Their results show that mortgage debt diminishes the likelihood of entrepreneurship by amplifying risk aversion, particularly when income volatility increases. Overall, according to the authors' theoretical predictions and empirical analysis, the link between housing equity and entrepreneurship is ambiguously signed because of the competing portfolio and wealth effects. The impact of the portfolio risk effect in the context of HTB is unclear, as risk exposure is lower for households who could borrow without the scheme while higher for those that do not have this choice. This seems to suggest that the first group could use HTB to limit their housing market risk and start a business. Indeed, this is consistent with reports that HTB borrowers are more likely to default despite being exposed to less housing market risk than comparable borrowers who do not use the scheme (Benetton et al., 2018). Unfortunately, we are unable to add to this literature by directly testing this prediction, as we cannot track either wealth or portfolio composition of entrepreneurs. We can, however, provide indirect evidence and consider the types of industries popular amongst the newly created firms. If they are in industries with highly volatile revenues, this would suggest that HTB encourages riskier businesses and would be consistent with an increased appetite for business risk.

A second strand in the literature has instead focused on the spatial correlation between home ownership and entrepreneurship mainly focusing on housing tenure, which captures more than just the financial aspects of owning a property and includes a range of aspects in relation to social status, mobility, household background and personal motivations (Dietz and Haurin, 2003; Parker, 2004). The managerial literature has shown that entrepreneurs tend to start their businesses in their "home" regions in which they live and have deeper roots and relatives (Michelacci and Silva, 2007; Dahl and Sorenson, 2009). According to this literature, two main factors could explain this evidence. First, entrepreneurs might choose the location of their new venture not in order to maximize profits, but also to spend more time with family and friends which increases their overall utility (Gimeno et al., 1997; Dahl and Sorenson, 2009). Secondly, the "regional embeddedness" of entrepreneurs in a local area provides them better information, resources and connections in the local market, which make it possible for their ventures to thrive even in places that appear unattractive to others (Blanchflower and Oswald, 1998; Benz and Frey, 2008; Andersson and Larsson, 2016). For instance, Dahl and Sorenson (2012) using Danish data have shown that entrepreneurs with longer tenure in a region where they both live and work have businesses surviving longer and generating greater profits. This research suggests that

if people living in a certain area become more likely to start business, outcomes for entrepreneurship rates can be observed in the same location. Once again this is more likely to apply to those who could buy houses without HTB. To demonstrate that the effects are truly local, we test for changes in business conditions across the GLA boundary and demonstrate no spillovers.

In conclusion, the research on entrepreneurship and housing finance seems to suggest that if HTB is used by people who have an option not to take advantage of it, but chose to free up some assets by taking advantage of the scheme, there should be a positive impact on local entrepreneurship rates in areas where HTB is available. It is difficult to imagine how a similar effect could be driven by households who were targeted by the scheme and have little assets in the first place. These would not only have limited resources to commit to a new business, but would also be exposed to higher levels of housing market risk.

4 Data and Methodology

The critical empirical challenge of this paper is to disentangle the impact of the HTB policy from all other determinants of entrepreneurship activity at the local level. To solve the identification problem, we focus on the differences in entrepreneurial activity before and after the reform of the HTB scheme on both sides of the Greater London Authority boundary. As we will demonstrate later, there is no evidence that local economic conditions and business support policies have significantly changed across the border,[7] but only the postcodes within the GLA have been affected by the HTB policy change. This allows us to exploit the boundary discontinuity effect that occurs between postcodes on both sides of the London boundary when the limit of equity loans is changed. This natural experiment also allows us to identify the impact of HTB on very small areas at the postcode sector level (around 7000 inhabitants over 600 hectares on average), and provides a comparable control group that allows disentangling the impact of higher government lending on entrepreneurial activity. This strategy focuses on looking at the treated houses rather than treated households. As a result, the identification assumption is that the affected (new) firms are owned by local residents while entrepreneurship rates of non-local residents do not vary across the treatment boundary. We perform several sensitivity tests

[7] In the UK, local entrepreneurship is supported by local authorities and by place-based policies of the central government. The two sources of support are mostly independent from each other and change over time. There was no substantial change in business or entrepreneurship support around the time of the change in HTB policy at the GLA level, although some new policies proposed by the central government were piloted in several local authorities across the UK, but not affecting London or the surrounding local authorities in this period. The main policy changes in this sense have been the reforms of the business rates retention and of the local government finance system, piloted during this period in local authorities other than those included in our study, while the 100% retention pilots affecting London differently from other places have been started only in 2018 after the end of our period of analysis (IFS, 2016, 2018). We have not found evidence of any other place-based business supporting activities taking place during this period in this area, such as the set up of new business parks, initiatives or funds for SMEs.

to check the validity of this assumption. Most notably, our results hold even when we limit our sample to start-ups registered in residential dwellings.

Our spatial discontinuity analysis relies on a difference-in-differences (DiD) design in which the treatment is assigned to geographical locations. By comparing observations lying closely on either side of the border, it is possible to estimate the average treatment effect even when randomization is unfeasible. The key identifying assumptions are that: a) the only variable that changes at the boundary at the specified time is the treatment; and b) the two sides of the boundary follow parallel pre-treatment trends. Following this spatial difference-in-differences design, the general empirical model is formulated as follows:

$$\Delta Y_{it} = \beta_0 + \beta_1 HTB_t + \beta_2 GLA_i + \beta_3 \left(GLA_i \times HTB_t\right) + \beta_4 X_{it} + j_i + j_t + \epsilon_{it} \tag{1}$$

where ΔY_{it} is the growth in entrepreneurial activity at the postcode sector i and year t level. The main parameter of interest is β_3, which captures the different impact of the HTB scheme reform for postcode sectors within the GLA boundary if $GLA_i = 1$ (and 0 otherwise) after the HTB policy reform has taken place at the beginning of 2016 (since when $HTB_t = 1$ or 0 otherwise). In addition, we include X_{it}, a vector of postcode-specific time-variant variables to control for other factors that could affect both entrepreneurial activity and house equity, such as house prices, number and value of new housing transactions, personal and SME lending, employment and productivity level, agglomeration index calculated following the Ellison and Glaeser (1997) method and total number of firms at the postcode level. Finally, we include both postcode j_i and year j_t fixed-effects[8].

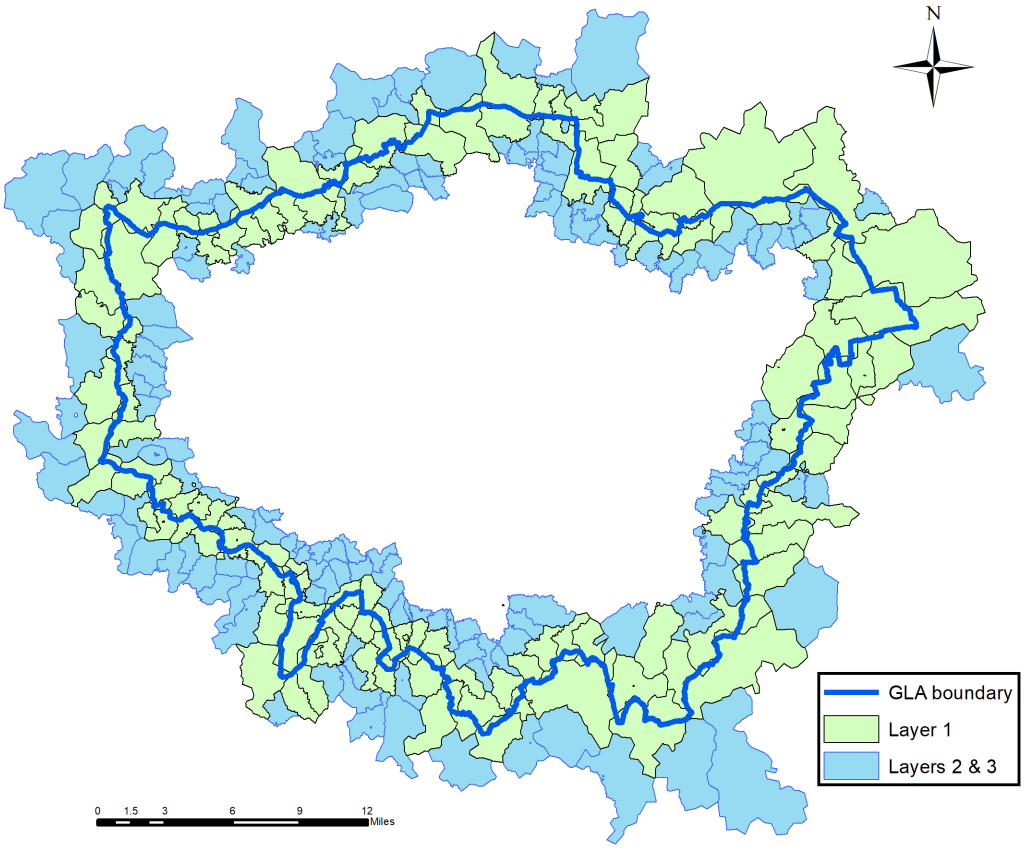
As we noted earlier, our identification strategy does not apply to households but to houses. We are also unable to identify individual entrepreneurs in our sample. This means that our treatment effects should be interpreted at the level of the treatment unit (house or area). We are unable to distinguish between locals who start a business because of the treatment and households who move from other parts of the country to start a business in the treated area. However, it is worth noting that we do not find evidence of spatial arbitrage due to the policy. We do not see existing firms moving from non-treated to treated areas even if they are close to the boundary. We also do not see any evidence of entrepreneurship rates decreasing with the distance to the treated area[9]

[8] Variables definitions and descriptions available in Table A1 in the appendix.

[9] Note that if the treatment was attracting entrepreneurs from other locations through a spatial arbitrage, most of them would come from similar areas. This means that HTB would have a negative impact on entrepreneurship on the non-treated side of the GLA boundary. This would occur as potential local entrepreneurs would move to London or as entrepreneurial movers from other parts of the country who are trying to decide between living in London or just outside of its boundary, choose to live in the affected area. This effect would be strong for areas that are direct substitutes (close

The spatial discontinuity in the treatment, combined with the difference-in-differences methodology, allows us to precisely estimate the impact of the HTB policy reform on the growth of entrepreneurial activity for postcodes within the GLA boundary after the policy change at the beginning of 2016. To control for the presence of parallel trends between postcode sectors on both sides of the GLA boundary before the HTB policy reform, we interact the GLA dummy with each of the year dummies in our period from 2014 to 2017. In this way we are be able to explicitly assess the change in entrepreneurial activity that occurred after the HTB policy in London has been changed, while controlling for potential pre-treatment differences in trends between postcode sectors within and outside the GLA boundary.

Figure 1: Postcode sectors included in the analysis bordering the Greater London Authority administrative boundary.



Note: Authors' elaboration based on ONS Open Geography Portal data at the postcode sector level.

We use information about the administrative boundaries of the Greater London Authority provided

to the boundary) and decrease as the areas differ. In appendix tables A3 and A5 we show that this is not the case.

by the Office for National Statistics Open Geography Portal as shown in Figure 1. Specifically, bordering postcode sectors are identified using the ONS postcode centroids shape-file, determining their adjacency to the border of GLA using ArcGIS proximity toolbox. The first layer comprises all postcode sectors that include at least one full postcode that is tangent to the boundary, while the second layer includes postcodes adjacent to the first layer and the third layer includes sectors tangent to the second layer. Once we identify the three different layers, we keep in our sample all postcode sectors with centroids within 2 kilometres from the boundary, precisely identifying similar and comparable sectors inside and outside of the Greater London Authority. In total, we identify 68 treated postcode sectors within the GLA boundary and 58 untreated outside the GLA.

We get information on entrepreneurship activity and other business-related variables using plant-level data from the ONS Business Structure Database (BSD) accessed through the UK Data Service, covering all businesses in the UK until 2017 (ONS, 2017). The annual BSD dataset is a live register of data based on the annual abstracts from the Inter-Departmental Business Register (IDBR) and collected by HM Revenue and Customs via VAT and Pay As You Earn (PAYE) records covering the population of firms operating in the UK. The BSD data provide information on plants' age, ownership, employment, industrial classification at the SIC 4-digit level and postcode at the street level. Entrepreneurial activity growth is then measured as the increase in the number of newly established businesses in each postcode sector since the previous year. However, previous empirical studies have stressed the importance of distinguishing between genuine entrepreneurship and other kinds of self-employment which could be driven instead by necessity such as adverse personal and economic conditions or unemployment (Hurst and Pugsley, 2011; Faggio and Silva, 2014; Bracke et al., 2018). For this reason, we differentiate entrepreneurs from self-employed individuals by considering new ventures with dependent employees, and looking at the different HTB externalities on both categories. In order to control for the overall economic performance of the postcodes sectors, from the BSD database we get information also about total employment, number of firms, the average labour productivity, measured as output per employee, and a measure of agglomeration estimated following Ellison and Glaeser (1997) methodology.

In addition, to demonstrate that the business environment has not changed at the GLA boundary, we get information on personal and SME lending by banks at the postcode level from UK Finance, accounting for almost 73% of all UK mortgages. We aggregate the quarterly data for each year, including new loans and borrowing agreements carried forward from the previous period less the amount repaid or written off[10]. Additional data on housing come from the Land Registry and include all transactions

[10]Data on the Help-To-Buy mortgages are available from the Department for Communities and Local Government,

of residential dwellings in England. This dataset provides information on the number and average value of all transactions, indicating if the sold property is newly built or existing. These are useful controls since credit supply can affect house prices (Szumilo, 2020a).

Table 1: Summary statistics of the main variables for postcodes within and outside the GLA boundary, before and after the implementation of the HTB reform.

	BEFORE				**AFTER**			
	IN		**OUT**		**IN**		**OUT**	
	mean	*s.d.*	*mean*	*s.d.*	*mean*	*s.d.*	*mean*	*s.d.*
New Start-ups	5.93	3.4	5.26	3.08	6.16	3.23	5.72	6.87
New Enterprises	1.18	1.18	1.23	1.41	1.33	1.16	1.14	1.36
New Self-Empl.	4.75	2.83	4.02	2.48	4.82	2.89	4.58	6.41
No. Firms	370.85	123.4	335.67	141.49	416.51	141.74	384.97	153.91
Start-up Rate	1.59%	0.76%	1.62%	0.85%	1.50%	0.62%	1.50%	1.18%
Entrepren. Rate	0.32%	0.31%	0.36%	0.36%	0.31%	0.26%	0.28%	0.33%
Self-Empl. Rate	1.27%	0.65%	1.25%	0.76%	1.19%	0.65%	1.22%	1.10%
Tot. Empl.	2,795	2,603	2,974	3,705	3,313	4,223	3,373	5,792
Av. Lab. Prod.	135.67	111.38	126.5	67.89	142.06	102.33	142.41	172.65
SME Loans	23,900	24,900	13,700	12,900	21,500	17,500	16,700	15,500
Av. Trans. Value	493339	333333	459418	246456	529327	324069	525527	363575
No. Postcode Sectors	68		58		68		58	
Observations	136		116		136		116	

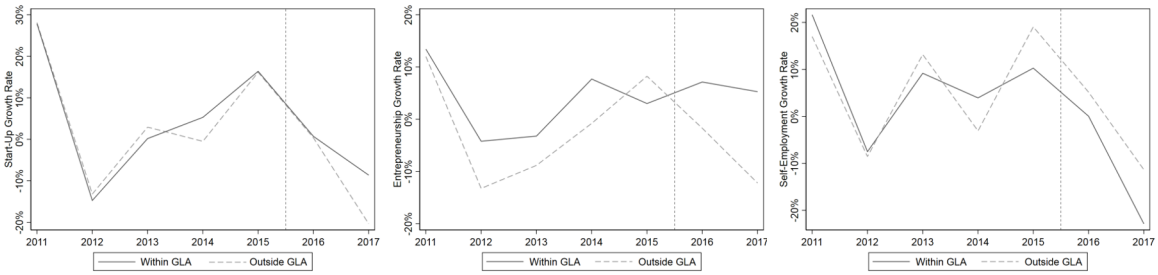
Note: data from the ONS Business Structure Database, UK Finance and the Land Registry for 2014-2015 (*before*) and 2016-2017 (*after*). Postcode sectors within the GLA boundary are considered in the *IN* columns or in the *OUT* otherwise. *Start-ups* is the number of new ventures per postcode, *new enterprises* the number of new ventures with dependent employees while *self-employed* is the number of self-employed new ventures. Rates are calculate as the ratio with the total number of firms in the postcode sector. *Labour productivity* measured as turnover per employee. *SME loans* reported in thousands of pounds. *Av. Transactions Value* reported in pounds.

Table 1 presents some descriptive statistics for the main variables included in our analysis, both for postcodes within and outside the GLA boundary and before and after the implementation of the HTB reform at the beginning of 2016. Note that postcodes on both sides of the GLA boundary are very similar in terms of entrepreneurship rate, economic performance, lending activity and housing markets characteristics. In particular, we address a potential concern for our analysis by showing that the number of new ventures and the entrepreneurship rates for postcode sectors within the GLA boundary are structurally similar to the non-affected sectors outside of the administrative boundary, even before the policy change in February 2016. We demonstrate that our estimation approach is unlikely to be biased by the presence of structural differences and pre-treatment trends in entrepreneurship rates between the set of treated and control groups of postcodes in Figure 2. It controls for possible pre-treatment trends and structural differences between postcodes on the two sides of the GLA border by plotting the trends of start-up, entrepreneurship and self-employment growth rates for both treated and control postcode sectors since 2011. It is noticeable that trends in terms of growth rates of new

but only at Local Authority District level, including the number and value of HTB loans made in each quarter.

ventures before the implementation of the HTB reform were very similar on both sides of the GLA boundary. It started to significantly diverge only post 2016, and mainly for entrepreneurial start-ups, while the trends within and outside the GLA stayed parallel in terms of self-employment growth.

Figure 2: Growth of start-up, entrepreneurship and self-employed rates for treated and control post-codes.



Notes: data from the ONS Business Structure Database from 2011 to 2017 for postcode sectors within and outside the GLA boundary. *Start-up* growth rate is the yearly increase in the ratio between number of new ventures and total number of firms per area, *Entrepreneurship* growth rate is the yearly increase in the ratio between number of new ventures with dependent employees and the total number of firms in the area, while *Self-employment* growth rate is the yearly increase in the ratio between number of new self-employed ventures and the total number of firms in the area.

Furthermore, we perform a number of additional tests to corroborate our main results, both in order to check the validity of the identification assumption and to deepen the understanding of the mechanism connecting the HTB scheme and entrepreneurship, as outlined in section 3. First, we explore the mechanism at play by performing a more disaggregated analysis of the distribution of the new ventures created, differentiating between start-ups in manufacturing and service industries, and between single-plant firms and new ventures belonging to other business groups. This will help us in identifying the link between HTB and entrepreneurship rather than the more general creation of new businesses. In addition, we exploit cross-industry variation to assess the different impact of the HTB scheme on entrepreneurship. As suggested in section 2, we expect that the effect would be stronger in less risky industries with low revenue volatility, and in capital intensive and financially constrained sectors.

Secondly, we perform several sensitivity tests to check the validity of our main identification assumption. This relies crucially on the co-location of affected new start-ups in the local area where the entrepreneurs are resident and benefited from the HTB reform to buy newly built houses. Thus, we first focus on specific service industries where a large majority of entrepreneurial businesses are operated from home (e.g. constructions, culture, IT and transports). In addition, we exploit information from a unique dataset on the location of commercial properties in order to focus only on start-ups

registered in postcodes without any commercial properties, thus which are registered at residential properties. Next, we show that the effect on entrepreneurship is not driven by other factors linked to the HTB reform, in particular the growth in local demand following the construction of new houses in these neighbourhoods. To do so, we exclude from our analysis industries directly affected by local demand growth (i.e. public administration, retail trade, restaurants and hospitality), and housing-market related industries, such as the real estate and constructions sectors.

Third, we perform further sensitivity tests in order to corroborate the main findings of our econometric estimation. We start by considering different dependent variables, such as the number of firms' closure, the net number of new firms measured as the number of new firms net of closures, and the respective rates weighted by the total number of firms in the postcode sector. In this way we take into consideration the exit rate of businesses in this area, measuring the net effect of the HTB scheme on entrepreneurship, and demonstrate that the new ventures do not crowd out existing businesses. Next, we control for potential spillover effects which could pose a methodological threat to our boundary DiD approach, for instance when gains in entrepreneurship inside the GLA could be compensated by losses outside, or if house prices on both sides are affecting each other (Szumilo, 2020b). To do so, we start by focusing only on the first layer of postcode sectors immediately tangent with the GLA boundary, and then only on the external layer of postcodes, or dropping alternatively different layers of postcode sectors within or outside the GLA boundary.

Finally, we demonstrate that our estimates are not biased by other confounding factors affecting the business environment differently across the boundary during this period. First, we replicate the baseline analysis for a number of performance indicators for already existing companies, such as total employment, turnover, labour productivity, and bank lending to SMEs and individuals (personal loans only). Secondly, we perform a placebo test where we arbitrarily move the treatment boundary on either side of the GLA border, thus comparing the fictionally treated and untreated layers within each side of the GLA boundary. These analyses are particularly helpful in demonstrating that the business environment across the boundary did not change at the same time as the HTB was amended. They also mitigate the concern of a potential bias related to confounding factors and structural differences between postcodes, comparing very similar and geographically close areas. In this way, we take into consideration also potential externalities of the HTB policy reform on unaffected areas through the relocation of households and businesses from postcodes outside to sectors inside of the GLA.

While our estimates of the treatment effect are very robust, it is important to note that we study a specific setting, and some of the results may not be universally externally applicable. The main claim

in our paper is that as some potential entrepreneurs face a liquidity trade off between buying a house and starting a business, more affordable mortgages could help them both become home owners and start a new business. This hypothesis is corroborated by the evidence provided by the HTB quasi-experiment. Therefore, we expect that in similar settings to the UK, where houses are unaffordable and deposits are a major issue for house buyers, households will face similar liquidity trade offs. Our results can also be viewed as a policy evaluation exercise. In similar settings, housing finance policy can be expected to have a similar effect on entrepreneurship. However, the magnitude of the effect and the exact impact on different sectors are likely to be specific to each setting.

5 Results

5.1 Main Results

Table 2 presents the results of the DiD analysis on the impact of the HTB reform on the growth of entrepreneurial activity in postcodes within the GLA boundary. The first 3 columns report the results of the estimations including only postcode and year fixed effects, while in the following 3 columns we add entrepreneurship controls, and in the last 3 columns we add both entrepreneurship and housing control variables.

First of all, there is no evidence of pre-treatment trends in terms of different entrepreneurship rates between postcodes within and outside the boundary before the reform of the HTB scheme at the beginning of 2016. Column 2 shows a positive effect of the HTB reform on the growth of the number of new entrepreneurial start-ups with dependent employees in 2017 in the postcodes affected in respect to unaffected postcodes outside of the boundary. These results are corroborated when adding more control variables related to the entrepreneurial performance of postcodes and their housing markets in columns 4 to 9. In particular, it is possible to notice that after adding more control variables the coefficients for the HTB-GLA interaction have increased in magnitude, especially when moving from no controls (columns 1-3) to some controls (columns 4-9). This is consistent with an omitted variable bias which is biasing the coefficients downwards in columns 1-3, where we omit to control for agglomeration and the number of firms, or the number and value of housing transactions. The results are consistent and robust across different specifications, finding also an overall positive and significant effect on the total number of start-ups once we control for other factors, with an increase by 20% mainly driven by entrepreneurial start-ups growing by around 30%. Looking at the average number of new stat-ups per postcode sector in the pre-HTB reform period, this coefficient translates in one new start-up per postcode per year being created on average. These findings suggest that entrepreneurial activity has

been affected with a time lag of one year, most probably because of the different time and resources needed to set up a structured new venture with dependent employees (Parker, 2004).

Table 2: Impact of the HTB reform on the growth of entrepreneurial activity by postcode sector.

	Baseline			**Entrepreneurship Controls**			**Entrep.& Housing Controls**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	No.StartUps	*Entr.StartUps*	*Self-Employ*	*No.StartUps*	*Entr.StartUps*	*Self-Employ*	*No.StartUps*	*Entr.StartUps*	*Self-Employ*
GLA#2014	0.0515	0.00966	0.0421	0.0423	0.00890	0.0312	0.0578	0.0284	0.0493
	(0.0866)	(0.112)	(0.104)	(0.0896)	(0.114)	(0.106)	(0.0927)	(0.114)	(0.107)
GLA#2015	0.0131	0.00937	0.0580	-0.00092	0.00173	0.0450	0.0115	0.00746	0.0620
	(0.102)	(0.113)	(0.102)	(0.0996)	(0.113)	(0.101)	(0.0963)	(0.117)	(0.096)
GLA#2016	0.100	0.108	0.0851	0.0913	0.0953	0.0805	0.0517	0.0918	0.0334
	(0.104)	(0.117)	(0.112)	(0.101)	(0.121)	(0.109)	(0.0965)	(0.119)	(0.108)
GLA#2017	0.151	0.249**	0.0758	0.206**	0.283**	0.137	0.222**	0.328**	0.147
	(0.0916)	(0.121)	(0.114)	(0.0955)	(0.128)	(0.117)	(0.109)	(0.128)	(0.133)
Year-PC FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Entrep. Vars	N	N	N	Y	Y	Y	Y	Y	Y
Housing Vars	N	N	N	N	N	N	Y	Y	Y
Observations	504	504	504	504	504	504	504	504	504
No.Postcodes	126	126	126	126	126	126	126	126	126

Note: data from the ONS Business Structure Database, UK Finance and the Land Registry from 2014 to 2017. *Start-ups* is the growth of new ventures per postcode, *Entrepreneurship Start-ups* the growth of new ventures with dependent employees, while *Self-employed* is the growth of self-employed new ventures. Results estimated using a spatial DiD regression analysis. Robust standard errors clustered at the postcode sector level reported in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All specification include postcode and year fixed effects not reported. Entrepreneurship controls include total employment, number of firms, average labour productivity, the Ellison and Glaeser (1997) agglomeration index and the value of SME loans at the postcode level. Housing controls include number and average value of new housing transactions at the postcode level and by transaction value range.

Table 2 shows that the increase in government lending has triggered growth in entrepreneurial activity one year after the introduction of the new scheme, with potential positive externalities also in terms of local employment. Now we are interested in understanding better the effect of the policy change on entrepreneurship within the GLA, and the mechanisms at play linking the HTB policy and entrepreneurial activity.

We also perform a more disaggregated analysis of the distribution of the new ventures created, investigating the heterogeneous impact of the HTB reform on entrepreneurship activity across industrial sectors and different characteristics of the entrepreneurial activities. We start in Table 3 by differentiating between new entrepreneurial activities consisting of single-plants or set up by multi-plant businesses in the first two columns. Consistent with the theory, the change in the policy affects only single plant entrepreneurial new ventures, suggesting that the HTB reform affects genuine entrepreneurship via improved home equity rather than stimulating the creation of new businesses more generally through other channels. In addition, columns 3-5 suggest that this effect is particularly relevant for the opening of new micro (less than 10 employees) and SME companies (less than 250 employees) but not for large firms, as expected.

Secondly, in Table 4 we focus on the industrial distribution of new ventures. From columns 1 and 2 we note that the HTB reform seems to stimulate the creation of new entrepreneurial activities both in manufacturing and in services industries, although the effect seems to be slightly larger for start-ups in services sectors. In unreported results, we find that the effect of the HTB scheme is positive and significant also for self-employed new ventures operating in service sectors. These findings suggest that the HTB scheme could push households more towards services industries either because of the release of trapped liquidity or by providing physical space needed for new entrepreneurs to establish their business at home (Reuschke, 2016). We then analyse the heterogeneous effect of the HTB policy reform at a more granular level across different characteristics of industrial sectors. For instance, in columns 3 and 4 we look at the effect on financially constrained sectors, based on the average capital expenditure over turnover per industry, but not finding any significant difference from unconstrained sectors. Finally, in columns 5 and 6 we distinguish between new entrepreneurial activities set up in risky versus non-risky sectors. We measure riskiness as the variation in industry-level profits using data from the ONS Annual Business Survey (ONS, 2018), calculated as profit variability adjusted for mean returns. As previously discussed, the existing literature has identified mainly two mechanisms through which mortgage lending and home equity could affect entrepreneurship: a "wealth" effect affecting an individual's risk aversion via a change in home-equity, or a "collateral" effect increasing the entrepreneurial propensity by providing collateral to get credit to start a new business. Previous

Table 3: Impact of the HTB reform on the growth of entrepreneurship by firm size.

	(1) **Single Plant**	(2) **Multi-Plant**	(3) **Micro**	(4) **SMEs**	(5) **Large**
GLA#2014	0.0834	0.0493	0.0239	0.0110	0.0590
	(0.0987)	(0.0452)	(0.111)	(0.0514)	(0.0927)
GLA#2015	0.0118	0.0620	-0.0426	0.0711	0.00544
	(0.0961)	(0.0480)	(0.105)	(0.0600)	(0.0958)
GLA#2016	0.0700	-0.0570	0.0336	0.0749	0.0427
	(0.0985)	(0.0444)	(0.120)	(0.0613)	(0.0969)
GLA#2017	0.231**	-0.0458	0.275**	0.209*	0.102
	(0.110)	(0.0321)	(0.116)	(0.107)	(0.0750)
Observations	504	504	504	504	504
No. Postcodes	126	126	126	126	126

Note: data from the ONS Business Structure Database, UK Finance and the Land Registry from 2014 to 2017. The dependent variables are the growth in the number of new entrepreneurial ventures: for single/multi-plant firms, micro (less than 10 employees), SMEs (between 10 and 250 employees) and large firms (more than 250 employees). Results estimated using a difference-in-difference regression analysis. Robust standard errors clustered at the postcode sector level reported in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All specification include postcode and year fixed effects not reported. Entrepreneurship and housing control variables included but not reported: total employment, number of firms, average labour productivity, the Ellison and Glaeser (1997) agglomeration index, the value of SME loans, number and average value of new housing transactions at the postcode level and by transaction value range.

studies have suggested that a growth of mortgage lending would negatively affect entrepreneurship by affecting the risk propensity of households, the "wealth" effect, and that these link would be stronger in sectors where profits have a higher variance and thus are more risky (Bracke et al., 2018). However, our findings suggest that the positive impact of the HTB scheme on entrepreneurship is stronger in non-risky sectors, experiencing a growth in new ventures one year after the policy reform, thus hinting in favour of a liquidity effect mechanism since the average propensity to risk in the area has not changed.

5.2 Robustness Tests

We perform several additional tests to corroborate our main findings, both in order to check the validity of the identification assumption and to test the soundness of the econometric estimation.

Our main identification assumption relies crucially on the co-location of affected new start-ups in the local area where the entrepreneurs are resident and benefited from the HTB reform to buy newly built houses. However, we are not able to observe directly whether individuals that benefited from

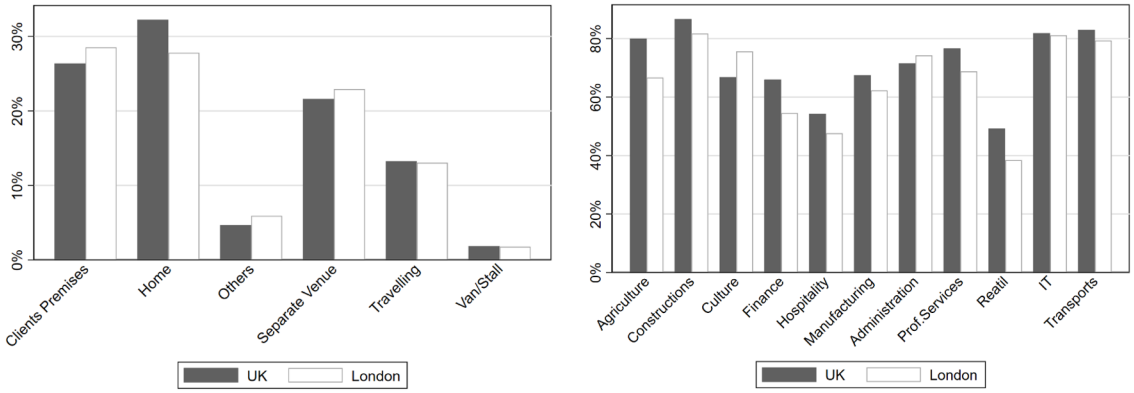
Table 4: Impact of the HTB reform on the growth of entrepreneurship by industrial sector, financially constrained and risky industries.

	(1) **Manuf.**	(2) **Services**	(3) **Fin.Constr.**	(4) **Non-Fin.Constr.**	(5) **Risky**	(6) **Non-Risky**
GLA#2014	-0.0156	0.0490	0.0206	0.0444	0.0631	0.0387
	(0.0641)	(0.0988)	(0.0988)	(0.124)	(0.108)	(0.123)
GLA#2015	0.0354	-0.00482	0.0285	0.0170	0.0715	-0.0255
	(0.0756)	(0.0936)	(0.0922)	(0.127)	(0.0990)	(0.124)
GLA#2016	-0.113*	0.0835	0.0514	0.0296	0.0701	0.00943
	(0.0658)	(0.0988)	(0.115)	(0.121)	(0.115)	(0.122)
GLA#2017	0.132*	0.208*	0.149	0.0742	-0.0289	0.442***
	(0.0940)	(0.112)	(0.163)	(0.137)	(0.148)	(0.128)
Observations	504	504	504	504	504	504
No. Postcodes	126	126	126	126	126	126

Note: data from the ONS Business Structure Database, UK Finance and the Land Registry from 2014 to 2017. The dependent variables are the growth in the number of new entrepreneurial ventures in manufacturing or service industries, in financially constrained sectors (based on the average industry capital expenditure over turnover), and in risky or non-risky sectors (defined as the average sector-level profits variability adjusted for mean returns). Results estimated using a difference-in-difference regression analysis. Robust standard errors clustered at the postcode sector level reported in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All specification include postcode and year fixed effects not reported. Entrepreneurship and housing control variables included but not reported: total employment, number of firms, average labour productivity, the Ellison and Glaeser (1997) agglomeration index, the value of SME loans, number and average value of new housing transactions at the postcode level and by transaction value range.

the HTB reform have subsequently started a new entrepreneurial venture. Thus, we follow alternative approaches to verify the validity of this assumption.

Figure 3: Distribution of entrepreneurs work location and share of entrepreneurs with a business registered at home by industry for London and the UK.



Notes: data from the UK Household Longitudinal Survey waves 6 and 7 (2014-2017). The diagram on the left shows the distribution of entrepreneurs main work location. The diagram on the right reports the share of entrepreneurs with a business registered at home by industry. Entrepreneurs with a business registered at home are considered as those who responded that their main work location is home, clients' premises, a van/stall or are usually travelling.

First, in Figure 3 we use data from the British Household Panel Survey (BHPS) and from the Understanding Society UK Household Longitudinal Study to provide anecdotal evidence about the work location of entrepreneurs across different industries in the UK and in London. From these statistics, we notice that less than a quarter of entrepreneurs report their work location to be at a separate venue than their residential properties. This evidence corroborates the claim that especially small ventures are more likely to be registered at the same location of the entrepreneur residence (Reuschke, 2016). In addition, from the diagram on the right it is possible to identify specific sectors for which the share of entrepreneurs with a business registered at home is particularly high, such as the constructions, cultural activities, IT and transports sectors.[11] Then, in the first column of Table 5 we replicate our baseline estimation focusing only on start-ups rates in these sectors, corroborating the main findings of the baseline model. In addition, we exploit a dataset from the Valuation Office Agency on the location of all non-domestic premises in the UK. This allows us to replicate our baseline specification focusing only on postcodes without any commercial properties registered, and thus to estimate the impact of the HTB reform only on new ventures that are registered at residential properties. The results of this estimation reported in column 2 are again consistent with the main findings, corroborating the validity of our identification assumption.

Then, we show that the effect on entrepreneurship is not driven by other factors linked to the HTB reform, in particular the growth in local demand following the construction of new houses in these neighbourhoods. To do so, in column 3 we exclude from our analysis industries directly affected by local demand growth, including public administration support, retail trade, restaurants and hospitality. In addition, following Corradin and Popov (2015), in column 4 we check that the HTB scheme is not driving entrepreneurship directly by inflating house prices and thus businesses in housing-related industries, such as real estate and constructions. In both cases, these robustness tests confirm the results of the main specification. Apparently, the increase in start-ups is significant also in sectors not directly linked to the housing market and to local demand, providing evidence that the HTB scheme reform in London has increased entrepreneurship by releasing trapped liquidity for households who become home owners and sequentially entrepreneurs. This is another finding suggesting and indirect externality of the HTB policy, affecting entrepreneurship by increasing households' equity rather than operating through demand pull-factors.

We perform several other sensitivity tests in order to corroborate the unbiasedness of our econometric estimations. First, in Table A2 in the Appendix we consider different dependent variables in order

[11] Entrepreneurs with a business registered at home are considered as those who responded that their main work location is home, clients' premises, a van/stall or are usually travelling.

Table 5: Impact of the HTB reform on the growth of entrepreneurship - home-registered businesses, new developments and local demand checks.

	(1) **Home Registered**	(2) **No Comm. Properties**	(3) **Non-Local Demand/PA**	(4) **Non Housing**
GLA#2014	0.116	-0.0464	0.106	0.0174
	(0.091)	(0.108)	(0.102)	(0.103)
GLA#2015	0.0515	-0.0989	-0.0588	-0.00781
	(0.110)	(0.117)	(0.0920)	(0.109)
GLA#2016	0.159	-0.0161	0.129	0.0393
	(0.174)	(0.125)	(0.146)	(0.102)
GLA#2017	0.191**	0.168*	0.134*	0.228*
	(0.066)	(0.088)	(0.071)	(0.130)
Obs.	504	504	504	504
No.PC	126	126	126	126

Note: data from the ONS Business Structure Database, UK Finance and the Land Registry from 2014 to 2017. The dependent variables are the growth in the number of new entrepreneurial ventures for different sub-sample: *home-registered* are ventures in industries characterised by high rates of home-registered businesses (constructions, culture, IT, transport); *non-commercial properties* are ventures in postcodes where no commercial property is recorded; *non-local demand/PA* are ventures in industries other than public administration and sectors linked to local consumers demand (retail trade, food, beverage and hospitality); *non-housing* are ventures in non housing-related sectors (real-estate, finance and constructions). Results estimated using a difference-in-difference regression analysis. Robust standard errors clustered at the postcode sector level reported in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All specification include postcode and year fixed effects not reported. Entrepreneurship and housing control variables included but not reported: total employment, number of firms, average labour productivity, the Ellison and Glaeser (1997) agglomeration index, the value of SME loans, number and average value of new housing transactions at the postcode level and by transaction value range.

to control for the possible effect on firms' closure, or to take into account the growth in entrepreneurship rate rather than the sheer number of new businesses. From column 1 we find no evidence of an effect of the HTB reform on the number of firms' closure, while in column 2 we find a negative and significant effect on the death rate, measured as number of closures over total number of firms at the postcode sector level, suggesting that the HTB reform has also helped existing firms in reducing the likelihood of closure through the release of trapped liquidity. In column 3 we test the robustness of our main results looking at the effect on the growth of the entrepreneurship rate, measured as number of new entrepreneurial venture over total number of firms in the postcode sector, in order to take into account for the overall stock of existing firms per postcode. The result is consistent with our main

specification. In columns 4 and 5 we use as a dependent variable instead the growth rate in the net number of overall start-ups and of new entrepreneurial ventures, net of the relative number of firms' closure. After controlling for closure, we find that the net effect of the HTB reform is positive, for the overall number of start-ups and in particular driven by entrepreneurial new businesses. Finally, in columns 6 and 7, we repeat the same estimation but taking into account the net rates, scaling net entry by the overall number of existing firms per postcode, finding again consistent results.

Secondly, in Table A3 we test further the robustness of our results, by performing more sensitivity tests focusing on alternative layers of postcode sectors within or outside the GLA, based on their distance from the GLA boundary, in order to control for potential spillover effects outside of the Greater London Authority which could invalidate the results of our boundary DiD estimation. In columns 1-3 we focus only on the first layer of postcode sectors immediately tangent with the GLA boundary, while in columns 4-6 we consider only the external layers of postcodes. In columns 7 to 12 we alternatively drop the first layer of postcode sectors within or outside the GLA boundary. In this way, we will be able to test whether our analysis might suffer from bias related to structural differences between postcodes on both sides of and at different distances from the boundary. This exercise will help us also to take into account the potential externalities of the HTB policy change on unaffected areas through the relocation of households and businesses from postcodes outside to sectors inside of the GLA. Note from column 2 that even after controlling for the similarity of economic performance across postcodes only in the first layer, we find a positive impact on the growth of entrepreneurial activity in the postcodes located immediately within the GLA, with very similar magnitudes to the effects estimated in Table 2. It is possible to notice that also the other results are robust across different estimations and consistent with our baseline specifications, confirming that the main results of our analysis should not be affected but these sources of bias. In fact, if spillover would have been an issue, we would have found divergent results in columns 4 to 12 in respect to the baseline, as we drop from our specification the closest layers of postcodes to the border where the potential spillovers would be more likely to occur. Similarly, the results hold when excluding alternatively the first layer within or outside the GLA, thus comparing layers potentially affected by spillover, with postcodes which are less likely to be affected by externalities, those located in layers 2 and 3 further away from the boundary.

Thirdly, in Tables A4 and A5 we demonstrate that our estimates are not biased by other confounding factors which we have not been considered so far affecting the business environment differently across the boundary during this period. Specifically, in Table A4 we replicate the baseline analysis for a number of performance indicators of already existing companies, such as total employment, turnover, labour productivity, and bank lending to SMEs and individuals (personal loans only). Our results show

no evidence of significant differences between postcodes on the opposite sides of the GLA boundary before nor after the HTB reform in terms of business performance. Interestingly, total employment and turnover have not changed within the GLA, suggesting that a growth in entrepreneurial activity might have increased the number of jobs and the wealth created in the affected area without hollowing out resources and business from other existing companies. In addition, this table provides also evidence about the similarity of the business performance in postcodes on opposite sides of the GLA border, reassuring that we are comparing geographically proximate areas very similar in terms of economic performance.

Finally, in Table A5 we perform several placebo tests where we arbitrarily move the treatment boundary on either side of the GLA border, thus comparing fictionally treated and untreated layers within each side of the GLA boundary. The results of all these placebo tests are statistically insignificant, thus confirming that the observed effect is indeed coming from the boundary that decides what percentage of the house value can fall under the HTB loan. These findings rule out the possibility that there might be some other unobserved factors at play simultaneous to the HTB reform, which could affect the business environment, and thus entrepreneurship, in different ways for postcodes immediately inside or outside the Greater London Authority. Overall, these robustness tests corroborate our main findings, confirming the indirect effect of the HTB reform on the increase of entrepreneurial activity in postcodes within the Greater London Authority through released trapped liquidity.

6 Conclusions

This study exploits a recent policy change in the UK "Help-to-Buy" (HTB) scheme for the Greater London Authority in order to identify the causal link between mortgage affordability and the rate of entrepreneurial activity at the local level. We contribute to the existing literature in two ways: by putting forward an argument that there is a liquidity trade-off between home ownership and entrepreneurship, and by identifying a causal link between lower mortgage requirements and entrepreneurial activity. We also provide an interpretation of the mechanisms through which the HTB scheme fosters entrepreneurship activity.

Our results show that an increase in home equity lending fosters the creation of new ventures in affected postcode sectors, mainly creating new micro enterprises in the local area. Further robustness tests show that the growth in entrepreneurship rates is particularly relevant both in manufacturing and services industries, but it is not related to housing-related or local-demand dependent sectors, and it

is driven by small single-plant companies. In addition, our results hold even when we limit our sample to businesses started at home (rather than a commercial building). Our findings, corroborated by several robustness tests, suggest a relevant indirect impact of the HTB scheme reform on the creation of new ventures, identifying a causal effect linking home equity lending and entrepreneurship, likely by relieving the financial constraints faced by potential entrepreneurs, and unveiling interesting policy implications for the indirect positive effects of this policy.

One such implication is that housing and entrepreneurship policies and their outcomes are inexplicably linked. Any policy that affects one of these areas can likely spill over to the other. This conclusion is supported by a large body of research that argues that both decisions (to become an entrepreneur and to become a home owner) are driven by similar factors such as risk aversion, wealth and liquidity. However, this is the first paper to document a spill over from a housing policy to entrepreneurship. The results do not show that housing finance can be a policy tool for fostering entrepreneurship in specific sectors. Instead, our paper emphasizes the importance of liquidity in starting a business and shows a liquidity trade off that seems to be important in the sample we study. Another important conclusion from our study is that spatially targeted financial policies may have unintended consequences in the form of creating an unequal economic development. Spatial differences in credit availability have long been theorized (Pollard, 2003; Martin et al., 2005; Gabriel and Rosenthal, 1991) to contribute to differences in economic outcomes. We provide empirical evidence that clearly shows how a spatial discontinuity in liquidity constraints leads to changes in economic performance across the boundary. Although the effect we find is small, the fact that it exists has important implications for regional economic unevenness and financial inclusion.

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A Appendix

Table A1: Variables Definitions and Descriptions.

Name	Definition	Source
Start-ups	Number of new ventures per postcode sector and year	ONS BSD
Entrepreneurship Start-ups	Number of new ventures with dependent employees per postcode sector and year	ONS BSD
Self-employed	Number of new self-employed ventures per postcode sector and year	ONS BSD
GLA	Dummy variable equal to 1 for postcode sectors within the Greater London Authority (GLA) and 0 otherwise	ONS
HTB	Dummy variable equal to 1 for years after the reform of the HTB scheme for the GLA (2016 and 2017) or equal to 0 otherwise.	ONS
No. of Firms	Total number of firms per postcode sector and year	ONS BSD
Tot.Employment	Total number of employees per postcode sector and year	ONS BSD
Labour Productivity	Average ratio of turnover per employee per postcode sector and year	ONS BSD
SME Loans	Total amount of loans provided to SMEs per postcode sector and year	UK Finance
Agglomeration Index	Agglomeration measure estimated following the Ellison and Glaeser (1997) methodology	ONS BSD
No. Transactions	Total number of new housing transactions per postcode sector and year	Land Registry
Av. Value of Transactions	Average value of new housing transactions per postcode sector and year	Land registry
Single Plant	Firms consisting of only one plant	ONS BSD
Multi-Plant	Firms consisting of multiple plants	ONS BSD
Micro	Firms with less than 10 employees	ONS BSD
SME	Firms with more than 10 but less than 250 employees	ONS BSD
Large	Firms with more than 250 employees	ONS BSD
Manufacturing	Firms with SIC (2003) industrial classification between 15 and 37	ONS BSD
Services	Firms with SIC (2003) industrial classification above 37	ONS BSD
Housing-Related	Sectors of real-estate, finance and constructions	ONS BSD
Finance Constrained	Sectors with an average industry capital expenditure over turnover above the mean	ONS ABI
Risky	Sectors with an average sector-level profits variability adjusted for mean returns above the mean	ONS ABI
Closure	Number of firms shutting down per postcode sector and year	ONS BSD
Death Rate	Number of closures over total number of firms per postcode sector and year	ONS BSD
Entrepreneurship Rate	Number of new entrepreneurial venture over total number of firms per postcode sector and year	ONS BSD
Net Entry	Number of new start-ups minus the number of firms' closure per postcode sector and year	ONS BSD
Entrepreneurship Net Entry	Number of new entrepreneurial activities minus the number of entrepreneurial activities closed per postcode sector and year	ONS BSD
Net Entry Rate	Ratio between net entry and the total number of firms per postcode sector and year	ONS BSD
Entrepreneurship Net Entry Rate	Ratio between entrepreneurship net entry and the total number of entrepreneurial firms per postcode sector and year	ONS BSD

Table A2: Impact of the HTB reform on the number of firms' closure, death, birth and net entry rates.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Closure	Death Rate	Entrep.Rate	Net Entry	Entr.Net Entry	Net Entry Rate	Entr.Net Entry Rate
GLA#2014	0.209**	0.003	0.0002	-0.384	-1.316**	-0.0021	-0.0028
	(0.095)	(0.0015)	(0.0008)	(0.884)	(0.593)	(0.0022)	(0.0016)
GLA#2015	0.0493	-0.00037	-0.0005	0.386	0.0461	0.0001	-0.0001
	(0.103)	(0.0015)	(0.0007)	(0.830)	(0.641)	(0.0022)	(0.0016)
GLA#2016	0.0252	-0.0009	0.0001	-0.887	-0.183	-0.00041	0.0011
	(0.104)	(0.0017)	(0.0007)	(1.418)	(0.722)	(0.0023)	(0.0019)
GLA#2017	-0.139	-0.0045*	0.0016**	3.120***	2.299**	0.007***	0.006**
	(0.130)	(0.0025)	(0.0007)	(1.027)	(0.950)	(0.002)	(0.002)
No. Obs.	504	504	504	504	504	504	504
No. PCs	126	126	126	126	126	126	126

Note: data from the ONS Business Structure Database, UK Finance and the Land Registry from 2014 to 2017. Results estimated using a panel OLS with postcode-year fixed-effects. Robust standard errors clustered at the postcode sector level reported in parentheses. Significance levels: *** p < 0.01, ** p < 0.05, * p < 0.1. Closure is the number of firms shutting down per year; Death Rate is measured as number of closures over total number of firms. Entrepreneurship Rate is measured as number of new entrepreneurial venture over total number of firms. Net Entry is the number of start-ups minus the number of firms' closure. Entrepreneurship Net Entry is the number of new entrepreneurial activities minus the number of entrepreneurial activities closed. Net Entry Rate is measured as net entry divided by the total number of firms. Entrepreneurship Net Entry Rate is equal to entrepreneurship net entry divided by the total number of entrepreneurial firms in the postcode sector. Entrepreneurship and housing control variables included but not reported: total employment, number of firms, average labour productivity, the Ellison and Glaeser (1997) agglomeration index, the value of SME loans, number and average value of new housing transactions at the postcode level and by transaction value range.

Table A3: Impact of the HTB reform on the growth of entrepreneurship by postcode sectors – Different Layers.

	(1)	(2)	(3)	(4)	(5)	(6)
	Only Layer 1			**Only Layers 2 & 3**		
	No.StartUp	Entr.StartUp	Self-Empl.	No.StartUp	Entr.StartUp	Self-Empl.
GLA#2014	-0.106	-0.148	-0.107	0.151	0.159	0.145
	(0.132)	(0.162)	(0.161)	(0.134)	(0.166)	(0.145)
GLA#2015	-0.172	-0.161	-0.0800	0.181	0.166	0.198*
	(0.171)	(0.172)	(0.169)	(0.112)	(0.170)	(0.111)
GLA#2016	-0.129	0.0597	-0.175	0.154	0.0208	0.171
	(0.156)	(0.180)	(0.178)	(0.138)	(0.168)	(0.145)
GLA#2017	-0.0471	0.260**	-0.169	0.463***	0.466***	0.363
	(0.150)	(0.107)	(0.189)	(0.163)	(0.171)	(0.220)
Observations	288	288	288	216	216	216
No. Postcodes	72	72	72	54	54	54
	(7)	(8)	(9)	(10)	(11)	(12)
	No Layer 1 OUT			**No Layer 1 IN**		
	No.StartUp	Entr.StartUp	Self-Empl.	No.StartUp	Entr.StartUp	Self-Empl.
GLA#2014	0.135	0.0525	0.180	0.157	0.190	0.0915
	(0.129)	(0.144)	(0.133)	(0.104)	(0.143)	(0.125)
GLA#2015	0.118	0.122	0.139	0.164*	0.101	0.201**
	(0.108)	(0.145)	(0.108)	(0.0906)	(0.150)	(0.0954)
GLA#2016	0.129	0.00833	0.143	0.166*	0.181	0.138
	(0.133)	(0.149)	(0.143)	(0.0943)	(0.141)	(0.105)
GLA#2017	0.344***	0.372**	0.284*	0.437***	0.401*	0.407***
	(0.122)	(0.147)	(0.153)	(0.156)	(0.212)	(0.153)
Observations	376	376	376	344	344	344
No. Postcodes	94	94	94	86	86	86

Note: data from the ONS Business Structure Database, UK Finance and the Land Registry from 2014 to 2017. Start-ups is the growth of new ventures per postcode, Entrepreneurship Start-ups the growth of new ventures with dependent employees while Self-employed is the growth of self-employed new ventures. Results estimated using a spatial DiD regression analysis. Robust standard errors clustered at the postcode sector level reported in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All specification include postcode and year fixed effects not reported. Entrepreneurship controls include total employment, number of firms, average labour productivity, the Ellison and Glaeser (1997) agglomeration index and the value of SME loans at the postcode level. Housing controls include number and average value of new housing transactions at the postcode level and by transaction value range.

Table A4: Differences in business performance before and after the HTB reform by postcode sectors across the GLA boundary.

	(1) Employment	(2) Turnover	(3) Lab. Prod.	(4) SME Lending	(5) Pers. Lending
GLA#2014	0.0229	0.0603	-0.0326	-0.257	0.0396
	(0.0339)	(0.0367)	(0.0245)	(0.524)	(0.0259)
GLA#2015	0.0203	0.0533	0.0332	-0.251	-0.0114
	(0.0291)	(0.0382)	(0.0256)	(0.599)	(0.0159)
GLA#2016	-0.00730	0.0499	0.0195	-0.0308	0.00558
	(0.0378)	(0.0449)	(0.0213)	(0.720)	(0.0124)
GLA#2017	0.0137	0.157	-0.0427	0.884	-0.0241
	(0.0772)	(0.167)	(0.0948)	(1.005)	(0.0184)
Observations	504	504	504	504	504
No. Postcodes	126	126	126	126	126

Note: data from the ONS Business Structure Database, UK Finance and the Land Registry from 2014 to 2017. Results estimated using a spatial DiD regression analysis. Robust standard errors clustered at the postcode sector level reported in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All specification include postcode and year fixed effects. The dependent variables are averaged at the postcode sector level. Labour productivity measured as turnover divided by employment.

Table A5: Placebo Test arbitrarily moving the boundary within and outside the Greater London Authority.

IN	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		1 v 2,3			**2 v 1,3**			**3 v 1,2**	
	Start-Up	Entrep.	Self-Empl.	Start-Up	Entrep.	Self-Empl.	Start-Up	Entrep.	Self-Empl.
GLA#2014	-0.202	-0.258	-0.0288	0.129	0.284	0.0264	0.0919	0.216	0.00577
	(0.123)	(0.147)	(0.150)	(0.138)	(0.175)	(0.152)	(0.140)	(0.171)	(0.163)
GLA#2015	-0.0683	-0.213	0.0213	0.126	0.136	0.0826	-0.0441	0.111	-0.103
	(0.151)	(0.163)	(0.147)	(0.131)	(0.160)	(0.136)	(0.147)	(0.155)	(0.163)
GLA#2016	-0.113	-0.217	0.0281	0.0123	0.219	-0.0638	0.123	0.257	0.0372
	(0.127)	(0.153)	(0.133)	(0.135)	(0.166)	(0.141)	(0.127)	(0.160)	(0.129)
GLA#2017	-0.0479	-0.174	-0.0148	0.165	0.296	0.0836	-0.107	-0.104	-0.0586
	(0.121)	(0.153)	(0.135)	(0.121)	(0.159)	(0.132)	(0.137)	(0.153)	(0.156)
Observations	272	272	272	272	272	272	272	272	272
No. Postcodes	68	68	68	68	68	68	68	68	68
OUT	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
		1 v 2,3			**2 v 1,3**			**3 v 1,2**	
	Start-Up	Entrep.	Self-Empl.	Start-Up	Entrep.	Self-Empl.	Start-Up	Entrep.	Self-Empl.
GLA#2014	0.222	0.0314	0.264	-0.291	-0.0248	-0.360	0.0489	-0.0234	0.104
	(0.225)	(0.231)	(0.279)	(0.230)	(0.258)	(0.279)	(0.243)	(0.303)	(0.241)
GLA#2015	0.00161	-0.132	0.0256	0.0316	0.287	-0.0724	-0.00990	-0.148	0.113
	(0.256)	(0.229)	(0.276)	(0.260)	(0.237)	(0.294)	(0.331)	(0.342)	(0.315)
GLA#2016	0.0861	-0.135	0.0399	-0.238	-0.276	-0.0891	0.115	0.354	0.0911
	(0.321)	(0.252)	(0.347)	(0.395)	(0.248)	(0.437)	(0.354)	(0.300)	(0.347)
GLA#2017	0.601	0.0646	0.742	-0.660	0.0275	-0.900	-0.315	-0.350	-0.167
	(0.346)	(0.305)	(0.386)	(0.439)	(0.402)	(0.517)	(0.452)	(0.407)	(0.578)
Observations	232	232	232	232	232	232	232	232	232
No. Postcodes	58	58	58	58	58	58	58	58	58

Note: data from the ONS Business Structure Database, UK Finance and the Land Registry from 2014 to 2017. Start-ups is the growth of new ventures per postcode, Entrepreneurship Start-ups the growth of new ventures with dependent employees while Self-employed is the growth of self-employed new ventures. Results estimated using a difference-in-difference regression analysis. Robust standard errors clustered at the postcode sector level reported in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All specification include postcode and year fixed effects not reported. Entrepreneurship controls include total employment, number of firms, average labour productivity, the Ellison and Glaeser (1997) agglomeration index and the value of SME loans at the postcode level. Housing controls include number and average value of new housing transactions at the postcode level and by transaction value range.