Will We Ever Be Able to Track Offshore Wealth? Evidence from the Offshore Real Estate Market in the UK

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Discussion Paper

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Abstract

This paper provides evidence of the growing importance of real estate assets in offshore portfolios. We study the implementation of the first multilateral automatic exchange of information norm, the Common Reporting Standard (CRS), which introduces cross-border reporting requirements for financial assets but not for real estate assets. Exploiting administrative data on property purchases made by foreign companies in the UK, we show that the implementation of the CRS led to a significant increase of real estate investments from companies incorporated in the tax havens that were the most exposed to the policy. We confirm that this increase comes from company owners of countries committing to the new standard by identifying the residence country of a sub-sample of buyers using the Panama Papers and other leaked datasets. We estimate that between £16 and £19 billion have been invested in the UK real estate market between 2013 and 2016 in reaction to the CRS, suggesting that at the global scale between 24% and 27% of the money that fled tax havens following this policy were ultimately invested in properties. (JEL Codes: D31, H24, H26, K34)

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1 Introduction

International macroeconomic statistics indicate that the equivalent of 8% of households' financial wealth is held in tax havens (Zucman, 2013), leading to substantial tax losses (Pellegrini et al., 2016). Since the financial crisis of 2008 and the large deficits that followed, governments have renewed the set of policies aimed at curbing offshore tax evasion, with limited efficiency (Johannesen and Zucman, 2014; Johannesen, 2014; Caruana-Galizia et al., 2016). A major policy development took place in 2014 when the OECD designed the Common Reporting Standard (CRS).[1] The CRS is a standard of automatic exchange of information (AEOI) designed to limit the possibilities for taxpayers to hold undeclared assets, as it introduces third-party reporting of foreign financial assets between participating jurisdictions (Kleven et al., 2011). It is to date the most comprehensive policy enacted to increase tax transparency, and it led to a reduction in cross-border bank deposits held in tax havens (Menkhoff and Miethe, 2019; Casi et al., 2020; O' Reilly et al., 2021; Beer et al., 2019). The CRS, however, only covers financial assets. This means that investing offshore holdings in non-financial assets constitutes an attractive strategy to dodge the reporting requirements after the implementation of the agreement.[2]

In this paper we study this alternative evasion strategy by focusing on real estate assets, and analyze the ownership of undeclared properties - *real estate evasion*. We show that the implementation of the CRS – that we also refer to as the beginning of AEOI throughout the paper – led to a substantial inflow of investments from tax havens to the UK real estate market. This suggests that there was a significant shift from financial to real estate assets, when the policy was announced. Offshore real estate matters for at least three reasons. First, despite scarce evidence on the precise amounts at stake, it is substantial (Alstadsæter et al., 2022b). Second, it can have an effect on real estate prices, and this throughout the whole distribution of property prices, ejecting some residents out of the property market (Sá, 2016). Third, it may be used for illicit purposes, like money laundering or the avoidance of international sanctions (Collin et al., 2022; OECD, 2007). We use administrative data on corporate foreign ownership of properties in England and Wales merged with several leaks from offshore financial institutions and with the corporate registry of Luxembourg to document how real estate serves as a new favored final destination for offshore wealth after 2014 and the enhanced efforts to crack down on financial evasion. The UK offers a particularly interesting setting to investigate this issue for two reasons. First, the real estate market in the UK, and London in particular, is highly globalized and attracts large amounts of foreign investments (Sá, 2016; Badarinza and Ramadorai, 2018), a high proportion of which comes from individuals at the top of the wealth distribution (Knight Franck, 2016). Second, it is often considered as a "safe haven" for foreign capital, meaning an asset for which demand is not curtailed in

[1] See O' Reilly et al. (2021) for a detailed timeline of the expansion of tax transparency and the introduction of the CRS.
[2] See Knobel and Meinzer (2014) for a detailed analysis of the CRS loopholes.

periods of political or economic uncertainty (Badarinza and Ramadorai, 2018). Third, properties in the UK can easily be acquired anonymously through companies registered in jurisdictions such as the British Virgin Islands, Jersey or Cyprus, making this form of investment particularly attractive to investors seeking secrecy (De Simone, 2015). As an illustration, about 90% of all property purchases in England and Wales involving a foreign company are made by entities incorporated in tax havens.

From a theoretical perspective, the CRS changes the trade-off faced by non-compliant taxpayers. It leads to an important increase in the expected cost of *financial evasion* – i.e. owning undeclared financial assets and receiving unreported income – as it substantially increases the probability of getting caught. Under this standard, participating countries have to automatically exchange information about account holders. That is, if a UK taxpayer owns an account in e.g. Switzerland, the Swiss tax administration will automatically and annually report to the British tax authorities the information linked to this account. Over 100 countries are exchanging information with each other in 2022, and this number is still growing as new jurisdictions already committed to enter the agreement. Thus, taxpayers engaged in financial evasion will have three possibilities. They can choose to do nothing in the face of this increased detection probability, but take the risk of being caught. They can also start to comply with their reporting requirements, which means they will have to pay back taxes avoided, start paying higher taxes, potentially pay an additional penalty and sometimes face criminal charges. Finally, they can revise their evasion strategy in order to reduce their detection probability. Usually, there are three main ways to adapt to new enforcement rules. It is possible to reorganize the way one holds assets offshore, for example by transferring the ownership of one's assets to a shell company instead of owning them directly (Johannesen, 2014; Omartian, 2017). An alternative is to switch the location of the offshore assets, toward a tax haven not participating to the new policy (Johannesen and Zucman, 2014; Casi et al., 2020). The broad scope of the CRS and the fact that it covers financial assets held both directly and indirectly greatly limit the possibilities for non-compliers to use these first two strategies. However, evaders can still restructure their offshore portfolios away from financial assets to avoid the reporting requirements. When considering real estate evasion, ultimately, the new offshore portfolio allocation will depend on the degree of substitution between financial and real estate evasion, which is an empirical question.[3]

Our paper provides evidence of a substantial shift of offshore holdings toward real estate assets following the 2014 transparency shock. We establish a causal relationship between the introduction of the CRS and a sharp increase in offshore real estate investments in the UK. We derive four key results. First, we find that offshore real estate in the UK is large. We estimate that in January 2018, foreign companies held the equivalent of £109 billion in properties in England and Wales, including £73 billion in London. When adding

[3]Note that the degree of substitution between financial and real estate evasion also depends on the relative attractiveness of the different alternative evasion strategies, which is directly impacted by the CRS.

up real estate owned directly by foreign individuals, these figures rise to £219 billion for England and Wales, and £142 billion for London.

Second, we show that real estate investments from (shell) companies incorporated in the tax havens mostly used by CRS-adopting countries increase significantly when these countries commit to the CRS. We make an important methodological contribution to circumvent the fact that we do not know the identity of those investing in the UK through shell companies. We exploit the Panama Papers and other tax-related leaks data which provide information on the identity and the residence country of shell company owners in many tax havens worldwide, and show that individuals from different regions of the world do not use the same countries to create companies. This allows us to identify a group of tax havens particularly exposed to the CRS, because they are mainly used by individuals coming from CRS-adopting countries. Using a difference-in-differences design, we show that real estate investments coming from the most exposed tax havens are very similar in trend and level to investments from less exposed havens during the 14 years preceding the CRS, but start to diverge sharply just after.

Third, we confirm that the increase in real estate purchases following the CRS is due to an increase in the investments of individuals affected by the transparency shock. In order to do that, we match the Panama Papers and the other leaked foreign ownership datasets to our administrative data. We identify the ultimate owners of purchasing companies in almost 4% of the real estate transactions in our sample and show that owners from CRS-adopting countries invest significantly more in real estate than non-affected individuals after the transparency shock. We find that British residents account for a large proportion of those investing in the offshore real estate market in the UK after the CRS. This is coherent with the fact that we see no peak in the number of disclosures under the UK amnesty program around 2014, contrary to what happened in some other countries (see Alstadsæter et al. (2022a) for Norway).[4] This seems to suggest that UK tax evaders decided to engage in alternative evasion strategies like real estate evasion rather than enter into compliance. This finding also indicates that a significant part of foreign real estate investments in the UK are actually made by residents wanting to hide their identity or to avoid certain property taxes, which shows that disentangling "real" foreign investments from "disguised" domestic flows is necessary in order to study the effects of foreign investments on domestic real estate markets.

Fourth, we estimate that between £16 and £19 billion have been invested in real estate in England and

[4]In the UK, several voluntary disclosure schemes were available to evaders around 2014, when the UK committed to the CRS. The most "popular" was the Liechtenstein disclosure facility (LDF) introduced in 2009 and closed in December 2015. The number of new amnesty participants increased more in Norway than in the UK around 2014 (in relative terms), which can partly be explained by the fact that the Norwegian amnesty program is very generous. Indeed, Norwegian "disclosers" pay no penalties and suffer no criminal sanctions, while in the UK some penalties have to be paid. According to the British tax authorities, a total of 6,000 disclosures were made under the LDF for an average settlement of £180,000. See https://www.gov.uk/government/publications/offshore-disclosure-facilites-liechtenstein/yield-stats. Note that other voluntary disclosure schemes were available around the CRS for UK taxpayers, namely the UK-Swiss Tax Cooperation Agreement, Jersey, Guernsey and Isle of Man Disclosures Facilities. In 2016, the World Wide Disclosure Facility was opened.

Wales over the 2013-2016 period because of the threat Automatic Exchange of Information constitutes for people hiding assets offshore. Translating these figures to a global effect and comparing them to estimates of the effect of the CRS on financial assets found in the literature, our results suggest that between 24% and 27% of the offshore financial wealth that left tax havens due to enhanced tax enforcement through AEOI was shifted to real estate globally.[5] This result sheds light on the growing importance of real estate as an offshore asset, and provides a new insight into the composition of offshore portfolios. Combined with the finding that the distribution of offshore wealth is very concentrated at the top of the income and wealth distribution (Alstadsæter et al., 2019; Guyton et al., 2021; Londoño Vélez and Ávila-Mahecha, 2021; Leenders et al., 2021), it has important implications on the composition of wealth at the top, suggesting that the share of real estate has been substantially underestimated.

Our paper has major implications for the design of information exchange policies. It suggests that the CRS' efficiency at curbing tax evasion has been substantially reduced by the omission of real estate assets, leaving opportunities for non-compliant individuals to ensure they still avoid the new reporting requirements. Broadening the scope of the agreement to cover not only all jurisdictions, but also all type of assets, would fix this leaking pipeline of information exchange. The pre-requisite to achieve such an ambitious policy is for governments to improve their existing real estate assets registers, in order to guarantee they systematically collect information about the identity of individuals buying properties indirectly.

This paper first contributes to a broad strand of the literature studying the amount of financial wealth held offshore (Zucman, 2013; Pellegrini et al., 2016; Vellutini et al., 2019; Henry, 2012) and its distribution across countries (Alstadsæter et al., 2018) and within countries (Alstadsæter et al., 2019; Guyton et al., 2021; Londoño Vélez and Ávila-Mahecha, 2021; Leenders et al., 2021). It is closest to Alstadsæter et al. (2022b) which shows that offshore real estate is large and mainly owned by individuals at the top of the wealth distribution. Our paper also relates closely to the growing literature on the effects of policies aimed at improving tax transparency (see Slemrod (2019) for an overview), and more particularly to papers assessing the efficiency of the CRS (Menkhoff and Miethe, 2019; Casi et al., 2020; O' Reilly et al., 2021; Beer et al., 2019) and of FATCA, the US policy of AEOI (De Simone et al., 2020). It confirms that non-compliant individuals adapt their behavior in response to changes in the international tax environment, and find alternative concealment strategies to continue under-reporting their assets (Johannesen, 2014; Johannesen and Zucman, 2014; Casi et al., 2020). Close to our results, De Simone et al. (2020) find that real estate prices in markets open to for-

[5]Where did the rest of the money go? Part of this money was repatriated in the context of voluntary disclosure schemes that were put in place in many countries. But evidence suggest that alternative evasion strategies other than investing in real estate assets have also been adopted by tax evaders after the CRS, which could explain part of the decrease in offshore deposits owned by countries participating to the agreements. Relocation of unreported assets to the US (Casi et al., 2020) or the use of citizenship-by-investment program (Langenmayr and Zyska, 2021) seem to have been used by reluctant taxpayers. Using a trust is also a way to avoid any reporting under the CRS (Knobel and Meinzer, 2014). See appendix table 20 for a list of strategies allowing to circumvent the CRS.

eign investments increased more than in markets with investment restrictions after the implementation of FATCA, which they interpret as evidence that evaders invested more in real estate to circumvent the reporting requirements. Third, we complement empirical studies exploiting foreign ownership leaked datasets to analyze the extent, the distribution, or the structure of offshore tax evasion (Caruana-Galizia et al., 2016; Omartian, 2017; Alstadsæter et al., 2019; Londoño Vélez and Ávila-Mahecha, 2022; Collin, 2021). Finally, our paper contributes to a small set of studies focusing on the determinants and the effects of foreign investments in the real estate market, without taking into account the key role that the international tax transparency environment can have on domestic property markets (Badarinza and Ramadorai, 2018; Sá, 2016; Cvijanovic and Spaenjers, 2020).

The rest of the paper is organized as follows. Section 2 provides some background elements on foreign ownership of real estate in the UK, and describes our data. Section 3 shows how corporate real estate investments in the UK responded to the CRS. In section 4, we identify the country of origin of a subsample of individuals buying properties through offshore entities. This allows us to estimate the distribution of offshore real estate in the UK across countries and to analyze where responses to the CRS come from. Section 5 estimates the global shifting effect from financial to real estate assets. Section 6 concludes.

2 Data

2.1 Overseas Companies Ownership Dataset

The offshore real estate market in the UK. The UK, and London in particular, constitute an attractive location for global real estate investments, especially for investments from people at the top of the wealth distribution (Knight Franck, 2016). Average property prices in the UK real estate market have been increasing a lot and part of this hike is due do increased foreign investments in the market since the beginning of the 2000s (Sá, 2016).

In this paper, we study a very specific set of the property market in the UK, which we call the offshore real estate market: properties that are owned by companies incorporated in tax havens.[6] This ownership scheme is not illegal per se and some of the investors behind these companies might use an offshore intermediary for legitimate purposes. However, using a shell company allows one to keep their identity hidden, which in turns makes it easier not to report on the property to the tax administration of their home country.

Holding a property through a shell company, nonetheless, does not allow its owners to completely avoid paying taxes in the UK. Four main taxes apply to the owners of UK properties: Stamp Duty and Land Tax

[6] In other papers like Alstadsæter et al. (2022b), transactions where a foreign individual buys a property in their own name is also included in the definition of the offshore real estate market. We leave aside such transactions in our main analysis.

(SDLT) when buying the property (with a top rate of 15% from 2012 onward), Capital Gains Tax when selling it, Income Tax if the property generates rental income and Inheritance Tax in case of death of the owner. Until recent years, UK residents, non-UK residents and UK-residents non-domiciled ("non-dom")[7] have been able to decrease their liabilities with respect to the four taxes by "enveloping" UK properties with an offshore company (i.e. owning the property through a company instead of directly), the scale of the "savings" depending on each specific tax status. From 2012 onward, the UK government has progressively introduced a series of tax changes which greatly reduced the tax advantages previously enjoyed by the owners of enveloped UK properties. For each of the four taxes mentioned above, we describe in Appendix A1 the advantages of indirect ownership and give information on how they evolved since 2012.

Presentation of the dataset. In order to capture these offshore real estate investments, we exploit public data released by the British Land Registry. The Land Registry records all real estate purchases made in England and Wales by foreign companies in the Overseas Companies Ownership Dataset (OCOD).[8] The registry compiles information on the time and location of the purchase, the price paid (when available), the tenure (Freehold or Leasehold)[9] and on the purchasing company (name, country of incorporation, address). It is exhaustive, as companies are required to lodge their purchase with the Land Registry.

The OCOD suffers from two main limitations. First, when one company buys several properties at the same time, the bundle of properties is frequently recorded in the registry as one unique transaction. In these cases, we recover from the addresses the number and the location of properties that have been bought by the same company. To give an example, one address in our sample is: "24 and 26 Brompton Road and 15, 16 and 17, Knightbridgegreen, London". Here, and in similar cases, we split this observation into five distinct transactions, corresponding respectively to "24 Brompton Road, London", "26 Brompton Road, London", "15 Knightsbridegreen, London", "16 Knightsbridegreen, London" and "17 Knightsbridegreen, London". Then, we divide the price indicated for the whole transaction by the number of properties bought at once - in this case 5. Almost 30,000 properties in our sample are sold in bundles, which represents around 20% of all the transactions.

The second limit of our dataset is that the purchase price is only specified for 36% of the transactions. Therefore, we predict missing prices using the sample of transactions where the price is available. We use the characteristics of the purchase (type of property, location, date of the purchase, etc) to infer the price paid,

[7] In the UK, a "non-domiciled" status can be given to foreign individuals living (i.e. resident for tax purposes) in the UK but domiciled (i.e. with their permanent home) in another country. This can lead to significant tax advantages for people whose foreign income is taxed only if repatriated to the UK, under the principle of "remittance basis". For a detailed analysis of the non-domiciled status and the reforms which affected it over the years, see Advani et al. (2022).

[8] The OCOD does not include transactions made by companies incorporated in the UK or by private individuals, whether British or foreign.

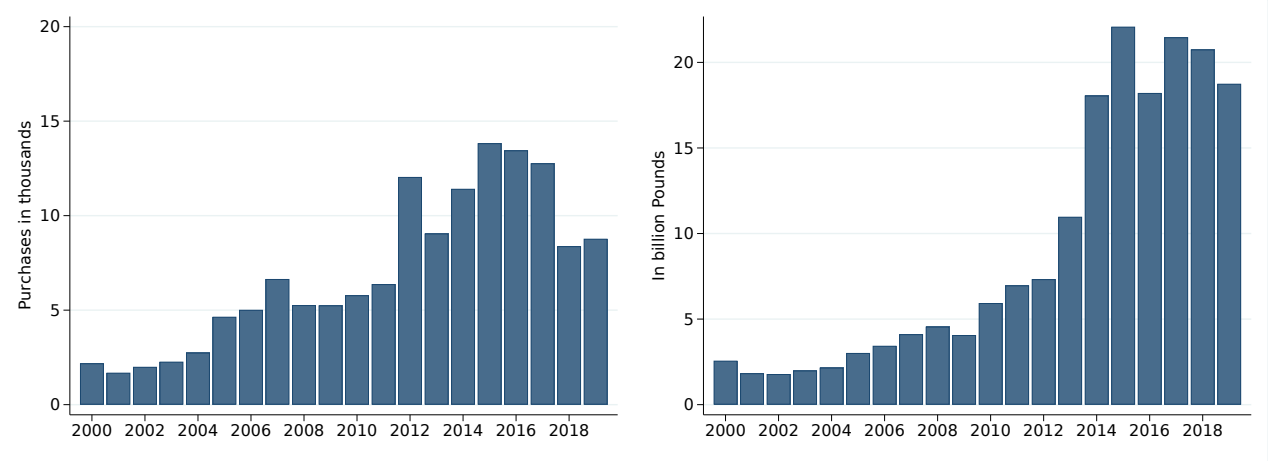
[9] Freehold estates are held for an infinite duration, while leasehold estates have a fixed or maximum lease duration.

estimating an OLS with 5-fold cross-validation model. We detail our inference method in Appendix section A2. Appendix Figure 9 displays the distribution of out-of sample predicted prices and the distribution of observed prices. They are very similar, indicating that our model closely matches the true distribution of prices. Appendix Figure 10 plots the out-of-sample predicted prices against observed prices. It confirms that our model doesn't systematically overestimate or underestimate prices, as observations are symmetrically distributed around the 45 degree line.

Descriptive statistics. The first transaction in the registry dates back to 1959, but most of the purchases take place from 2000. The registry records more than 143,000 transactions over the period 2000-2020. Panel A of figure 1 shows the evolution of the number of transactions in the dataset and their total value from 2000 to 2019.[10] The number of purchases increased slowly from 2000 to 2011, with a maximum of more than 6,000 transactions in 2007. There is a first peak of purchases in 2012 with approximately 12,000 properties bought that year. The number of purchases steadily increases in the following years and reaches almost 14,000 in 2015 before starting to decline. The aggregate value of real estate transactions follows a roughly similar evolution.[11] Panel B shows that the value of purchases made by foreign companies grows steadily, from more than £2 billion in 2000 to £10 billion in 2013. It jumps to £18 billion in 2014 and reaches a peak of £22 billion in 2015. In total, the OCOD records transactions for a value of more than £190 billion.

Table 1 displays the average characteristics of the transactions in our dataset. The average price in our dataset is £1.38 million (£2.31 when only taking into account transactions with non-missing prices). There is an equal number of Freeholds and Leaseholds, and about 43% of the transactions take place in London. However, the OCOD does not provide a lot of details about the properties bought by foreign companies. Using the addresses of the properties purchased, we are able to match about 43% of the transactions in the OCOD to the Energy Performance Certificates (EPC) data.[12] The EPC compiles information on the type of property, its size and the number of rooms, obtained when a property is put on the market and its owners have to proceed to an energy assessment. Table 1 shows that among the residential properties that we match to the EPCs data, the average size is 104 square meters and the average number of rooms is above 4. The average size of the commercial properties reaches almost 2000 square meters, which is consistent with a much higher average price.

[10] We do not include year 2020 as we do not have complete data for the year yet.
[11] Prices are corrected using the UK House Price Index (HPI) computed by the Land Registry. We apply the UK HPI to all transactions in our dataset, regardless of their location.
[12] We provide more information on the EPCs dataset in Appendix section A2.



(a) Number of transactions

(b) Total amount invested

Figure 1: Real estate investments from foreign firms in England and Wales, full OCOD sample

Notes: This figure shows the yearly count of purchases made by foreign firms in England and Wales (Panel A) and their aggregated value (Panel B), over the period 2000-2019. It is based on the Overseas Companies Ownership Dataset. The calculations are made after we cleaned the data according to the process detailed in section 2.1, and imputed the prices as described in appendix section A2. Prices are corrected using the UK House Price Index (HPI) computed by the Land Registry. We apply the UK HPI to all transactions in our dataset, regardless of their location.

Variable	All – full	Matched to EPC – residential	Matched to EPC – commercial	All – no prices	All – with prices
Price indicated in M Pounds	2.31	0.89	5.43		2.31
Final price in M Pounds	1.38	0.71	3.13	0.85	2.31
Freehold	0.54	0.47	0.71	0.56	0.50
London	0.43	0.48	0.44	0.42	0.45
Expensive London	0.21	0.25	0.19	0.23	0.19
House		0.38	0.00		
Flat		0.56	0.00		
Bungalow		0.02	0.00		
Area (in sq)		104.06	1964.16		
Number of rooms		4.28			
Transactions	143634	47152	11994	91979	51655

Table 1: Characteristics of the properties purchased

Notes: This table displays the characteristics of the transactions in the OCOD. Column "All – full" provides information on the full dataset. Columns "All – no prices" and "All – with prices" shows the average characteristics of properties for which the price is missing or indicated, respectively. We are able to match 35% of the bought properties to The Domestic Energy Performance Certificates (EPCs) data for residential real estate and about 8% to the Non-Domestic EPCs data for commercial properties. The EPCs dataset provides more detailed information on the property characteristics. More information on the EPCs dataset in Appendix section A2. Columns "Matched to EPC – residential" and "Matched to EPC – commercial" shows the average characteristics of the sample of properties matched to the domestic and non-domestic EPCs, respectively. The average price of the properties with non-missing price is £2.31 million. After inferring the missing prices, the average price in our dataset is £1.38 million. The row "Expensive London" gives the proportion of properties located in Westminster, Kensington and Chelsea, the City of London or Camden.

About 43% of the purchases take place in London. Figure 2 shows the location of the transactions across

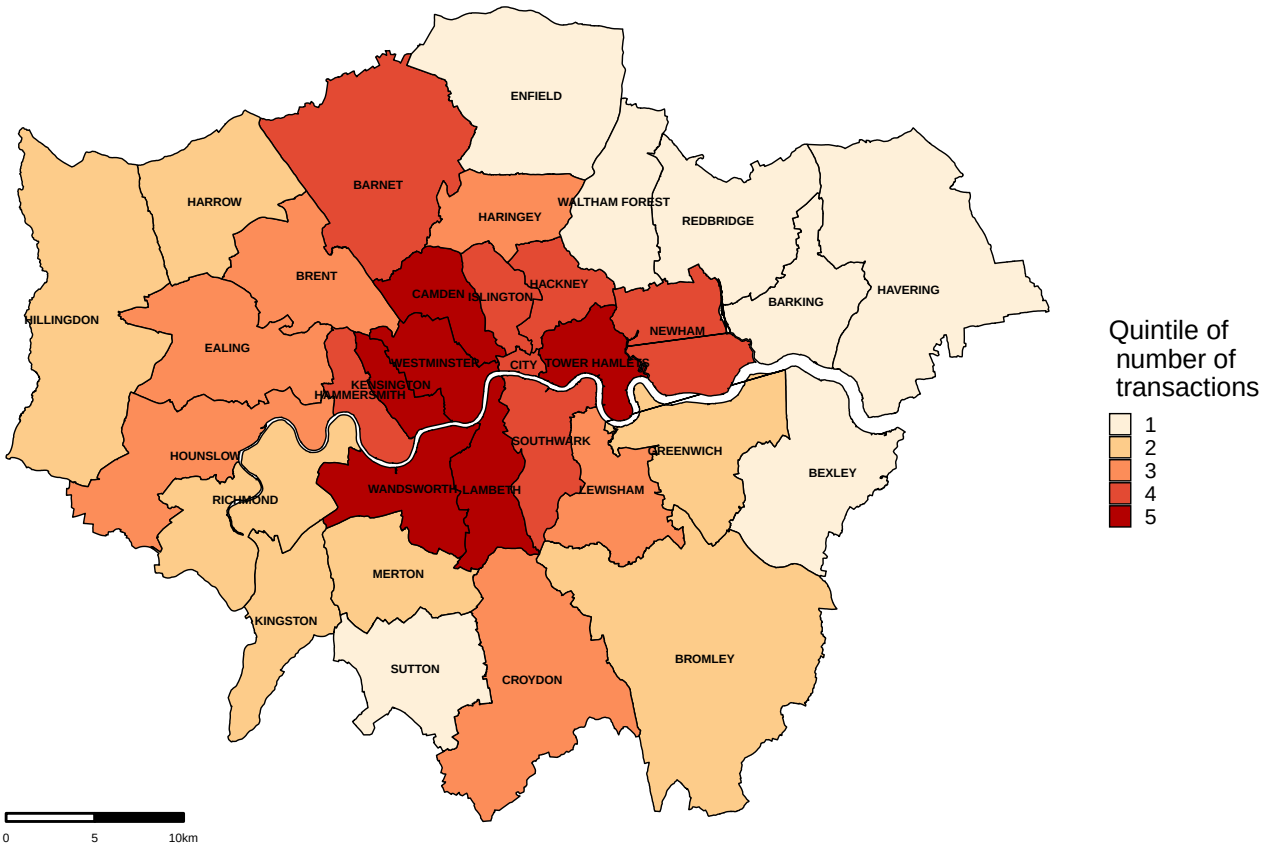


Figure 2: Number of foreign purchases in London in the full OCOD sample, ranked by quintile

Notes: This figure shows the location of the purchases made by foreign firms in London, as recorded by the OCOD. The region of Greater London is composed of 32 boroughs and the City of London local government. The boroughs are ranked in five quintiles according to the total number of purchases made by foreign firms over the period 2000-2020, from the boroughs where foreign companies make the less purchases (quintile 1) to the boroughs where they make the most (quintile 5).

London boroughs. We divide the 33 boroughs of the city in five quintiles, from the boroughs where companies make the less purchases (quintile 1) to the boroughs where they make the most (quintile 5). They are concentrated in the Center and in the North-West of the city, the most expensive areas of London residential real estate market (see table 11 in appendix section A3 showing the average price per property per London borough, in 2013 and in 2017).

To give a sense of the importance of foreign companies in the British real estate market, appendix figure 13 in section A3 shows the evolution of the proportion of the total number of transactions (panel A) and of the total investments (panel B) in the English and Welsh real estate market coming from foreign companies. Purchases made by foreign firms represent between 0.3% and 1.3% of the total number of real estate transactions over the 2005-2019 period.[13] The amounts involved in these transactions lie between 1% and 6% of

[13]Statistics for the whole UK real estate market are only available from 2005.

the total value of the English and Welsh property market over the same period - with an important increase in 2014. This suggests that the properties bought are on average more expensive. We confirm this observation in Figure 3 which displays the price distribution of properties bought in our sample and the price distribution of all residential properties bought in the English and Welsh real estate market. The distribution of prices among the properties bought by a shell company exhibits a much thicker right tail, indicating that very expensive properties are much more common than in the overall residential property market.

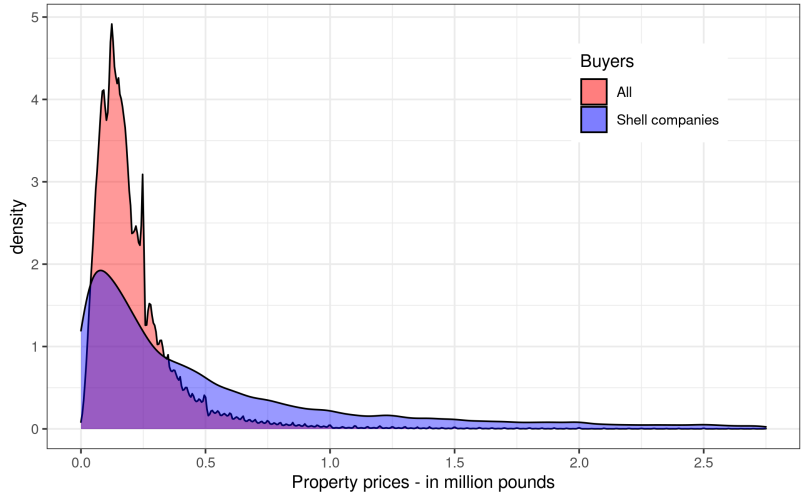


Figure 3: Distribution of prices of properties bought through shell companies, and of all residential properties in the UK real estate market.

Notes: This figure presents the distributions of prices of properties bought through foreign companies (from the OCOD) and of all residential properties bought in the UK (from the Price Paid Dataset) over the period 2000-2020. For better visibility, the prices are capped at 99.8% of the price distribution of the Price Paid Data.

More than 90% of the transactions in the registry are made by companies incorporated in tax havens.[14] Table 2 shows the top-five buyers in volume and value of purchases, separately for havens and non-havens. Four of the five main buyers in the haven group are the havens with the strongest links to the UK: the Channel Islands (Jersey and Guernsey), the British Virgin Islands (BVI) and the Isle of Man. Companies incorporated in Jersey are the most popular vehicle of investment, and purchased more than 30,000 properties for a total value of more than £54 billion over the period 2000-2020. Purchases from non havens are mainly coming from European countries (the Netherlands,[15] Germany, Sweden, France) and the United States.

[14]There is no consensus on which countries should be considered as tax havens. We use the list of tax havens of Menkhoff and Miethe (2019), which is obtained by combining the lists of Gravelle (2009) and Johannesen and Zucman (2014). They classify 58 countries as tax havens, which are listed in Appendix section A8 (Table 19). We present robustness checks of our results using alternative lists of tax havens.

[15]Note that in the list of Menkhoff and Miethe (2019) we follow, Netherlands is not considered as a tax haven.

Havens				Non-havens			
Country	Value of purchases (in billion £)	Country	Number of purchases	Country	Value of purchases (in billion £)	Country	Number of purchases
Jersey	54.2	Jersey	31,192	United States	3.9	Netherlands	2,377
BVI	39	BVI	30,369	Netherlands	3.9	United States	1,674
Guernsey	21.5	Guernsey	24,654	Germany	3.3	Germany	1,321
Luxembourg	18.9	Isle of Man	14,316	France	0.9	Australia	1,014
Isle of Man	14.5	Luxembourg	4,284	Sweden	0.9	United Arab Emirates	573

Table 2: Top five of companies buying in England and Wales, incorporated in haven and non-haven countries

Notes: This table shows the five most frequent countries of incorporation of companies buying English and Welsh real estate, over the period 2000-2020. Columns 1-4 show the ranking for companies incorporated in tax havens, in terms of value and volume of purchases. Columns 5-8 show the same but for companies incorporated in non-haven countries. The table is based on data from the Land Registry OCOD.

2.2 Beneficial ownership data

Presentation of the dataset. The Overseas Companies Ownership Dataset provides information on the country of incorporation of companies investing in UK real estate but not on the residence of their ultimate owners. These two variables are likely going to be identical for legitimate businesses; but most shell companies incorporated in tax havens belong to foreign citizens and have no real activity in the country in which they are registered (Kristo and Thirion, 2018).

To recover information on the country of residence of the owners of companies buying in the UK, we exploit several files leaked from offshore service providers over the period 2013-2021: the Offshore Leaks, the Bahamas Leaks, the Paradise Papers, the Panama Papers and the Pandora Papers. These documents from law firms and offshore financial institutions provide data on the beneficial owners of thousands of shell companies they created or managed for their clients. Taken together, they shed light on the structure and activities of more than half a million offshore entities created between 1865 and 2018. The files have been analyzed by the International Consortium of Investigative Journalists, who published the name, address and countries of the entities' owners.

We also use the recently unveiled OpenLux data. OpenLux is not a leaked dataset, but is the result of an investigation led by the French newspaper *Le Monde*, who scraped Luxembourg's companies registry and gathered information on more than 260,000 entities. When the country made its register of beneficial ownership public in September 2019, the journalists were able to access to the details of more than 70,000 company owners.

Finally, we exploit data leaked in 2019 from the Cayman National Bank and Trust in the Isle of Man (CNBIOM), an Isle of Man subsidiary of a financial services provider based in the Cayman Islands. The CNBIOM dataset provides precise beneficial ownership information for more than 1,400 companies, most of

them incorporated in the Isle of Man.[16]

Descriptive statistics. Table 3 details the characteristics of each of the foreign ownership dataset we use. The first company to appear in the leaks was incorporated in 1865, while we also have entities created as recently as 2020. In total, we have an insight into the organization of more than one million companies and into the holdings of more than 500,000 identified beneficial owners;[17] more than half of these records come from the Panama Papers and the Paradise Papers.

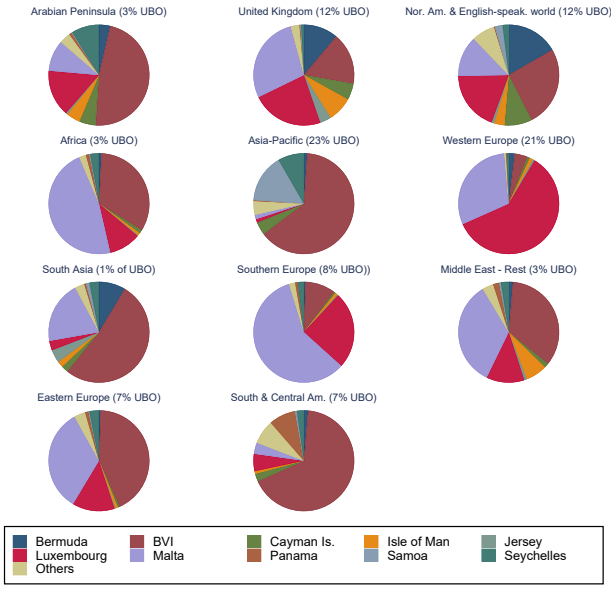
Data source	Period covered	Number of companies	Number of unique beneficial owners
Bahamas Leaks	1919-2016	175,888	6
CNBIOM	2007-2019	1,406	927
OpenLux	1907-2020	261,249	70,795
Offshore Leaks	1918-2010	105,516	75,948
Panama Papers	1936-2015	213,634	238,055
Pandora Papers	1980-2018	17,693	26,083
Paradise Papers	1865-2017	290,086	133,555
Total	-	1,065,472	545,369

Table 3: Characteristics of foreign ownership datasets

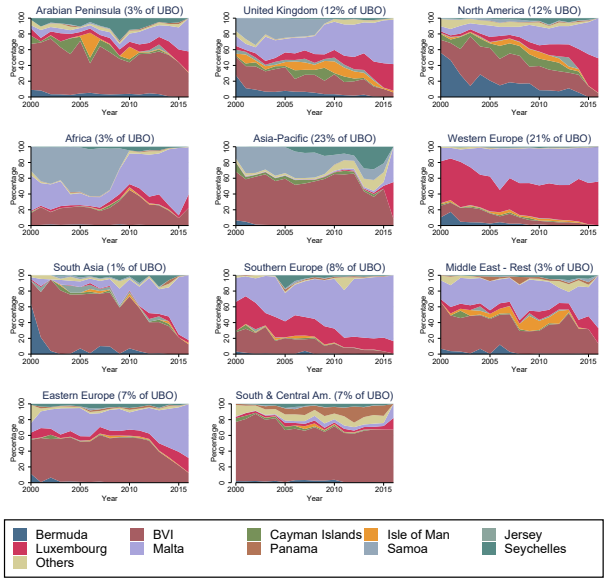
Notes: This table details the characteristics of the seven corporate ownership datasets we exploit in our analysis. For each of the datasets, it presents the period covered, the number of companies and the number of unique beneficial owners we get information on.

[16] The complete CNBIOM data have been extensively analyzed in Collin (2021).

[17] Note that we do not have information about the beneficial owners of all the companies listed in the leaks and in the OpenLux data; sometimes we only have access to the identity of the administrators, the directors, or no information at all about its ownership/management.



(a) Most frequent tax havens used by world region of UBO



(b) Most frequent tax havens used by world region of UBO, over time

FIGURE 4: MOST FREQUENT TAX HAVENS HOSTING COMPANIES BY WORLD REGION OF ULTIMATE BENEFICIAL OWNER

Notes: This figure shows the most frequent tax havens used to incorporate companies, by region of the beneficial owner(s). It is constructed using beneficial ownership data and company data from the Bahamas Leaks, the Offshore Leaks, the Panama Papers, the Paradise Papers, OpenLux data and CNBIOM data. We display the percentages of owners from each world region in the leaks on top of the figure. To compute the percentages, we remove beneficial owners who are linked to a tax haven, and beneficial owners who are companies. The total might not add up to 100% because of rounding. Panel A pools all years of our data together, while Panel B shows the evolution of tax haven use from 2000 to 2016. The graph stops in 2016 because one of the main leak we use, the Panama Papers, was released in April 2016. As a consequence, the composition of intermediaries could be mechanically affected after this date.

Panel A of Figure 4 shows where the companies in our offshore ownership datasets are incorporated,

by region of residence of the beneficial owner.[18] We display the proportion of UBOs in the leaks from each world's region on top of the figures. The individuals creating the most shell companies are from the Asian-Pacific region (23%), Western Europe (21%), North America and the English-speaking world (12%), and the United Kingdom which represents 12% of the owners alone. Panel A presents the pooled-years distribution of countries of incorporation. It highlights the heterogeneity of tax haven use, by world region. While owners from the Arabian Peninsula, the Asia-Pacific area, South Asia and South and Central America incorporate their shell companies mostly in the British Virgin Islands, European nationals and United Kingdom residents seem to favor Luxembourg[19] and Malta, European havens. North America has a slightly more diversified distribution of haven use, incorporating a roughly similar number of companies in the British Virgin Islands, Luxembourg, Bermuda, Malta and other havens.

Several factors could potentially explain this heterogeneity in tax haven use by individuals. First, residents from different countries could have specific preferences over countries in which to incorporate their shell companies, for example because tax havens offer specialized services, or cater to particular segments of the population. Omartian (2017) analyzes the Panama Papers and find that some jurisdictions seem to be specialized in certain activities; for example, companies owned through bearer shares are often incorporated in Panama. Second, this heterogeneity could be explained by the preferences of the intermediaries used by individuals to create shell companies. These corporate service providers could be more likely to use a specific set of havens to incorporate entities, for example if they rely on their own network of actors and infrastructures built over time for the incorporation process. If, in turn, they attract residents from different parts of the world, this would lead to an heterogeneous pattern of tax haven use depending on the residence country of the individual.[20]

Panel B of Figure 4 provides an insight into the dynamics of these patterns of tax haven use. It shows that some tax havens like the British Virgin Islands are less and less used to incorporate companies, while some others, like Malta, gain in importance as incorporation centers.

[18] We draw on the groups defined in Badarinza and Ramadorai (2018), who study foreign real estate investments in London, and we create finer sub-groups in order to reflect the importance of the countries we identify as buying UK properties in section 4.1. We therefore create 11 groups: the United Kingdom alone, the Arabian Peninsula, the rest of the Middle-East, North America and English world (including South Africa), Africa (excluding South Africa), Asia-Pacific, Western Europe, South Asia, Southern Europe, Eastern Europe and South and Central America.

[19] As we have access to administrative data on companies incorporated in Luxembourg, but only to a sub-sample of companies incorporated in other havens with the leaks, it is likely that the share of Luxembourg for each region of the world is overestimated. However, the differential use of havens by individuals from different regions of the world is not affected by this bias.

[20] Note that the two explanations can be combined: resident from country A might prefer to use corporate service provider B because B is specialized in the incorporation of companies in tax haven C.

3 The effect of tax transparency on the demand for offshore real estate

In this section we study how the offshore real estate market in the UK reacted to the launch of automatic exchange of information among OECD countries. We provide evidence that some tax havens are likely to be more impacted by the CRS, because they are used primarily by residents from CRS-adopting countries. Then, we show that the trend in real estate investments from these tax havens starts to diverge sharply from investments from other tax havens once the CRS is launched.

3.1 Methodology

When studying the effect of tax transparency on the UK real estate market, we are faced with two main challenges. First, the UK real estate market is highly globalized and its dynamics depends on many factors (see e.g. Poon (2017) for a review). Therefore, we need a sufficiently sharp and salient shock in tax transparency in order to precisely estimate a potential effect of tax enforcement on the amounts invested in the UK property market. Thus, we consider two sets of events affecting many countries at the same time. The first one is when G20 leaders committed to Automatic Exchange of Information as the new global standard of cross-border information exchange on September 6, 2013. This event, together with the announcement of the US-Swiss Bank Program (August 29, 2013) is shown to be concomitant to a sudden decrease in foreign-owned deposits in Switzerland (O' Reilly et al., 2021), suggesting that it constituted a credible threat for those holding non-reported wealth in Switzerland. The second event we consider is the joint statement signed by forty-four jurisdictions on 19 March 2014, announcing they would implement the OECD Common Reporting Standard by the end of 2015. This "Joint Announcement" reduced offshore deposits owned by residents of the committing countries by 11% (O' Reilly et al., 2021). On 6 May 2014, the OECD adopted its Declaration on Automatic Exchange of Information in Tax Matters, where forty-seven countries also committed to implement a single global standard of Automatic Exchange of Information. In our analysis, we pool the Joint Announcement and the May Declaration together as they are published almost at the same time, and they are signed by a very similar set of countries. In the rest of the paper, we call the events of Mars and May 2014 together the "Joint Announcement". We call the countries committing to the CRS in 2013 or 2014 the "early adopters", as opposed to countries which will adopt the CRS later, or never. The lists of participating countries for each of these events are presented in Appendix table 12.

The second issue when studying the offshore real estate market in the UK is that we only observe the country of incorporation of the companies purchasing properties, not the country of residence of their owners. This means that we are not able to analyze directly the evolution of real estate purchases of residents from countries adopting the CRS. To circumvent this issue, we exploit the heterogeneity of tax haven use

by country of residence that we documented in section 2.2. We exploit the leaks and the OpenLux data to find country patterns of tax haven use, which allows us to identify a group of tax havens that are mostly used by investors from the countries adopting the CRS in 2013 or 2014. More specifically, we compile the country of incorporation and the country of residence of the owners of the companies in the offshore ownership datasets; then for each tax haven, we compute the proportion of owners coming from each country. For example, we find that 53% of the people creating companies in Jersey are from the United Kingdom, 7% are from South Africa, 4% are from the US, 3% from Israel etc.[21]

Using these figures, we construct a measure of "CRS exposure", which is equal to the proportion of company beneficial owners coming from countries adopting the CRS in 2013 or 2014. We build two groups of tax havens according to their degree of exposure:

- **Highly-exposed tax havens:** jurisdictions that have more than 75% of their company beneficial owners coming from early-adopting countries
- **Other havens:** jurisdictions that have less than 75% of their company beneficial owners coming from early-adopting countries, or tax havens that do not appear in our leaks data as hosts for shell companies

Figure 14 (appendix section A4) displays the distribution of CRS exposure for the 52 havens in our sample and shows where the top 5 buyers of both groups are located. The group of the most exposed countries includes some of the havens investing the most in the offshore real estate market, Jersey, Guernsey, the Isle of Man and Luxembourg. The British Virgin Islands however, second investor overall both in value and volume of transactions, counts only 62% of owners residing in early-adopting countries and therefore belongs to the less exposed group, along with Gibraltar, Panama and the Cayman Islands. Twenty three havens have a CRS exposure of zero, either because none of the individuals owning a company there come from early-adopting countries or because they do not appear in our leaks-lux data as incorporation countries.

We make the hypothesis that purchases coming from tax havens highly exposed to the CRS are going to react to the early commitment waves of 2013 and 2014. Indeed, some non-reporters from the G20 and the Joint Announcement countries will want to invest part of their offshore wealth in real estate to dodge the new reporting requirements. If they do so using shell companies incorporated in their preferred tax havens, we should see an increase in purchases coming from these countries. On the other hand, we expect investments from less exposed tax havens to react less to the CRS; as they are also used by a lot of individuals from non-committing countries, their real estate investments should be less affected by the policy.

[21] To compute these figures, we only use companies incorporated before or during the second quarter of 2013; this is to take into account the fact that the CRS might lead to a change in tax haven preferences for the incorporation of shell companies. Reassuringly for our identification strategy, our results are robust to using weights computed using the full leaks data, suggesting that this was not the case.

As a result, to test whether the commitment to AEOI among OECD countries had an effect on real estate purchases in the UK, we compare transactions made through highly exposed tax havens to transactions made by other havens, around the two waves of commitment of 2013 and 2014. We use a difference-in-differences setting, with highly-exposed tax havens as the treatment group and the other havens as the control group. Our identification hypothesis is that both groups' investment trends would have evolved in the same way without the commitment to the CRS. Using less exposed havens as the control group allows us to take into account the evolution of the dynamics of the UK real estate market, as well as the tax changes faced by foreign companies buying properties throughout the period. Note that we estimate a lower-bound of the effect of the CRS, as the control group of less-exposed havens is also used by residents from early-adopting countries. We estimate the following equation:

$$Y_{iq} = \sum_{j \neq 2013q2} \beta_q \cdot Quarter_{j=q} \cdot Treat_i + \gamma_i + \eta_q + v_{iq} \quad (1)$$

where Y_{iq} denotes the amount in million Pounds invested in real estate by country i in quarter q (in 3-quarters moving average), $Quarter_{j=q}$ is a quarter dummy, $Treat_i$ is a dummy equal to 1 when country i is a highly-exposed haven, γ_i is a country fixed effect, η_q a quarter fixed effect and v_{iq} the error term. We have a balanced panel of 52 tax havens.

The difference-in-differences coefficient β_q captures the effect of the AEOI events in quarter q relative to the pre-commitment period, the second quarter of 2013. A coefficient β_q equals to 100 means that on average, the difference between a highly-exposed haven and another haven's real estate investments in quarter q exceeds the investment difference in 2013q2 by £100 million.

3.2 Results

Before moving to the results of the formal difference-in-differences analysis, we show in Figure 5 the aggregated value of real estate investments coming from firms incorporated in highly-exposed havens and firms incorporated in the other havens. The flows of investments follow each other closely during a very long period spanning from 2000 to mid-2013, with strikingly similar levels of investments being in both groups during the whole period. The two trends start to diverge sharply in the third quarter of 2013, right when the G20 countries commit to AEOI; we observe a large jump in real estate investments from highly-exposed havens, that is not matched by investments from the other havens.

Figure 6 displays the coefficients $\hat{\beta}_q$ estimated from equation 1. It confirms that the trends in real estate investments from highly-exposed havens and the other havens are not significantly different between 2000 and the second quarter of 2013, supporting our identification hypothesis. They diverge immediately after

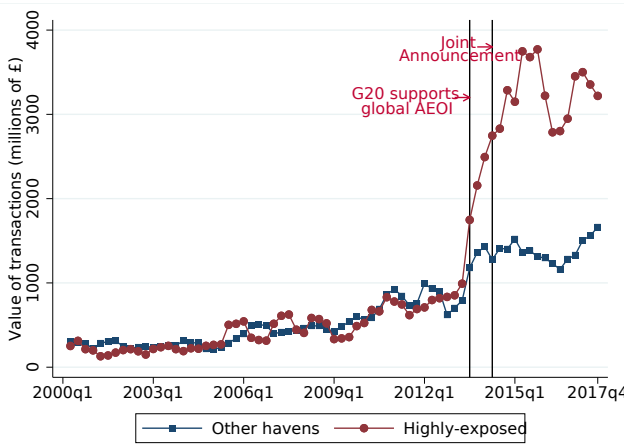


Figure 5: Total value of transactions from companies incorporated in "highly-exposed" tax havens vs other havens

Notes: This figure presents the aggregated amounts invested in England and Wales by companies incorporated in "highly-exposed" tax havens vs. companies incorporated in the other havens, over the period 2000-2017. It is based on the Overseas Companies Ownership Dataset.

the G20 support for AEOI. After September 2013, the difference in the value of purchases made by highly-exposed havens and the other havens surges and reaches on average about £150 million until the end of 2017. We observe a first increase in investments in the treatment group compared to the control group in the third quarter of 2013, and a second increase after the second quarter of 2014; this corresponds to the two major steps taken by early-adopting countries toward the implementation of AEOI.

In Appendix figure 15 (section A5), we replicate our analysis using other real estate market outcomes as our dependent variable. We study the evolution of the overall number of transactions as well as the number of transactions above £1 million, £2M, £3M, £4M and £5M, respectively. For expensive transactions, the graphs are very similar to the one in figure 6, with no significant difference between the highly-exposed havens and the other havens until the CRS is launched, and then a great divergence between the two groups that remains significant. The picture is somewhat different when looking at the total number of transactions. We observe an increasing trend in the volume of purchases from highly exposed tax havens compared to other havens slightly before 2013. This pre-trend is driven by differences in purchases of less expensive properties, as it disappears when restricting the sample to purchases of more than £1M.

To sum up our results, we use a simple static difference-in-differences model with a continuous treatment variable, and present the results in table 4. We estimate the following equation on the sample of tax havens:

$$Y_{iq} = Post + Post \cdot Exposure + \gamma_i + \eta_q + ER_{iq} + v_{iq} \tag{2}$$

Where Y_{iq} is the outcome variable, $Post$ a dummy for the post-CRS period (2013q3-2016q4), $Exposure$ is

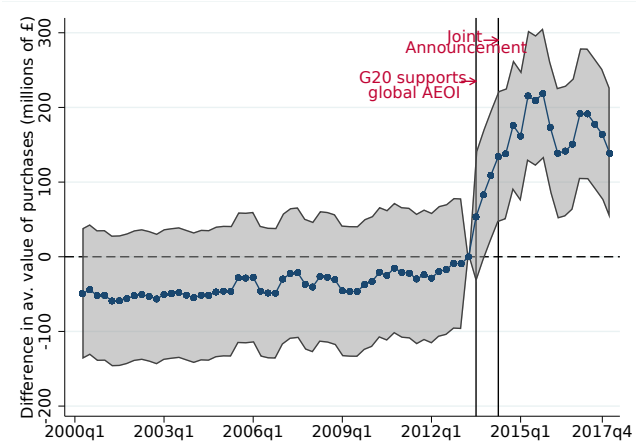


FIGURE 6: DIFFERENCE-IN-DIFFERENCES COMPARING REAL ESTATE INVESTMENTS FROM COMPANIES INCORPORATED IN HIGHLY-EXPOSED HAVENS TO COMPANIES INCORPORATED IN THE OTHER HAVENS

Notes: This figure shows the difference-in-differences coefficients comparing quarterly amounts of real estate investments from companies incorporated in highly-exposed havens to investments from companies incorporated in the other havens. The flows are normalized at their value of 2013q2. The estimation is based on the full data provided in the Land Registry OCOD.

the measure of exposure to the CRS, γ_i a country fixed effect, η_q a quarter fixed effect, ER_{iq} the exchange rate of the currency used in country i at quarter q and v_{iq} the error term. A positive coefficient associated to "$Post$ x $Exposure$" would indicate that the more a tax haven is affected by the CRS, the more its real estate investments increase compared to the pre-CRS period. Our cut-off period here is the second semester of 2013.[22] We control for exchange rates evolution, which can influence cross-border investments.

In column (1) of table 4, we look at the value of investments in Pounds, and in column (2), at the number of transactions. In both cases, coefficients associated to "$Post$ x $Exposure$" are large and highly significant. We find that the average quarterly difference in real estate investments between fully exposed tax havens ($Exposure$ is equal to one i.e., tax havens only used by residents of CRS-adopting countries) and not exposed tax havens ($Exposure$ is equal to zero) is higher by £180 million after the CRS compared to the reference period (2013q1 and 2013q2).

We also look at the effect of the CRS on investments in Pounds (column (5)) on the subsample were prices are indicated i.e. on the subsample for which we didn't have to infer prices. The coefficients are very similar in column (1) and in (5), indicating that our results are not driven by the way we infer the missing prices.

[22]Note that we use two quarters as our reference period instead of one as before, in order for our estimates not to be too dependent on the value of investments in a single quarter. The results are similar when using 2013q2 only as the reference period.

	Full OCOD				Price indicated	
	(1) Amount	(2) Transactions	(3) Amount scaled	(4) Transactions scaled	(5) Amount	(6) Amount scaled
Post x Haven x Intensity	179.776***	67.025**	1.606***	0.359	166.709***	5.694***
	(36.250)	(26.763)	(0.484)	(0.366)	(33.046)	(1.033)
Post	-0.216	-1.134	0.288	-0.102	-0.171	1.604***
	(19.728)	(14.565)	(0.263)	(0.199)	(17.902)	(0.560)
Observations	3632	3632	3632	3632	3382	3382
Country FE	YES	YES	YES	YES	YES	YES
Control for ER	YES	YES	YES	YES	YES	YES

Table 4: Summary results

Notes: This table shows the results of the estimation of equation 2. Columns (1) and (2) shows the results for our whole sample, respectively for the value and the volume of the purchases. Columns (3) and (4) presents the results for the same outcome, scaled by their average value during the pre-CRS period. Columns (5) and (6) restrict our sample to the transactions for which the price is indicated in the OCOD, for the value of the purchases and the scaled value of the purchases.

3.3 Robustness checks

Are some extreme values driving our results? One potential concern with our results stems from the fact that a large part of the purchases made by tax havens is attributable to a few countries only. Therefore, one could fear that our estimates are driven by increased purchases made by a single tax haven. An ideal way to deal with this issue would be to simply use a log-transformation, but there are many zeros in our estimation sample and a log-specification would be misleading. Thus, in columns (3) and (4) of table 4 we normalize the outcome variable of each country i by scaling it by its pre-CRS period average value.[23] This standardization ensures our results are not driven by some havens which would be investing heavily throughout the whole period. For each quarter q and country i, we scale the amount invested and the number of transactions in each period q by the average quarterly value for country i between 2005 and 2010.[24] With this specification, the effect remains significant for the amounts invested, but becomes insignificant - though still positive - for the number of transactions. We also look at the effect of the CRS on scaled investments (column (6)) on the sub-sample where prices are indicated and the coefficient remains highly significant. Its size increases substantially compared to the coefficient in column (3) because information on prices is more often missing at the beginning of the period - and therefore between 2005 and 2010 - than in later years, which mechanically decreases the denominator of the scaled variable compared to a specification where predicted prices are included.

To further check that our results are not driven by only one outlier country, we replicate our analysis on 52 sub-samples, excluding successively one different haven in each sub-sample. We also vary our sample of analysis in two major ways, first by excluding the two most important buyers in the treatment group (Jersey

[23] We windsorize at the 95% level in order to avoid extreme values due to very low pre-CRS investments.
[24] Our results are robust to other pre-periods.

and Guernsey) and second by including only those tax havens that are themselves participating to the Joint Announcement in 2014. We present the results in Appendix table 13, where coefficients are obtained from the estimation of a variation of equation 1 using a single Post-CRS dummy to capture the effect of the policy. In all of these cases, our findings stay qualitatively unchanged, although the size of the coefficient may vary.

Another concern with our specifications in Pounds (equation 1 and 2) is that our positive effect could be driven by some extremely expensive properties being bought just after the CRS by highly exposed tax havens. To check this is not the case, we estimate equation 1 but windsorize the price of each property at the 0.1%, the 0.5%, the 1% and the 5% levels (both for the bottom and top tails of the distribution). The graphs obtained from the various windsorization levels are shown in appendix figure 16. The magnitude of the effect decreases with the level of windsorization, which indicates that it is partly driven by very expensive properties. However, the results remain qualitatively unchanged: the 14 years pre-trend are still insignificant and there starts to be a statistically significant difference between the highly-exposed tax havens and the other havens immediately after September 2013. It indicates that the positive effect of the CRS on real estate investments we estimate does not come from extreme values in property prices.

Robustness of our main results to alternative specifications. Because our results are obtained by forming two groups of tax havens based on a proxy for their attractiveness for residents of CRS-adopting countries, it is straightforward to assess how changing this measure affects our result. A first concern could be that the threshold of 75% of owners from CRS-adopting countries we use to define highly-exposed tax havens drives the difference in investments between the two groups; even though we show in table 4 that our findings still hold when using a continuous measure of exposure. We show in Appendix figure 17 how our results vary when we change this threshold. In every specification, the trends of the purchases of both groups is not significantly different before the second quarter of 2013, at which point they start to diverge sharply. The difference in the post-CRS period is significant for all thresholds but the 90% one, in which case only 5 countries are in the treatment group while all the main buyers are in the control group.

Another issue could be that the leaks and OpenLux data we exploit to compute heterogeneity in the use of tax havens are not representative of the true distribution of offshore preferences among countries. Indeed, these datasets suffer from several limitations. First, the Offshore Leaks, the Panama Papers, the Pandora Papers and the Paradise papers data only provide information on people who used specific providers of offshore services to incorporate shell companies.[25][26] If the clients of these providers are not representative

[25] Note that this is not the case for the Bahamas Leaks, as they are a sample of files taken from the company register of the Bahamas.

[26] There is a potential selection bias in the OpenLux data as well, for a different reason. The Luxembourg registry of beneficial ownership was made public in 2019, at which date a large number of entities were struck off the companies registry, indicating that some individuals closed down their company to avoid the reporting requirements. If residents from some countries were more likely to adopt this strategy than others, then the resulting preference distribution we get from the OpenLux data will be biased.

of tax haven uses in their own countries, we will not capture the true attractiveness of each tax haven for residents from CRS-adopting countries. Second, we identify only a portion of the UBOs of all the companies present in the leaks-lux data. For some companies, we only have access to the identity of the directors, the managers etc. For others, the listed owner is either another company or individuals residents in a tax haven and as such are likely to be nominees instead of the actual owners. To address this potential selection bias, we exploit haven use information computed with data from the Bank for International Settlements (BIS). The BIS provides information on cross-border bank deposits on a bilateral basis, for 48 countries. Studying tax haven uses by CRS-adopting countries using the BIS data draws a very similar picture than with the leaks data. The only notable difference in group composition is that Guernsey appears to be less favored by residents from early-adopting countries according to the BIS, and as such moves to the less-exposed havens group. As a result, our key finding of a divergence in investments trends between both groups just after the commitment to the CRS remains unchanged (Appendix figure 18).

Finally, table 13 also shows that our results are robust to varying the sample of countries we consider to be tax havens, whether we use the "consensus list" compiled by Menkhoff and Miethe (2019) of the 29 countries classified as tax havens in all recent studies on tax evasion and international taxation, or the 41 countries from the list of Hines and Rice (1994). The different countries included in these lists are presented in Appendix section A8, table 19.

Missing transactions. An issue in our dataset is that the Land Registry record of overseas companies transactions starts only in November 2015. This means that all properties that are bought and then sold before this date will not appear in our data. It could be an issue if the treatment group (highly-exposed havens) sells properties relatively less frequently than the control group (other havens). In this case, we would miss more purchases from the control group than from the treatment group before 2015. In turn, this would lead us to overestimate the additional investments made by highly-exposed havens, because we would miss relatively more transactions made by the control group.[27]

To check this is not the case, we exploit available data from the years 2015-2020. Over this period, we have access to the complete set of purchases and sales of properties made by offshore companies. In particular, we can observe whether a property bought from 2015 onward was sold during the 2015-2020 five-year window. This allows us to compare the selling behavior of the control and of the treatment group. For the years 2015-2020, we compute the proportion of properties that are bought in year t and then sold one year later, 2 years later, ... and 5 years later. The results are shown in Appendix figure 19.[28] We see that the treatment group

[27] On the contrary, if the treatment group sells properties relatively more frequently than the control group, the effect of the CRS would be underestimated.

[28] Appendix figure 20 in section A5 provides a detailed breakdown of the sales made from one year to another over the period.

almost always sells its properties more often than the control group. The only exception is for properties sold after one year. However, the difference is very narrow, as 12.3% of properties are sold after one year for the control group, and 12.1% for the treatment group. We take this figure as evidence that we are likely to miss more purchases from the treatment group than the control group before November 2015. It means that the databreak would actually lead us to underestimate the effect of the CRS on real estate investments.

Are some countries ejected from the real estate market? Another concern one may have is that the surge in real estate investments following the CRS would lead some countries not affected by the CRS to be "ejected" from the market due to higher prices. Indeed, if higher demand for real estate from the investors affected by the CRS results in property price increases in the UK, this could divert some buyers from this market - especially if their incentives for buying real estate are unaffected by the CRS. The extent of this effect depends on the price elasticity of real estate assets with respect to the demand. If the elasticity is high enough, real estate investments from individuals not directly hit by AEOI would in reality be affected negatively by the transparency shock. As by definition these investors mainly use tax havens from the control group, i.e. the less-exposed jurisdictions, real estate investments from this group would be negatively impacted, leading to biased estimates of the CRS effect. To assess whether some buyers were effectively ejected from the UK property market following the CRS, we simply compute for the highly-exposed havens and for the other havens the number of countries making at least one purchase during the year, for each year of our period of analysis. We plot the results in Appendix figure 21 (section A5). If buyers from the less-exposed group were massively ejected from the UK property market after the CRS, we would expect the number of countries in this group making at least one purchase a year to decrease from 2014. Reassuringly for our identification, we see on the contrary that the curve for the "other havens" group remains relatively constant throughout the whole period.

4 Direct evidence of asset shifting

We have shown in the previous section that real estate investments from companies incorporated in tax havens the most exposed to the CRS have increased significantly once the policy is announced. One limitation is that we don't observe directly who are the ultimate investors behind the corporate vehicles and the evidence of responses to the CRS we provide is therefore only indirect. Thus, we match the OCOD data to leaked corporate registries in order to identify the nationality of a number of company owners appearing in the property transactions records. In this section, we first describe our matching process. Second, we provide descriptive evidence on where investors buying UK real estate through offshore shell companies come

from. Third, we combine our data on *indirect* ownership to alternative sources containing information on *direct* ownership of UK offshore property in an attempt to give for the first time a comprehensive picture of who owns offshore real estate in England and Wales, and how much is owned from abroad. Fourth, we check that responses to the CRS we documented in the previous section come from individuals effectively affected by the policy. For that purpose, we show that investors from early-adopting countries increase substantially more their real estate investments after the CRS than investors from non-adopting countries.

4.1 Identifying who hides behind the shell companies buying real estate in the UK

To identify the nationality of the ultimate beneficial owner(s) (UBO) of companies buying properties in the UK, we match the property transactions data to beneficial ownership data - the Leaks, the OpenLux and the CNBIOM data presented earlier. We proceed in several steps:

1. We use standardized companies names to match beneficial ownership data to the OCOD. [29]
2. We keep only companies for which the country of incorporation is the same in both datasets.
3. We keep companies that were active at the time of the purchase.[30]
4. If a matched company appears to be owned by another company instead of a real person, we go one layer further and look for the owners of this second company in the leaks data. We repeat the operation four times in order to identify the "true" UBO of as many matched companies as possible.[31]
5. We drop the "true" UBOs that still appear to be companies.[32]
6. We drop UBOs listed as residents from tax haven countries.[33]
7. We allocate the shares of the companies identified. If a matched company is owned by n identified owners, we allocate $\frac{1}{n}$ share to each UBO.

Table 5 displays, by data source, the number of companies we match, as well as the number of ultimate owners we are able to identify and the number of transactions they are involved in. In total, we identify

[29] For example, we replace all the occurrences of "Ltd" by "Limited", "Corp" by "Corporation" etc.

[30] We have access to the company's status over the years.

[31] In some cases, the owners of a given company do not remain the same throughout the whole period. For cases when a person owns a company through different layers of companies, we impose the restriction that the owner owns each company at least over the period 2013-2015, which is the key period of interest for the CRS.

[32] We exclude UBOs with the following words in their name: "COMPAGNIE", "CORPORATION", "COMPANY", "INCORPORATED", "TRUST", "LTD", "BUSINESS", "LIMITED", "LLC", "FUND", "INTERNATIONAL", "EUROPE", "FONDATION", "FOUNDATION", "INVESTMENT", "CAPITAL", "BANK", "INC", "LP", "ACTION", "ACTIVITY", "HOLDING", "GMBH", "LLP", "PLC".

[33] We make the hypothesis that in these cases, the UBO is probably an intermediary or a second shell company and not an individual. Since our main tax havens list includes countries such as Austria, Ireland or Lebanon, which are likely to be the true residence country of company owners, we only discard UBOs linked to tax havens that have less than 2 million inhabitants, except Hong Kong, Panama, Singapore and Switzerland, which are all in the top fifteen of the Financial Secrecy Index of the Tax Justice Network (https://fsi.taxjustice.net/en/). Thus, we keep UBOs linked to Austria, Bahrain, Belgium, Chile, Costa Rica, Ireland, Jordan, Liberia, Malaysia, Lebanon and Uruguay.

roughly 3,000 investors owning UK properties through an offshore vehicle. As shown in the table, the most important data source for the matching is the Panama Papers which allow us to identify 1,846 ultimate owners. In Appendix table 14 (section A7), we compare the number of transactions and amount invested in the identified sample to the full OCOD dataset. We are able to identify the ultimate investors in 2.8% of the property transactions in our sample. These transactions are more expensive on average than the rest of the sample, as they represent 3.8% of the total amount invested in our data. When restricting our sample to London only, we recover the identity of the ultimate owner for more than 4.4% of all purchases made in London through shell companies (Appendix table 15). This figure is relatively high, as it indicates that at least 4.4% of foreign companies buying in London are listed in one of the main offshore leaks of this last decade.[34] The fact that we find more than twice as many companies buying in London than in the rest of the UK in the leaks data provides anecdotal evidence that real estate in the capital is a destination of choice for illegal flows of money (Tax Transparency International UK, 2015).

Source	Number of companies	Number of transactions	Number of UBO
CNBIOM	48	203	62
OpenLux	185	545	220
Offshore Leaks	58	107	83
Panama Papers	1,115	2,128	1,846
Pandora Papers	292	589	386
Paradise Papers	140	488	427
Total	1,838	4,060	3,024

Table 5: Number of companies, transactions and ultimate beneficial owners matched to leaks and OpenLux data

Notes: This table shows the number of companies, of transactions and of ultimate beneficial owners we identify in the OCOD, by data source. Note that we do not identify any beneficial owners using the Bahamas Leaks, hence we do not show it in the data sources.

4.2 Descriptive facts about offshore real estate ownership in the UK

Where do the buyers come from? Figure 7 shows where the offshore real estate investors come from, ranked by total amount invested over the 2000-2020 period. As mentioned above, we take into account the fact that the ownership of some companies is split into several owners (often with the same family name). When this is the case, we divide the value of the property bought by the number of individuals owning the company making the purchase. For example, if *Dupont Real Estate Limited* buys a property in London for a value of £1 million and if this company is owned by a French resident and a Canadian resident, we

[34]The figure is actually higher than 4.4%, if we include companies identified in the leaks but with listed UBOs who are either companies or linked to tax havens.

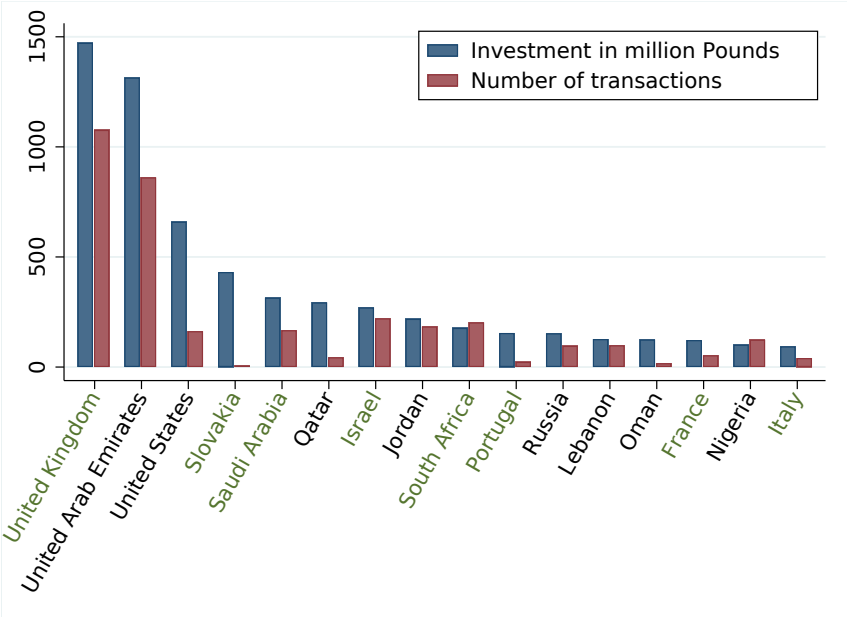


Figure 7: Importance of real estate investments in England and Wales through an offshore company.

Notes: This figure shows the value and the volume of real estate investments in England and Wales made through an offshore company, by country of residence of the ultimate beneficial owner. The data comes from the OCOD sample matched with the Offshore Leaks, the Bahamas Leaks, the Paradise Papers, the Panama Papers, the Pandora Papers, the CNBIOM and the OpenLux data. Countries written in green take part to the May 2014 Joint Announcement while countries written in black do not.

will attribute $\frac{1}{2}$ transaction for France and $\frac{1}{2}$ for Canada and the amount invested from each country will be £500,000.

Interestingly, residents of the United Kingdom constitute the first group of buyers through offshore companies in our identified sample. Between 2000 and 2020, they bought more than 1000 properties for a total of almost £1.5 billion and an average price per purchase of about £1.4 million. While this is suggestive of a "home bias" in the individuals' investments decisions (Coeurdacier and Rey, 2013), one would not expect to find so many UK residents buying UK real estate via an offshore entity in the absence of tax planning or secrecy motives for such investment schemes. A UK resident may own a UK property through an offshore entity both for "legal" tax avoidance or illegal motives. For "non-domiciled" residents - which are not taxed on their non-remitted foreign income - enveloping UK properties through an offshore entity may be particularly attractive, as it is a way to exclude rental income or capital gains from their personal income tax base.[35]

Investors from the Middle-East, first and foremost the United Arab Emirates, represent another important share of the identified ultimate investors. Residents from these countries face very low – sometimes zero – effective tax rates on their income and wealth; this suggests that these investors are using a shell company

[35]See appendix section A1 for more details on the legislation.

to channel their purchases for secrecy motives rather than to lower their tax liabilities. Indeed, for high net worth individuals living in a politically unstable country, avoidance of political reprisals is sometimes pointed as a major consideration in the use of tax havens (Harrington, 2016).

Where do they buy? Appendix figure 22 (section A6) displays maps of London showing the most favored London neighborhoods per investors' country of residence - for the top 5 buyers and for Russia. First, we see in these figures that two boroughs, Westminster and Kensington and Chelsea, are the top-location of real estate investments for all main groups of buyers, except Israeli residents. More generally, the North-west of the city seems to be favored by buyers of every nationality. However, there is still some heterogeneity in location choices according to the country of residence. When comparing country maps to the location of all transactions in our London sample (figure 2), we see for example that citizens from the United States buy relatively more properties in the South-West and in the North-east, while United Kingdom residents are more likely to purchase estates located in the South-east borough of Bromley.

What are the intermediaries involved? Figure 23 replicates our analysis of tax haven use by region of the world, restricting our sample to companies we observe as buying real estate in the UK. Comparing this figure to Figure 4, the first striking element is the relative importance of companies incorporated in the British Virgin Islands when we focus on entities buying real estate in the UK. This is partly explained by the fact that among the popular havens to hold real estate in the UK, the British Virgin Islands is relatively well represented in the tax-related leaks data while Jersey, Guernsey, Luxembourg and the Isle of Man are not.[36]

Appendix figure 23 also displays the proportion of owners identified in our sample by world region. Comparing these proportions to the ones displayed in Figure 4 allows us to identify regions which are relatively more represented in the identified sample. There are two main reasons why some regions could be over-represented in the identified sample. First, residents from these regions could have a strong propensity to choose the British Virgin Islands to incorporate companies. This is because we identify a relatively high proportion of companies from the BVI. Second, residents from these regions could have specific preferences for offshore assets: if a group of countries accounts for a higher proportion of the identified owners in the Land Registry data than in the leaks, this suggests that they hold relatively more UK real estate in their offshore portfolio than the rest of the individuals in the leaks. This is the case for residents of the United Kingdom, who represent 12% of the UBOs in the full leaks and OpenLux data but 24% of the identified UBOs in our sample. This makes sense, as we expect UK residents to be more likely to hold UK assets in

[36] We do have access to administrative companies data for Luxembourg. However, a very high number of companies were closed when it was announced that the beneficial ownership registry would be made public in 2019 – probably to avoid public reporting requirements. This means that we only have information on beneficial ownership for a reduced sub-sample of Luxembourg companies.

their offshore portfolio. However, this is the case for other groups of countries as well: the Arabian Peninsula (3% of UBOs in leaks data, but 22% in the identified sample), North America (12% of UBOs in leaks data, but 17% in the identified sample) and Africa (3% of UBOs in leaks data, but 10% in the identified sample).

Property purchases through shares of companies. If an investor - individual or company - buys a residential property in the UK, the Stamp Duty and Land Tax (SDLT) is charged on the whole amount of the purchase. The rate is progressive and reaches 15% for purchases above £500K made by corporate bodies.[37] A way to avoid the SDLT is to purchase the property through a corporate structure and to buy the shares of the company instead of the property itself. This investment scheme is well known but the size of the phenomenon remains uncertain. Our leaked corporate records allow us to identify some transactions of this kind. For almost 60% of the companies buying real estate for which we can identify the beneficial owner, we have information on the exact dates of beneficial ownership. Thus, if person 1 appears as UBO of company A until March 2015 and person 2 starts to be UBO of the same company from March 2015 onward, we consider that person 1 sold company A to person 2 in March 2015. Out of the 1,838 companies buying real estate we are able to match, 107 seem to have been sold to other owners after the property is bought. This represents about 10% of the 60% of companies for which we have information on the dates of beneficial ownership, which indicates that this phenomenon is substantial. In total, 222 properties in our matched sample appear to be purchased through the shares of the holding company rather than directly. Appendix table 16 (section A7) displays, for the top 10 countries using this tax loophole, the amounts invested as well as the number of transactions.

4.3 Combining direct and indirect ownership of offshore real estate.

We combine our figures on country-by-country ownership of real estate through foreign shell companies to new data on *direct* ownership of UK properties by overseas individuals (recently published by the Centre for Public Data - CFPD)[38] in an attempt to give for the first time a comprehensive picture of who owns offshore real estate in England and Wales. The estimation we give is based on January 2018 data. First, we estimate how much of UK real estate is held through shell companies in January 2018 in total. For that purpose, we match the stock of properties listed in the OCOD register in January 2018 to our tax-related data leaks following the same method as the one presented in section 4.1. In the matching process, we recover information on the country of residence of the owners of 3.31% of the properties held through shell companies at that date, which represents 4.28% of the total in value. Then, we multiply the total value owned

[37] The 15% rate was introduced in 2012 and applied initially to purchases made by corporate bodies when the price exceeded £2M. It was extended to transactions above £500K in 2014.

[38] The data are available at https://www.centreforpublicdata.org/property-data-overseas-individuals.

by each country in the identified sample by $\frac{1}{0.0428}$ in order to allocate all properties appearing in the OCOD in January 2018 to one country. This gives us an estimation of how much of UK real estate held through foreign shell companies is ultimately owned by residents of each country. The assumption we make here is that the distribution of ownership across countries in the matched sample is similar to the distribution in the full stock of properties owned by foreign companies in January 2018.

Second, we estimate the amount of UK real estate that is *directly* held from abroad, meaning that the buyers purchase the properties in their own name rather than through an anonymous shell company. The data on direct ownership we use here have been obtained through FoI requests to HM Land Registry, the British tax authority, and gathered by researchers from the CFPD. It gives information on the number of property titles owned by individuals with an overseas correspondence address, every two years between January 2010 and August 2021. Since there is no information on the value of the owned properties, we estimate the price of each property based on its location (district) and the average price of residential properties bought in that district in January 2018, using Office for National Statistics data.

Appendix table 17 shows the value of real estate wealth held directly and indirectly in January 2018, for all buyers in the world with nonzero ownership, excluding tax havens. We give estimates for England and Wales and also for London in particular. In total, in January 2018, we estimate that offshore real estate in England and Wales is equal to £219 billion, and to £142 billion for London only. The biggest owner is the United Arab Emirates with £26.11 billion, then comes the United States with £11.28 billion.[39] Overall, the Arabian Peninsula is very well represented with Saudi Arabia, Qatar, Kuwait, Oman and Bahrain all belonging to the top buyers.

4.4 CRS and real estate investments

Observing the country of residence of roughly 3,000 individuals buying real estate in England and Wales through an offshore company, we can check whether the increase in real estate investments in the UK following the adoption of Automatic Exchange of Information is due to investors effectively affected by the increase in tax transparency i.e. residents from CRS-adopting countries. We focus again on the G20 support for global AEOI (September 2013) and on the commitment announcements of March and May 2014. The most important buyers for each group of countries are displayed in Figure 7 where early adopters appear in green and the others in black.

In our analysis, we split our sample of early adopters into one sample of G20 countries (excluding the United States which followed a distinct path toward AEOI adoption with the implementation of their own

[39] If we consider UK properties owned by UK residents through offshore companies, then the United Kingdom comes second in the ranking.

policy, FATCA, and Russia which did not commit to AEOI in 2014) and a second sample of countries committing to the CRS in 2014 that do not belong to the G20. We then compare real estate investments from each CRS-adopting group (treated group) to investments from countries that do not commit to information exchange in 2013 or 2014 (control group). We use equation 1 and estimate two distinct difference-in-differences equations - one for each treatment group. Since our matched sample is small, we consider a specification where property prices are windsorized at the 0.5% level[40] in order to prevent some outlier transactions from having too much influence on our results. We show later that our results are robust to other windsorization levels or no windsorization at all.

Again, our identification hypothesis is that both groups' investment trends would have evolved in the same way without the launch of the CRS. Our observation unit is at the quarter-country level, investment is expressed in 3-quarters moving averages and our panel is balanced.

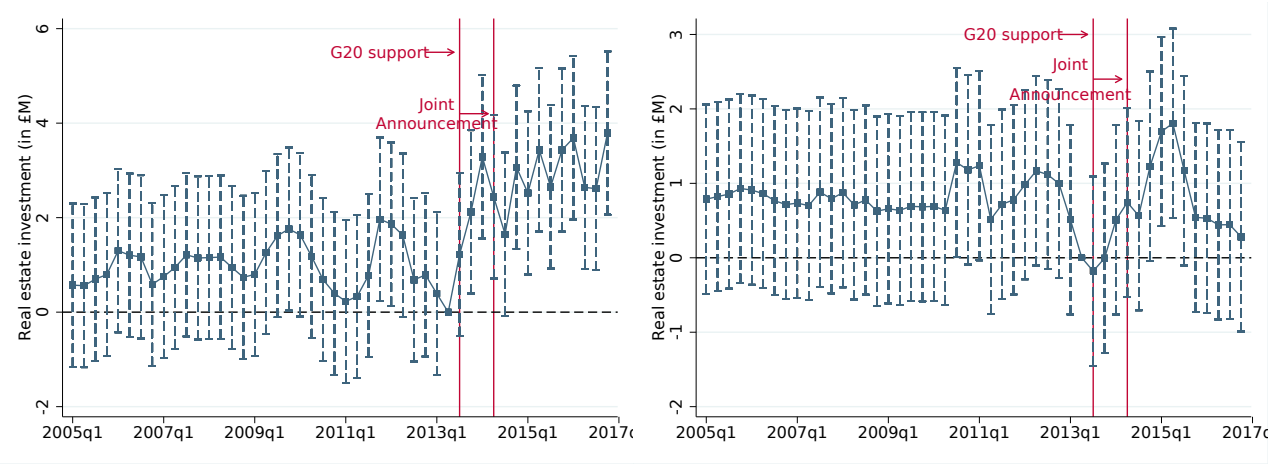
Results are presented in Figure 8. First, we confirm that the increase in property purchases from the highly-exposed havens documented in the previous section is indeed due to individuals affected by the CRS. Indeed, while there is no statistically significant difference in real estate investments between treated and control groups between 2005[41] and 2013, the difference becomes significant immediately after the commitment to the CRS of G20 countries for the G20 countries (Panel A) and just after the second quarter of 2014 for the other early adopters (Panel B). This is what we would expect, as individuals from non-G20 countries should not react to the commitment to AEOI of G20 countries. The event of September 2013 can thus for this latter group be considered as a "placebo event". Second, Figure 8 suggests that most of the increase of real estate investments in the UK offshore real estate market seems to come from individuals from G20 countries. We see that the increase in investments from individuals from G20 countries is significant and long-lasting, while it is more modest and less persistent for individuals from non-G20 countries. However, these differences are to be interpreted with cautious due to the small size of our identified sample.

Results from a static difference-in-differences estimation, where we estimate a variation of equation 1 using a single Post-CRS dummy to capture the effect of the policy, are presented in table 6. The coefficients associated to "Post x Treated" capture the effect of the CRS on quarterly real estate investments – evaluated over the 2013q3-2016q4 period – for the treated group relative to the control group. The reference period is the first semester of 2013. Importantly, while the size of the coefficients decreases as we increase the level of windsorization, they remain highly significant, which indicates that the positive effect of the CRS we measure is not due to extreme values in property prices.

One concern in our analysis could be that investors decide to buy real estate in the UK from 2013-2014

[40] The windsorization is done on both tails of the price distribution. This means that all properties prices are capped at 0.5% and 99.5% of the price distribution.

[41] For visibility, our analysis period starts in 2005 but starting in 2000 does not change the results at all.



(a) G20 countries

(b) Other early adopters

FIGURE 8: DIFFERENCE-IN-DIFFERENCES COMPARING REAL ESTATE INVESTMENTS OF CRS ADOPTERS TO COUNTRIES NOT COMMITTING TO THE CRS IN MAY 2014

Notes: This figure shows the difference-in-differences coefficients comparing investments from countries adopting the CRS to non-adopters, for each quarter. In Panel A, we restrict the sample of countries adopting the CRS to G20 countries. In Panel B, we restrict this sample to non-G20 countries. The flows of investments are normalized at their value of 2013q2. Property prices are windsorized at the 0.5% and 99.5% levels.

onward for other reasons than for tax purposes. The residents from some of the treated countries (e.g. Saudi Arabia) face low effective tax rates on income and wealth and a real estate response to the CRS in that case would suggest that tax evaders are not the only ones affected by the transparency policy. To test this assumption, we build two groups of countries according to their level of top marginal income tax rate in 2014.[42] We classify in the "low-tax group" the countries with a top marginal income tax rate below the median and in the "high-tax group" the countries above the median.[43] Column (7) of table 6 shows the results of the estimation of equation 1 with a single Post-period dummy for the subsample of countries for which we have information on the top marginal income tax rates. Column (8) displays coefficients associated to the Post-CRS period for low-tax and for high-tax countries. Only the coefficient associated to high-tax countries remains significant, which suggests that the tax-evasion motive behind the responses to the CRS is likely to be the most important one. Note that the coefficients associated to "Post" are positive and significant in columns 3, 4 and 5. This indicates that when we reduce the influence of extreme values through windsorization – as we do in our preferred specification – we find that countries not affected by the CRS also invest more in real estate after 2013 relative to the pre-CRS period. This can be rationalized by investors anticipating high inflation in the UK housing market and therefore investing in real estate in order to make capital gains. The increase in

[42]The database we use for top marginal income tax rate across countries is the individual income tax rate table built by KPMG and available at https://home.kpmg/sa/en/home/services/tax/tax-tools-and-resources/tax-rates-online/individual-income-tax-rates-table.html.

[43]The median top marginal tax rate in the KPMG database is 30%. Results are qualitatively unchanged if we compute the median top marginal tax rate based only on the countries that effectively appear in our matched transactions data.

	Amount invested					Number transactions	Amount invested	
	(1) No winsor.	(2) Winsor. 0.1%	(3) Winsor. 0.5%	(4) Winsor. 1%	(5) Winsor. 5%	(6)	(7) No winsor.	(8) No winsor.
Post	-0.108	0.360	0.431*	0.410*	0.295**	-0.165	-0.166	-0.166
	(0.414)	(0.279)	(0.238)	(0.214)	(0.148)	(0.135)	(0.526)	(0.525)
Post x Treated	1.946***	1.478***	1.311***	1.229***	0.620***	0.581***	2.003***	
	(0.628)	(0.424)	(0.362)	(0.325)	(0.224)	(0.205)	(0.734)	
Post x Treated x LowTax								1.540
								(1.072)
Post x Treated x HighTax								2.202***
								(0.807)
Observations	7544	7544	7544	7544	7544	7544	6396	6396
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Top tax rate available	NO	NO	NO	NO	NO	NO	YES	YES

TABLE 6: SUMMARY TABLE

Notes: This table shows the coefficients estimated from a difference-in-differences equation with a single "Post-event" dummy. Coefficients associated to "Post" capture average quarterly real estate investments in the post CRS period (2013q3-2016q4) relative to the first semester of 2013. Coefficients associated to "Post x Treated" capture the difference in real estate purchases increase between the treated and control group in the post CRS period. Columns (3) and (4) restrict the sample to countries for which information on top marginal income tax rates is available. Column (4) estimates the CRS effect for low-tax and high-tax treated countries separately.

real estate investments after 2013 is particularly strong for some countries that *do not* commit to the CRS like Qatar or Oman.

5 Estimating the global shifting effect

To give a sense of the amount of financial wealth that was shifted to real estate globally as a result of the CRS, we start by quantifying the effect of the CRS on real estate investments in the UK. Then, based on the relative size of the UK cross-border real estate market globally, we scale up our UK estimates to obtain a global effect. Finally, we compare this number to the effect the CRS had on financial assets, as estimated in the literature.

Effect of the CRS in the UK. To estimate the total effect of AEOI on investments in the UK real estate market, we compare the aggregated value of purchases made by highly-exposed havens and by the other havens. As trends in real estate investments follow each other closely before the commitment to the CRS in these two groups of countries, we simply aggregate investments of the two groups of havens and normalize the series to 1 during a reference pre-CRS period. Appendix Figure 24 (section A8) shows the aggregated series for both groups, normalized in 2013q2. Then, for each quarter q, we compute the effect of the CRS δ_q as:

$$\delta_q = \frac{Y_q^{highly}}{Y_{q_0}^{highly}} - \frac{Y_q^{other}}{Y_{q_0}^{other}}$$

with Y_q^{highly} the investments coming from companies incorporated in highly-exposed havens in quarter q, Y_q^{other} the investments from the other havens in quarter q and $Y_{q_0}^{j}$ the investments for each group j during

the reference period. To get the effect of the CRS in pounds Δ_q, we multiply our estimates by the amount invested by the highly-exposed group in the reference period:

$$\Delta_q = \delta_q \cdot Y_{q_0}^{highly}$$

We estimate the total effect of AEOI on UK real estate investments over the 2013-2016 period by summing Δ_q over the post-CRS period (2013q3-2016q4). We provide a range of estimates by using three different reference periods, in order to prevent our results from being dependent on a quarter-specific investments value from either group. Thus, we have $q_0 = 2012q4$, $q_0 = 2013q1$ or $q_0 = 2013q2$.

Table 7 presents the estimated effect, according to the reference period we choose. Overall, our results indicate that an additional £16 to £19 billion were invested in the English and Welsh real estate market as a result of the CRS. This effect is substantial: over the period, it amounts to between 25% and 30% of all purchases made by companies (incorporated in both havens and non-havens) and to almost 1.5% of all real estate investments made in the UK.

Reference period	Estimated effect of CRS (in billion Pounds)
2012 q4	16.3
2013 q1	18.8
2013 q2	18.1

Table 7: Estimates of the total effect of the CRS on the UK real estate market, for the period 2013-2016

Notes: This table shows the estimates obtained when computing the effect of the CRS as a simple difference between the aggregated investments of highly-exposed havens vs other havens, using three different reference periods. These estimates are for the period 2013q3-2016q4.

Effect of the CRS on offshore real estate globally How can we estimate the effect the CRS had on the real estate market at the global level? According to figures from an international real estate broker,[44] the UK represented about 20% of the value of global cross-border real estate transactions in 2016.[45] A simple back-of-the-envelope calculation entails that the effect of the implementation of the CRS on the global real estate market would lie between £82 and £94 billion. This represents about 1.5% of the total stock of offshore wealth held by households in all tax havens in 2015 (Alstadsæter et al., 2018).

[44]Investment flows around the globe: cross-border property transactions in 2016, https://tranio.com/articles/investment-flows-around-the-globe-cross-border-property-transactions-in-2016_5321/, retrieved on the 27/08/2021.

[45]Our sample of transactions only covers England and Wales, not the whole UK. Based on the total number of transactions in the UK reported in the UK Property Statistics (compiled by HM Revenue & Customs), we find that for year 2016, 90% of the real estate transactions in the UK took place either in England or in Wales. This would imply in turn that England and Wales amount to about 18% of global cross-border real estate transactions. However, we make the hypothesis that England, and more particularly London, is the choice destination for a large part of foreign real estate investments in the UK. As such, we consider the 20% figure instead of the 18% one. This leads to a more conservative estimate of the global real estate effect of the CRS.

Effect of the CRS on offshore financial wealth To estimate the extent of asset shifting resulting from the CRS, we need to compare additional real estate investments caused by the CRS to the decrease in financial assets it induced. We evaluate the financial effect of the CRS in two steps: i) we estimate the amount of offshore financial wealth that was owned by the residents of the early-adopting countries, ii) based on estimates from the literature, we compute how much of this offshore wealth fled participating tax havens following the CRS.

First, we compute the wealth early adopters held in tax havens in 2013. To do this, we draw on country-by-country estimates of offshore wealth obtained by Alstadsæter et al. (2018). They update the offshore wealth measure of Zucman (2013) and allocate this amount to each of the world's country.[46] The amounts of offshore wealth held by residents of each country are very heterogeneous, amounting to the equivalent of 60% of GDP for countries like Russia, and to only a few percentage points for countries like Japan or Denmark. The estimated shares of global offshore wealth owned by each country in Alstadsæter et al. (2018) are computed for 2007. In order to have estimates for 2013, we allocate their 2013 estimates of total offshore wealth ($7.7 trillion) to each country, according to the country-by-country shares of 2007. Thus, we make the assumption that the geographical distribution of offshore wealth has not changed between 2007 and 2013. We compute the total stock of offshore financial wealth owned by the early adopters in 2013 by simply adding the figures for all non-havens committing to the CRS in 2013 or 2014.[47] We find that these countries were holding more than £3 trillion in tax havens that year.

Second, we build on O' Reilly et al. (2021), who estimate the reduction in bank deposits held in tax havens caused by the Joint Announcement of March 2014, using Bank for International Settlements (BIS) cross-border deposits data. While other papers studied the effect of the CRS on offshore bank deposits (Menkhoff and Miethe, 2019; Casi et al., 2020; Beer et al., 2019), the paper from O'Reilly et al. is – to the best of our knowledge – the only one studying specifically the effect of the Joint Announcement, which is the event we exploit in our paper (together with the previous commitment to the CRS of G20 countries). The authors estimate a two periods difference-in-differences model with time and country-pair fixed effects where the treated group is made of non-haven/haven pairs both participating to the Joint Announcement of March 2014, and the control group of non-haven/haven pairs both not participating. Their results suggest that one year after the event, offshore deposits owned by treated jurisdictions have decreased significantly more than for the non-treated countries, leading to an estimated effect of the Joint Announcement on offshore bank deposits of -11%. By applying this estimate to the amount of offshore wealth held by early-adopting

[46] The complete results of this allocation are available in appendix table A.3 of their paper.

[47] Out of the 67 countries from the G20 (excluding the US and Russia) or participating either to the Joint Announcement or to the OECD Declaration on Tax Matters, we only keep the 42 non-haven countries (using the list from Menkhoff and Miethe (2019)). We also do not keep Greenland and Faroe Islands as we do not have information on the amount of offshore financial wealth they own in Alstadsæter et al. (2018). Thus, we are left with 40 countries.

countries, we find that the Joint Announcement would have led to a reduction in financial wealth of about £330 billion.

Asset shifting responses to the CRS Finally, we compare the reduction in financial assets caused by the Joint Announcement to the global effect the policy had on real estate investments. Table 8 sums up our results. We find that the global surge in cross-border real estate flows caused by the CRS would represent between 24% and 27% of the reduction in offshore wealth the policy induced. This suggests that between 24% and 27% of the financial wealth held in tax havens before the implementation of AEOI was ultimately shifted to real estate in order to dodge the new policy. This is a sizeable response, as it means that about a quarter of the assets targeted by the CRS ended up being shielded from any reporting requirements, by simply switching the final destination of the investments made through offshore portfolios.

How plausible are these figures? First, the real estate effect we estimate is based not only on the Joint Announcement shock but also on the G20 support for global AEOI from September 2013, and the impact of each event cannot be separately estimated. Ideally, we would take into account the effect the G20 event had on offshore deposits, but this has not been estimated in the literature. Indeed, O' Reilly et al. (2021) provide estimates of the effect of the Joint Announcement only, by studying the evolution of offshore deposits after the first quarter of 2014. However, we show that G20 countries already started to respond to AEOI from September 2013. Thus, our measure of the wealth decrease in table 8 may be somewhat underestimated.

Besides, the 11% decrease in offshore deposits from O' Reilly et al. (2021) is estimated on four post-announcement quarters (i.e. until March 2015), while the post-CRS period we consider when estimating the real estate effect goes from the second quarter of 2013 to the last quarter of 2016. We choose to consider a larger post-event period because real estate is much less liquid than deposits and thus property transactions may take more time to be completed. Moreover, even though new jurisdictions commit to the CRS during the post-period, the countries participating to the Joint Announcement enter effectively earlier into the CRS than the others, and thus we assume that the division between highly-exposed havens and the other havens remain relevant at least until the end of 2016. Nonetheless, the 11% estimate from O' Reilly et al. (2021) is computed on a period before the transparency policy effectively enters into force in many countries. Therefore, the estimated reduction in offshore bank deposits is likely to be a lower bound of the total effect of the CRS. Note that real estate responses to AEOI we estimate may also be a lower bound of the total response to the CRS, which might have accelerated in 2017 and 2018 when information exchanges effectively started. Drawing on different analysis periods and different samples of countries, other papers have found that the CRS caused a reduction ranging from 11.5% to 31.8% of bank deposits held in tax havens. We show in ap-

pendix table 18 how much our real estate effect represents compared to these alternative estimates of the financial effect of the CRS; the percentage ranges from 8% to 26% depending on the paper. These comparisons should however be interpreted with care as they are based on papers studying the *implementation* or the *signature* of the CRS rather than its *announcement*. As such, they capture responses to the CRS from more countries, and during a period when the coverage of the agreement is more extensive. Therefore, the effect they estimate might be of a different nature.

Second, our estimates are based on the UK real estate market, where transactions taxes (i.e. stamp duty taxes) are very high. In appendix section A9, we perform a bunching analysis following Best and Kleven (2018) and show that corporate buyers do seem to respond to this tax. Therefore, the cost of investing in the UK property market is likely to be higher than in other globalized housing markets. If real estate responses to the CRS are stronger in other markets - like New York or Hong Kong - we would underestimate the true shifting responses in reaction to the CRS.

Third, our results strongly rely on the estimates of the UK share in the global cross-border real estate market, which we find to be 20%. On the one hand, the true figure of the UK market share is likely to be indeed very important. The literature has shown that London real estate in particular is a safe-haven asset or a "safe-deposit box" for which demand increases in times of economic downturns (Badarinza and Ramadorai, 2018; Fernandez et al., 2016) and that UK real estate accounts for a sizeable share of real estate investments of households at the top of the income and wealth distribution globally (Knight Franck, 2016). On the other hand, there is no comprehensive data on cross-border real estate and more work is needed to precisely quantify the value of properties owned by individuals outside of their country of residence (Alstadsæter et al., 2022b).

Fourth, O' Reilly et al. (2021), as well as the other papers studying the CRS we exploit in table 18, estimates the reduction of *bank deposits* following the CRS, not the reduction of *total offshore wealth*. As a result, the figures we compute are correct only under the assumption that the effect of the CRS is homogeneous across all financial assets. Even though deposits are more liquid and therefore may react more rapidly to changes in the tax enforcement environment, the new trade-off imposed by the CRS is likely to be similar for other unreported offshore financial assets, like equities or mutual fund shares.[48] Therefore, we believe this assumption is relatively plausible.

In brief, even though there is still uncertainty about the exact amounts involved, our results suggest that investors affected by automatic exchange of information shifted a significant share of their offshore financial wealth – around 25% – to real estate as a result of the transparency policy.

[48]The sanctions in case the evader gets caught and the probability of detection are relatively similar.

Paper	Estimates	Wealth decrease (billion Pounds)	Shifting - lower bound	Shifting - upper bound
O' Reilly et al. (2021)	11%	334	24%	27%

Table 8: Estimation of asset shifting responses to the CRS

Notes: This table compares the effect of the CRS on real estate investments we estimate in our paper to the amount of offshore financial wealth that left tax havens due to the transparency shock as estimated in O' Reilly et al. (2021). Column "Estimates" gives estimates of the CRS effect in terms of reduction in offshore wealth. Column "Wealth decrease" refers to the stock of offshore financial wealth owned by early adopters in 2013 that fled tax havens because of the CRS (it depends on the column "Estimates" and on the total stock of offshore wealth held by early-adopters). Column "Shifting - lower bound" computes the ratio of our real estate effect over the offshore wealth decrease, taking the lower bound of the real estate effect (£82 billion). Column "Shifting - upper bound" does the same with the upper bound of the real estate effect (£94 billion).

6 Conclusion

The Common Reporting Standard closes some of the loopholes evaders could still exploit in previous enforcement policies to avoid their international reporting requirements. In particular, thanks to its multilateral feature, it makes the relocation of financial assets to non-cooperative tax havens difficult - and almost impossible over the long-term as more and more havens join the information exchange agreement. However, the policy leaves the door open for new evasion strategies to develop, as it only targets financial assets. In its current form, it creates incentives for non-compliant taxpayers to restructure their offshore portfolios away from financial assets and toward properties.

In this paper, we show that this new international transparency initiative played an important part in the growth of the offshore real estate market in the UK over the last decade. We show that it led to an inflow of investments of between £16 and £19 billion over the 2013-2016 period, which suggests that real estate investments to avoid the CRS reporting requirements were large at the global scale.

Our findings highlight the need for a more ambitious automatic exchange of information agreement. To effectively curb down tax evasion, we need a truly global information exchange treaty covering all assets, including non-financial ones. The first step to achieve such an agreement is to systematically gather information about the ownership of assets on a national level. In the case of real estate, this means in particular that tax authorities must collect data on the ultimate beneficial owners of shell companies used to buy properties.

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Appendix

A1. Tax advantages of buying a UK property through an offshore vehicle

Stamp Duty and Land Tax. If an individual buys a residential property in the UK, Stamp Duty and Land Tax (SDLT) is charged. The rate is progressive and has increased over time, with a top marginal rate of 12% in 2021. In 2012, a 15% rate is applied to purchases made by corporate bodies when the price exceeds £2M (£500K from 2014). The tax however does not apply in a number of cases, including when the property is used for property rental business. Moreover, a way to avoid the SDLT is to buy the property through a corporate structure and to buy the shares of the company instead of the property itself. In order to counterbalance this tax privilege, the Annual Tax on Enveloped Dwellings (ATED) is introduced in the Finance Act of 2013. It is an annual tax payable by companies owning UK residential property valued at more than £2M in 2013 (the threshold is now set at £500,000) and occupied rather than let out to an unconnected person.[49] The amount charged is progressive, lying from £3,700 (property value below £1M) to £237,400 (values above £20M) in 2021-2022.

Inheritance Tax. For non-UK residents and non-dom individuals, a common way to avoid inheritance tax on a UK property have been to hold it through an offshore company. Indeed, while the personal representatives or the beneficiaries of a non-dom individual owning UK property *directly* are liable to the inheritance tax in case of death (40% on the value of the property), no inheritance tax is applied to the shares of a foreign company - even though its sole asset is a UK property - and the inheritance tax can therefore be avoided.[50] This tax privilege was however drastically reduced in 2017, when companies which value are wholly attributable to a UK residential property interest (UK RPI) started to fall within the scope of Inheritance Tax.[51]

Capital Gains Tax. The rules related to the taxation of capital gains arising from the indirect ownership of UK properties have evolved during the period we consider. In 2013, the ATED-related Capital Gains Tax (CGT) is introduced. It applies to properties also covered by ATED at a rate of 28%. In 2015, a new tax, called the Non-Resident CGT, starts to apply, under which all non-UK resident persons and companies will pay a 20% capital gains tax on any profit realised on their property after 6 April 2015. However, it seems to have been possible for non-residents to avoid these taxes until 2019 by selling a property through the shares of

[49] Properties let to unconnected parties qualify for relief and are therefore exempt from the ATED charge.
[50] This scheme does not work for UK residents.
[51] If the company has other assets (e.g. located in France), Inheritance tax will only apply on the fraction of assets subject to the English Inheritance tax. Moreover, if the deceased person's stake in the company is too small (that is, less than 5% when combined with the stakes of persons connected to her) then the new rule doesn't apply.

the company owning it. From that 2019 however, indirect disposals of interests in "property rich entities"[52] started to be subject to the non-resident CGT as long as the non-resident investors holds, or has held, a 25% or greater interest in the company.

Income Tax. Regardless of who owns the property, any rental income will remain taxable in the UK. If the property is owned by an offshore company only the basic rate of UK income tax (20%) will apply regardless of the level of income.[53] This can result in substantial savings when compared with personal ownership under which the banded UK income tax rates (up to 50%) apply.

[52]"Property rich entities" include any company that derives 75% or more of its gross asset value from UK property whether residential or commercial

[53]While this is true for the period we consider in the paper, it no longer holds from 2020

A2. Prediction of missing prices

One limit of our dataset is that the purchase price is only specified for 36% of the transactions. Therefore, we predict missing prices using the sample of transactions where the price is available. Let us denote Z_i a set of properties' characteristics that we observe in our sample. We can express the properties' (log) prices as

$$p_i = \beta Z_i + \epsilon_i \tag{3}$$

Where ϵ_i is the price component not captured by the set of predictors that we assume to be orthogonal to Z_i. We estimate β from equation (3) using the subsample where the price is indicated, and the missing prices are then predicted using the resulting $\hat{\beta}$ as

$$\hat{p_i} = \hat{\beta} Z_i \tag{4}$$

The prediction model is estimated by OLS, using 5-fold cross-validation. The set of predictors includes the property tenure (leasehold, freehold), a postcode fixed effect, a quarter fixed effect. Using the exhaustive dataset of all residential transactions in the UK by quarter (UK Price Paid Data), we also include as predictors for each property the number of sales that occurred in the same postcode area, and the average price.[54] The $\hat{\beta}$ are estimated on a training sample composed of 80% of the transactions, and the quality of the predictions is evaluated with a test sample built with the 20% remaining observations. Table 9 displays information on our out-of-sample fit (computed with our test sample). The adjusted R^2 is 0.59, the root mean square error (RMSE) is 1.128 and the mean absolute error (MAE) is 0.683.

RMSE	Rsquared	MAE
1.128	0.589	0.683

Table 9: Price Prediction - All

Notes: This table describes the quality of our price inference and gives the value of the root mean squared error (RMSE), the R^2 and the mean absolute error (MAE) obtained when we regress p_i on Z_i (equation 3) using the full OCOD sample.

An important characteristic missing in our dataset to accurately infer prices is property size. To improve the quality of our estimates, we follow Chi et al. (2019) and exploit the Domestic Energy Performance Certificates (EPCs) dataset in order to retrieve housing size information. Energy Performance Certificates are mandatory in the UK before selling or renting a property, and the Department for Communities and Local

[54] In case the postcode x quarter of a given transaction in the OCOD data does not match to any transactions in the Price Paid data, we use information on average price by Ward, which is a greater level of aggregation. However, for most postcodes in the City-of-London, we do not have any in formations on the average price by ward. In this case, we approximate the price of the transaction based on the average price over all transactions with non-missing prices in the City-of-London that year. This is done for about 1000 transactions.

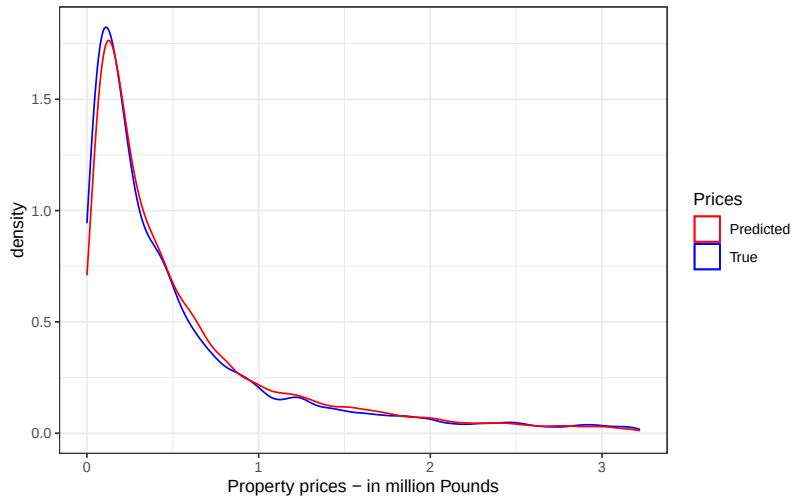


Figure 9: Distribution of predicted and observed prices in the test sample

Notes: This figure displays the distribution of observed and predicted prices in the test sample. This sample is selected by randomly picking 20% of the transactions for which we have price information. It is not used to estimate equation (3) but only to test the quality of our price prediction. Because the price distribution is heavily right-skewed, we cut the distribution at the 90th percentile in order to see what is happening lower down in the price distribution, where most transactions happen.

Government compiles a register of these assessments. The Domestic Energy Performance Certificates contains data on the exact address of the property, its energy performance but most importantly for us, its size (i.e. total floor area). We also use additional property characteristics provided in the dataset: the property type (e.g. maisonette, flat, house) and the building type of the property (e.g. detached, semi-detached). We use the algorithm detailed in Chi et al. (2019) to match the Domestic EPCs to our dataset.[55]

We are able to match 35% of our transactions, improving significantly the quality of of predictions for this sub-sample of matched properties.

Table 10 provides details on the out-of-sample fit in our matched sample. The R^2 is significantly higher and the RMSE much lower than when no information on the property size is available.

	RMSE	Rsquared	MAE
11	0.641	0.785	0.400

Table 10: Price Prediction - EPC

Notes: This table describes the quality of our price inference and gives the value of the root mean squared error (RMSE), the R^2 and the mean absolute error (MAE) obtained when we regress p_i on Z_i (equation 3) using the subsample of properties that we are able to match to the EPCs data, hence when information on the property size is available.

We show in 11 and in 12 how respectively the RMSE and the R^2 evolve when we windsorize p_i at different levels in (3). Ultimately, we pick the levels of windsorizing minimizing the RMSE of the prediction, i.e. a

[55]The algorithm is described in their Appendix tables B1 and C1. In order to be able to follow their matching process, we start by creating several variables from the Address string: PAON (Primary Addressable Object Name), SAON (Secondary Addressable Object Name), Street and Location.

windsorization of the top tail of p_i at 3% (and no windsorization at the bottom). For the subsample matched to the Domestic EPCs, we windsorize the top tail at 1%.

In figure 10, we plot the predicted against the observed price in log for each transaction from the test sample. The smaller the distance between a point and the 45 degree line, the better the prediction. The figure provides two important insights. First, when we observe the area of the property, the prediction is much more precise. Second, while some points are well above or below the 45 degree line, there is no evidence of systematic over- or underestimation of the true prices.

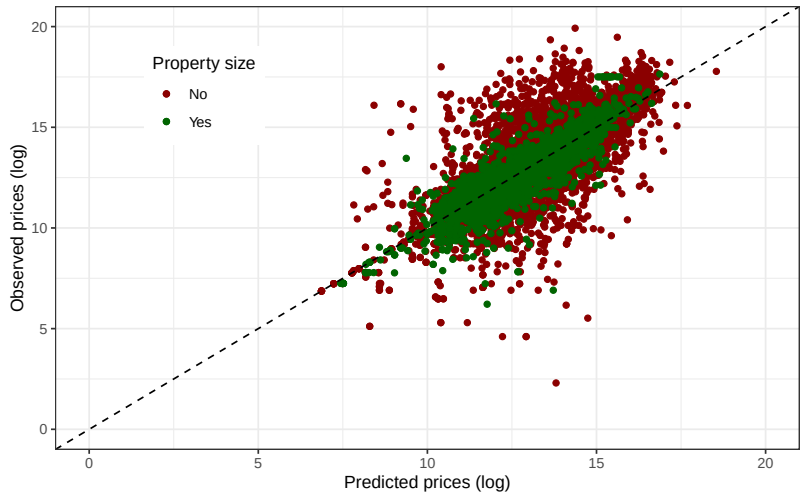
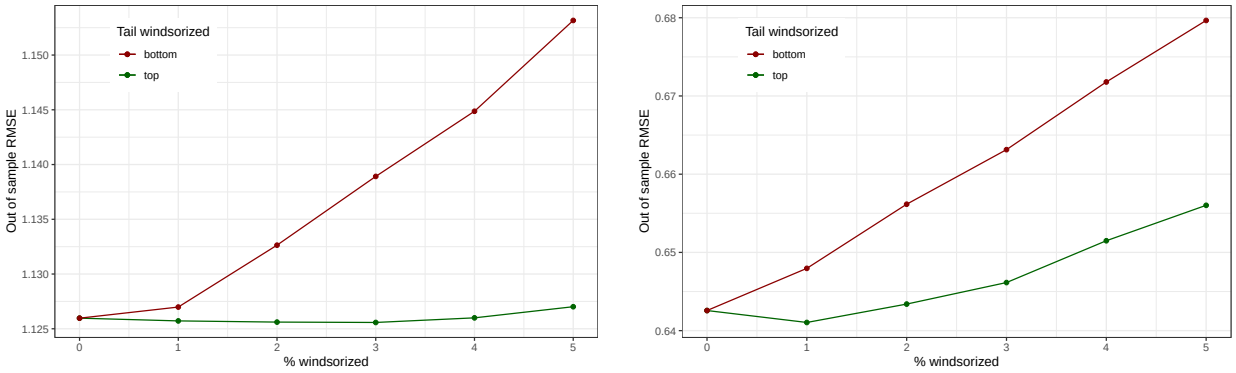


Figure 10: Distribution against observed prices in the test sample

Notes: This scatterplot displays the predicted against observed prices (in log) in the test sample, depending on whether we have information on the property size or not. The test sample is selected by randomly picking 20% of the transactions for which we have price information. It is not used to estimate (3) but only to test the quality of our price prediction . If a point lies on the 45 degrees line, this indicates that the predicted and observed prices correspond exactly.

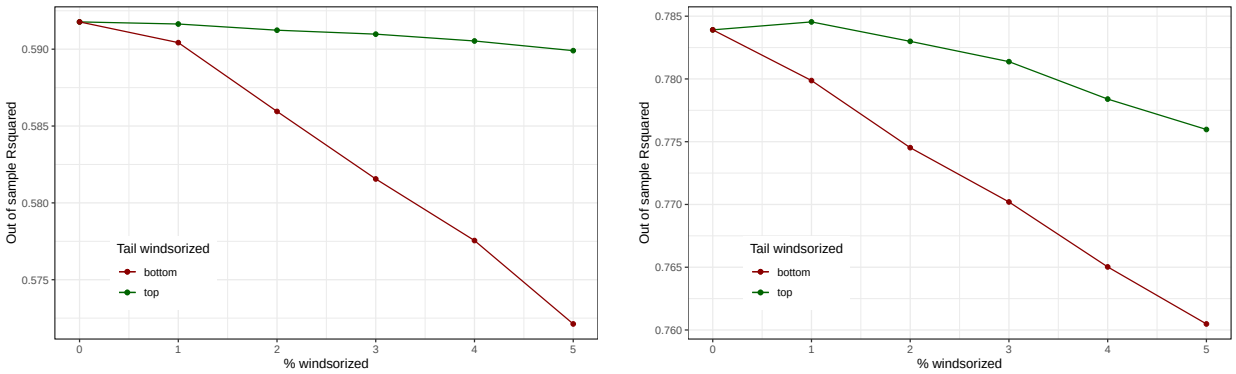


(a) Whole sample

(b) Matched with EPCs

Figure 11: Out-of-sample RMSE as a Function of Top and Bottom Windsorization

Notes: This graphs shows the out-of-sample root mean squared error (RMSE) as a function of windsorizing various shares of the bottom and top tails of the price in the prediction (equation 3). The Out-of-sample RMSE is computed as the average RMSE obtained from 5-fold cross-validation.



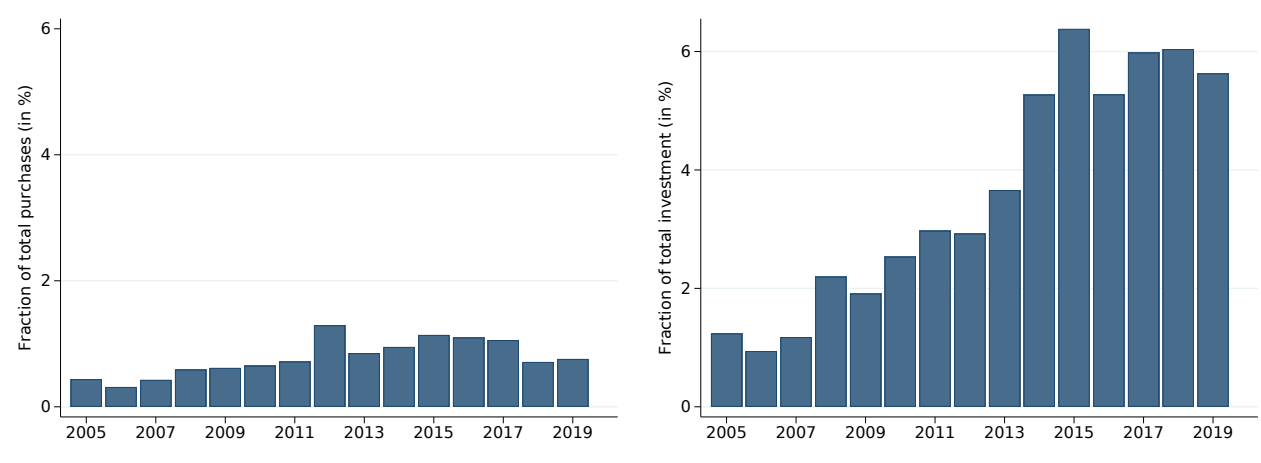
(a) Whole sample

(b) Matched with EPCs

FIGURE 12: OUT-OF-SAMPLE RSQUARED AS A FUNCTION OF TOP AND BOTTOM WINDSORIZATION

Notes: This graphs show the out-of-sample R^2 as a function of windsorizing various shares of the bottom and top tails of the price in the prediction (equation 3). The Out-of-sample R^2 is computed as the average R^2 obtained from 5-fold cross-validation.

A3. Additional descriptive elements on UK property purchases



(a) Number of transactions

(b) Total amount invested

Figure 13: Importance of real estate investments coming from offshore companies, compared to all real estate purchases made in England and Wales

Notes: This graph is constructed using two additional datasets maintained by the Land Registry, data on property transactions completed in the UK and the Price Paid Data. The Land Registry produces summary statistics on property transactions completed in the UK with a value of £40,000 or above. More precisely, the dataset provides monthly estimates of the number of residential and non-residential property transactions in the UK. The Price Paid Data provides information on all residential property sales in England and Wales (date of the transaction, address of the property bought, price paid). Panel A presents the ratio of OCOD transactions over all UK transactions as reported in the UK Property Statistics, by year. Because the UK Property Statistics does not provide information on property prices, we have to use Price Paid Data to construct Panel B. As Price Paid Data only covers residential transactions, we start by calculating how many transactions are missed in this dataset, by comparing yearly number of sales with figures from the UK Property Statistics. We correct yearly amounts invested in the UK as recorded in the Price Paid Data with this factor. Panel B presents the ratio of the value of the OCOD transactions over this total, by year.

Borough	Average price in 2013 (in £)	Average price in 2017 (in £)	Growth (in %)
Kensington and Chelsea	1,126,573.0	1,344,540.0	19.3
City of Westminster	789,972.5	1,064,772.0	34.8
Camden	667,447.6	839,347.5	25.8
Hammersmith and Fulham	631,529.1	756,900.4	19.9
City of London	570,008.7	849,790.2	49.1
Islington	495,766.2	650,114.7	31.1
Richmond upon Thames	492,115.7	665,284.7	35.2
Wandsworth	457,404	617,921.4	35.1
Barnet	374,770.6	538,280.9	43.6
Hackney	372,669	549,005.5	47.3
Haringey	372,233.7	557,307.1	49.7
Lambeth	362,965.7	518,503.6	42.9
Southwark	360,749.8	515,883.3	43
Kingston upon Thames	345,739.1	492,318.6	42.4
Merton	344,544.3	512,185.8	48.7
Brent	339,655.8	487,703.8	43.6
Ealing	338,088.8	484,592.1	43.3
Harrow	319,397.7	470,763.4	47.4
Tower Hamlets	309,051.1	459,279	48.6
Bromley	296,669.2	441,218.7	48.7
Hounslow	290,577.3	400,904.5	38
Redbridge	274,824.9	410,300.2	49.3
Hillingdon	270,594.8	413,586.7	52.8
Enfield	261,604.4	395,929.2	51.3
Lewisham	260,815.1	411,048.9	57.6
Waltham Forest	254,265.2	436,116.6	71.5
Greenwich	253,399.2	391,749.8	54.6
Sutton	252,002.8	376,924.5	49.6
Croydon	234,439.8	372,554.4	58.9
Havering	226,428.8	360,479.3	59.2
Newham	222,784.2	362,131.5	62.5
Bexley	213,470.2	335,694.4	57.3
Barking and Dagenham	173,733.7	287,734.8	65.6

Table 11: London Borough prices

Notes: This table shows the average price paid for a property in each London borough, as computed by the Land Registry in the House Price Index.

A4. Geography of tax haven use

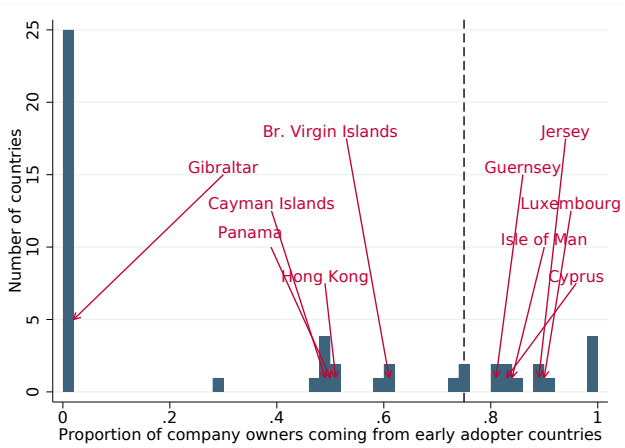


Figure 14: Distribution of CRS exposure, or "treatment intensity" amongst tax havens.

Notes: CRS exposure or treatment intensity in a given tax haven is computed based on the residence country of all individuals owning companies in that tax haven and on whether the residence country is an early adopter or not. A treatment intensity of e.g. 0.5 indicates that 50% of all company owners in the tax haven reside in countries participating to the Joint Announcement. Countries are labelled according to their importance in terms of flows of investments in the English and Welsh real estate market (e.g. in the less exposed group, British Virgin Islands companies invest more than Hong Kong companies, who invest more than Panama companies etc).

Australia	Austria	Brazil	Canada
China	Chile	Costa Rica	Indonesia
Israel	Japan	Luxembourg	Malaysia
New Zealand	Saudi Arabia	Singapore	Switzerland
Turkey	Belgium	Colombia	Czech Republic
Denmark	Estonia	Finland	France
Germany	Greece	Hungary	Iceland
India	Ireland	Italy	Korea
Latvia	Lithuania	Mexico	Netherlands
Norway	Poland	Portugal	Slovak Republic
Slovenia	South Africa	Spain	Sweden
Argentina	United Kingdom	Bulgaria	Croatia
Cyprus	Faroe Islands	Greenland	Liechtenstein
Malta	Mauritius	Romania	San Marino
Seychelles	Isle of Man	Guernsey	Jersey
Anguilla	Bermuda	Br. Virgin Islands	Cayman Islands
Gibraltar	Montserrat	Turks & Caicos Island	

Table 12: CRS early adopters: Countries participating to the Declaration on Automatic Exchange of Information (in purple and black) and to the Joint Announcement (in blue and black).

A.5 Additional outcomes and robustness checks

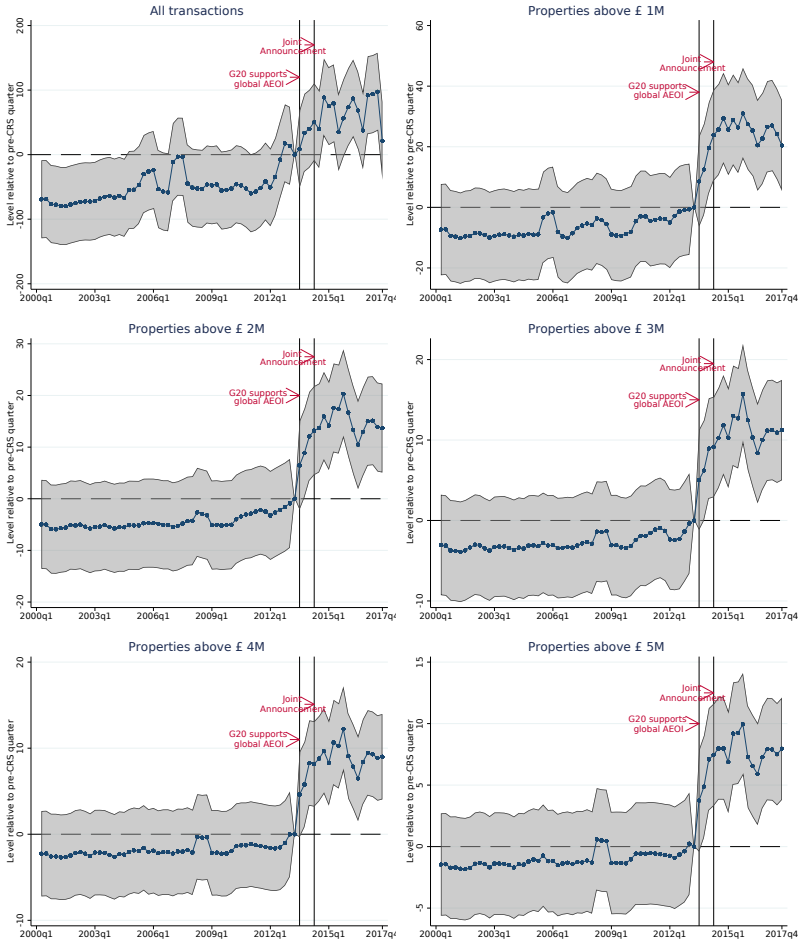


Figure 15: Effect of the CRS on the number of transactions

Notes: This figure shows the difference-in-differences coefficients comparing the quarterly number of purchases in England and Wales made through companies incorporated in highly-exposed havens to purchases from companies incorporated in the other havens, for different values of the purchases. The flows are normalized at their value of 2013q2. The estimation is based on the full data provided in the Land Registry OCOD.

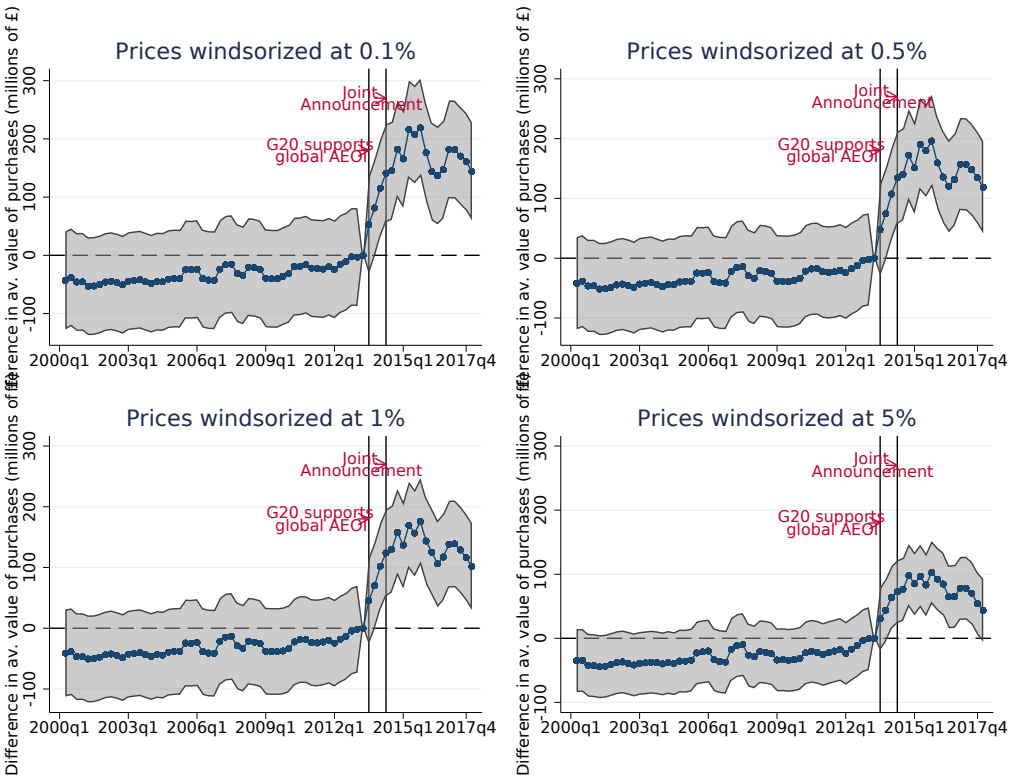


Figure 16: Effect of the CRS when prices are windsorized at different levels

Notes: This figure shows the difference-in-differences coefficients comparing quarterly amounts of real estate investments from companies incorporated in highly-exposed havens to investments from companies incorporated in the other havens, for different levels of price windsorization. The flows are normalized at their value of 2013q2. The estimation is based on the full data provided in the Land Registry OCOD.

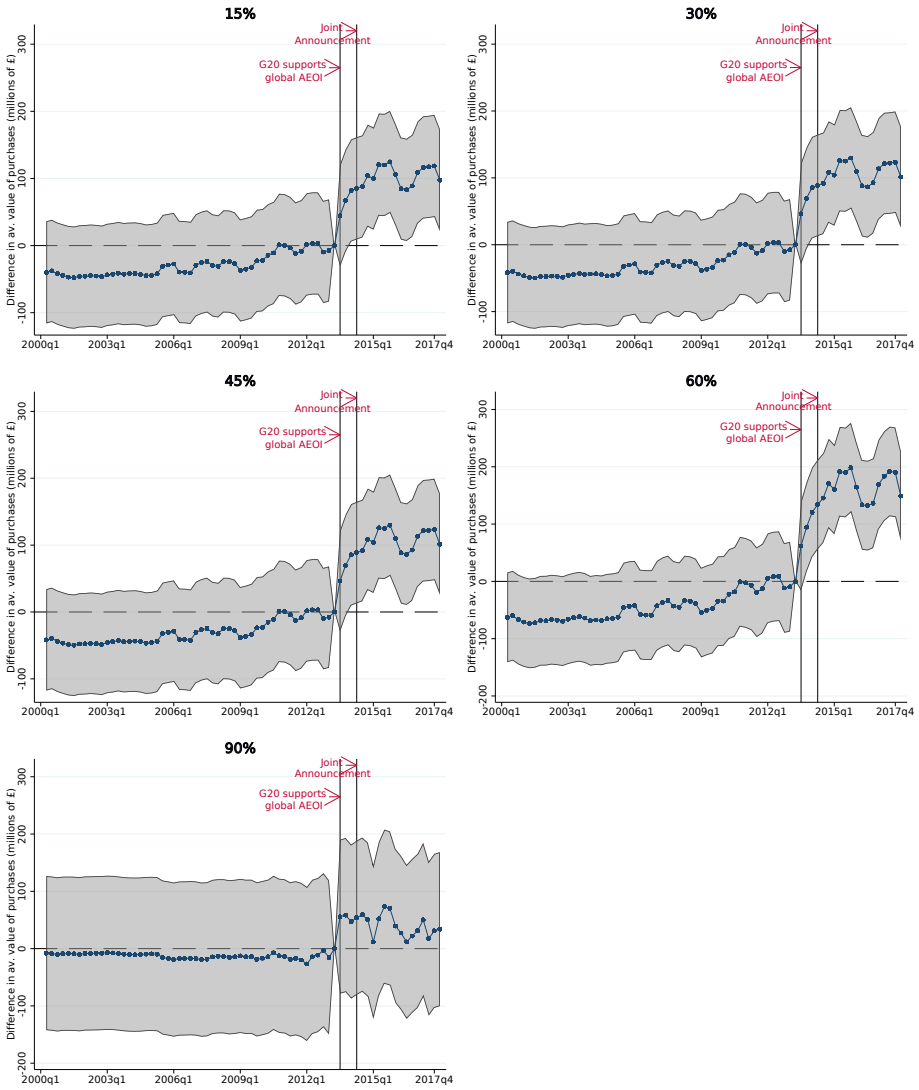


Figure 17: Difference-in-differences comparing real estate investments from companies incorporated in highly-exposed havens to companies incorporated in other havens, for different group thresholds

Notes: This figure shows the difference-in-differences coefficients comparing quarterly real estate investments from companies incorporated in highly-exposed havens to investments from companies incorporated in other havens. The flows are normalized at their value in 2013q2 and the estimation is based on the full data provided in the Land Registry OCOD. Each figure shows the difference-in-differences results for a different definition of the treatment group, varying the cut-off threshold. We show results when the treatment group is defined as tax havens for which more than 15% of the company beneficial owners come from early-adopting countries. We repeat the analysis for the 30%, 45%, 60% and 90% thresholds.

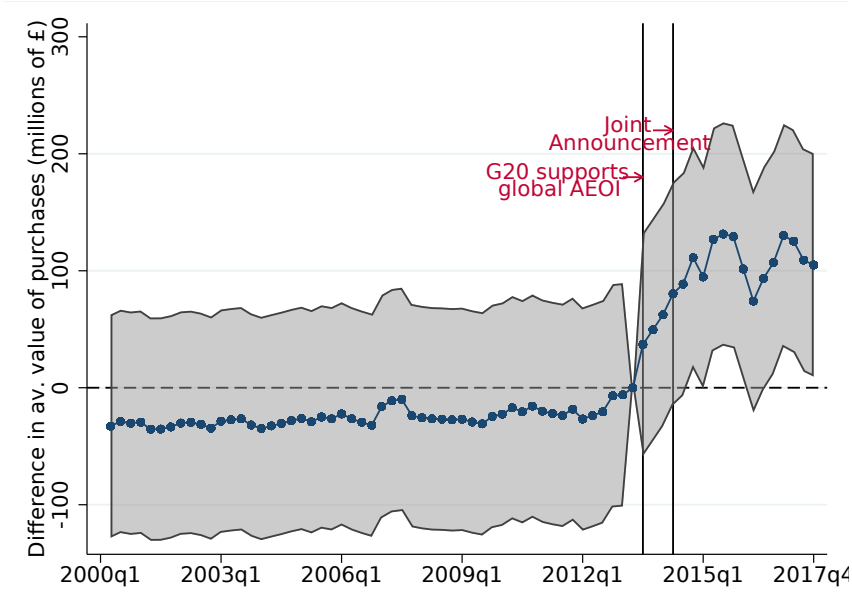


Figure 18: Difference-in-differences in the amount invested by highly-exposed havens vs other havens, using BIS weights

Notes: This figure shows the difference-in-differences coefficients comparing quarterly real estate investments from companies incorporated in highly-exposed havens to investments from companies incorporated in the other havens. The flows are normalized at their value in 2013q2 and the estimation is based on the full data provided in the Land Registry OCOD. We compute the weights used to define highly exposed and less exposed havens using data from the Bank for International Settlements.

	(1)	(2)	(3)	(4)	(5)	(6)
	Main spec.	No Jersey/Guernsey	CRS havens only	London only	Consensus list	Hines and Rice (1994) list
Post x High	165.622***	59.719***	195.892***	72.915***	199.105***	175.197***
	(32.662)	(19.932)	(59.281)	(18.763)	(52.227)	(39.767)
Post	20.249	19.640**	48.668	16.623*	51.468	27.442
	(17.058)	(9.726)	(38.809)	(9.799)	(32.001)	(22.622)
Observations	3632	3464	1760	3632	1961	2795
Country FE	YES	YES	YES	YES	YES	YES
Control for ER	YES	YES	YES	YES	YES	YES

Table 13: Robustness checks

Notes: This table presents the results of a variation of equation 1, using a single Post-CRS dummy to capture the effect of the policy. We take the first semester of 2013 as the reference period. Column (1) presents the results for our main sample. Column (2) shows the results of the estimation without Jersey and Guernsey, column (3) with only the tax havens participating to the CRS in 2013 or 2014, and column (4) for purchases made in the region of Greater London only. Finally, column (5) shows the results of our estimation using the consensus list of tax havens compiled by Menkhoff and Miethe (2019) and column (6) using the havens list of Hines and Rice (1994).

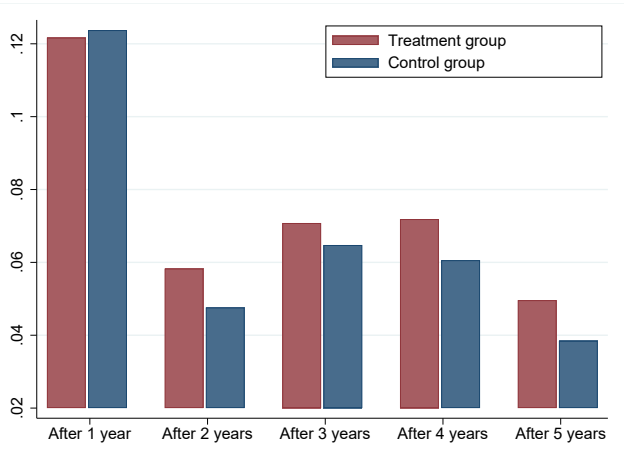


Figure 19: Proportion of properties sold after t years, for the treatment (highly-exposed havens) and the control (other havens) groups.

Notes: This figure shows the proportion of properties that are sold after one year, two years, etc, in the treatment group (highly-exposed havens) and in the control group (other havens). This figure is computed using our dataset from year 2015 to year 2020, as we have access to all the purchases and sells made by overseas companies during this period.

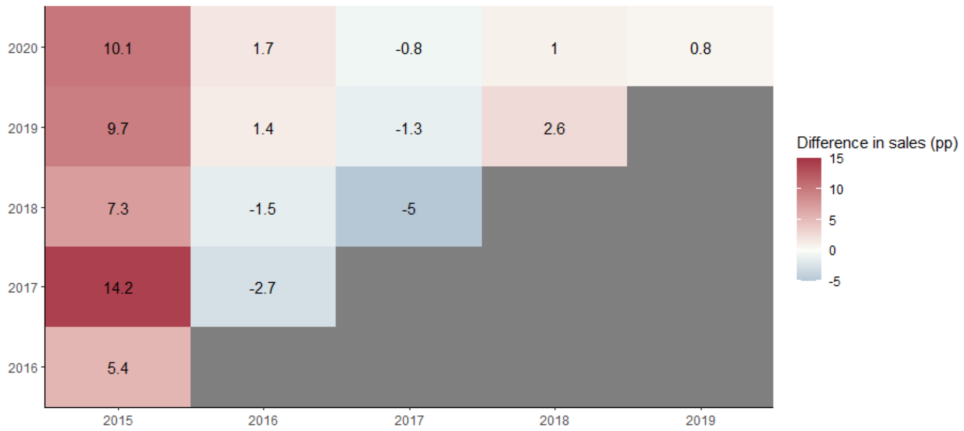


Figure 20: Heatmap of the difference of the percentage of sales made in the treatment and control group.

Notes: This figure shows a heatmap of the difference in percentage points of the percentage of sales made after one year, two years, etc, between the treatment and the control group. It is calculated over the 2015-2020 period. The x-axis shows the year of purchase of the property, while the y-axis shows the year it was sold. So for example, we see that the percentage of properties bought in 2017 and sold in 2018 was 5pp higher in the treatment group than in the control group.

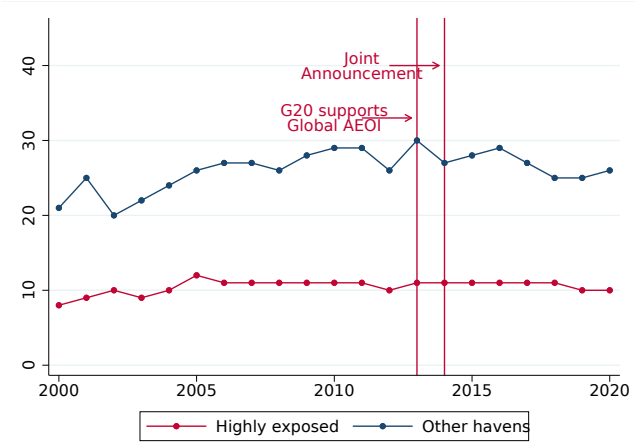
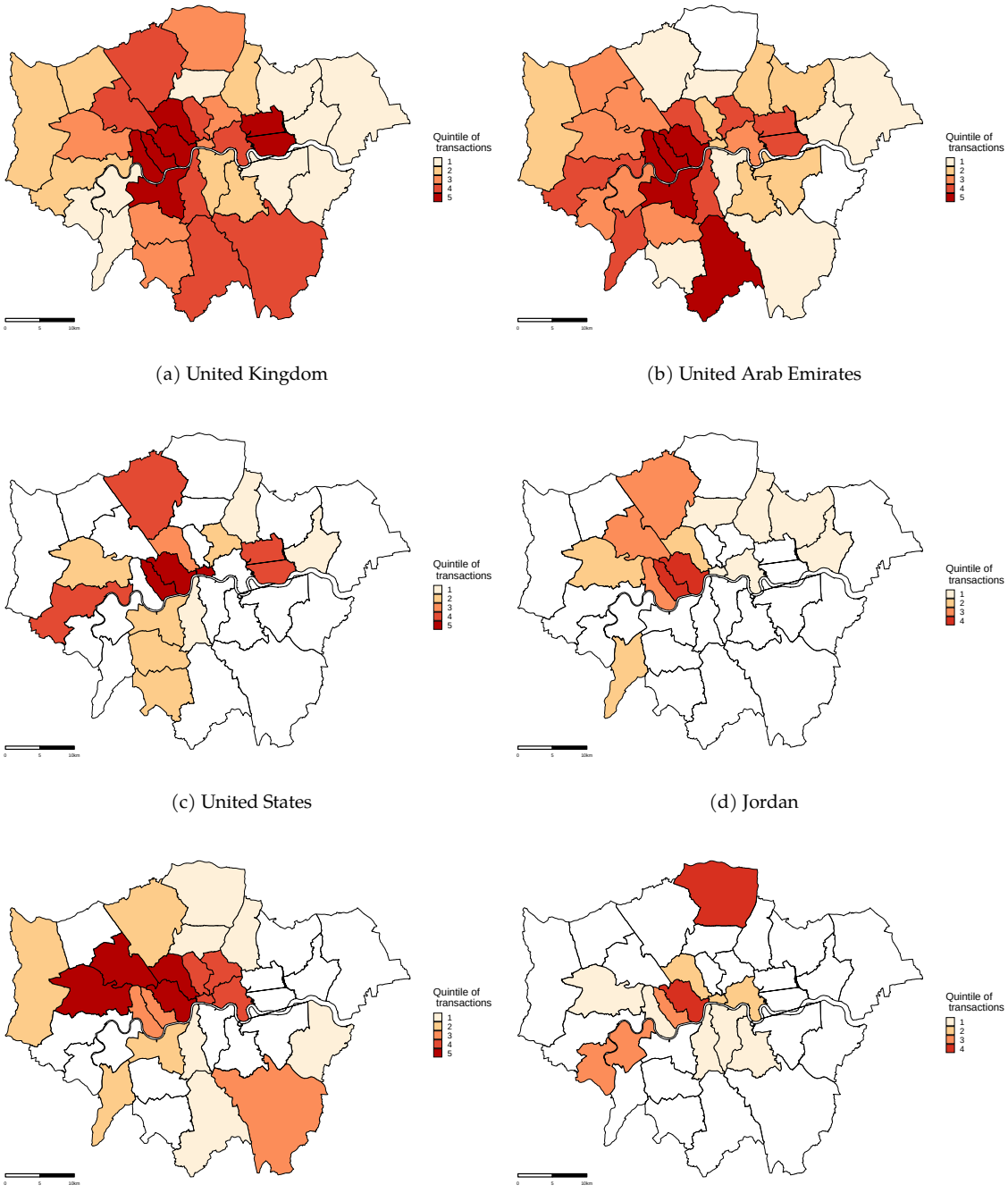


Figure 21: Number of countries making at least one purchase per year, in the treatment and the control group

Notes: This figure displays for each tax havens group the number of countries making at least one property purchase in England or Wales during the year. There is no drop for the less exposed countries after the CRS which suggests that no country is "ejected" from the UK real estate market due to higher property prices after 2014.

A6. Companies buying UK properties



(a) United Kingdom

(b) United Arab Emirates

(c) United States

(d) Jordan

(e) Israel

(f) Russia

Figure 22: Location of purchases made by identified buyers, by main nationalities

Notes: This figure shows the detailed location of the purchases made by individuals through a shell company in London, as recorded in the OCOD. The map represents the region of Greater London, which is composed of 32 boroughs and the City of London local government. The boroughs are ranked in five quintiles according to the total number of purchases made by foreign firms during the entire period covered by the OCOD (1959-2020), from the boroughs where individuals make the less purchases through foreign companies (quintile 1) to the boroughs where they make the most (quintile 5).

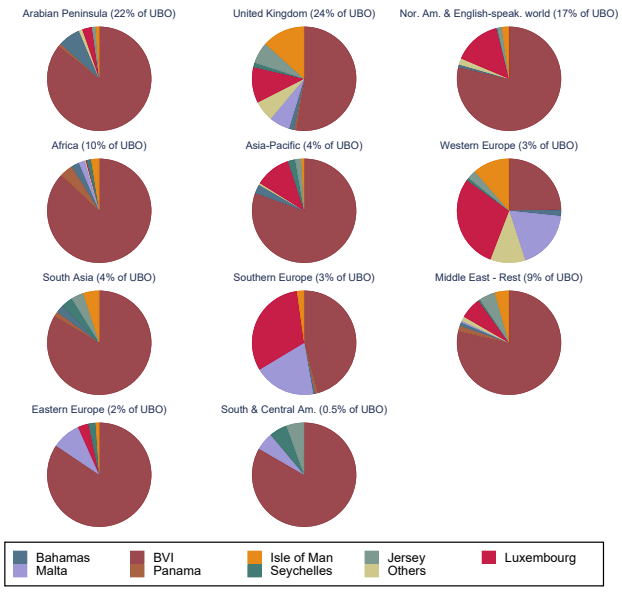


Figure 23: Tax havens involved in property purchases in the UK by ultimate owner's world region

Notes: This figure shows the most frequent tax havens used to invest in the UK real estate market, by region of the beneficial owner(s). We construct it matching the Panama Papers and other leaks data to the OCOD. We display the percentages of owners from each world region we identify in our sample on top of the figure. To compute the percentages, we remove beneficial owners who are linked to a tax haven, and beneficial owners who are companies. The total might not add up to 100% because of rounding.

A7. Analysis of the matched sample

Source	Number of transactions	Amount invested (in billion £)	Fraction of total transactions	Fraction of total amount invested
Full dataset	143,634	180	100%	100%
Matched	4,060	6.8	2.8	3.8

Table 14: Percentage of companies identified in the full OCOD sample

Notes: This table shows the number of OCOD transactions we manage to link with their ultimate beneficial owners' using the Bahamas Leaks, the Offshore Leaks, the Paradise Papers, the Panama Papers, the Pandora Papers, OpenLux and CNBIOM data. Columns 2 and 3 show the raw number of transactions and their value in the full and matched samples, while columns 4 and 5 show the corresponding percentages the matched transactions represent.

Source	Number of transactions	Amount invested (in billion £)	Fraction of total transactions	Fraction of total amount invested
Full dataset	62,392	114.800	100%	100%
Matched	2,739	5.3	4.4	4.6

Table 15: Percentage of companies identified in the London OCOD sample

Notes: This table shows the number of OCOD transactions location in London we manage to link with their ultimate beneficial owners' using the Bahamas Leaks, the Offshore Leaks, the Paradise Papers, the Panama Papers, the Pandora Papers, OpenLux and CNBIOM data. Columns 2 and 3 show the raw number of transactions and their value in the full and matched samples, while columns 4 and 5 show the corresponding percentages the matched transactions represent.

Country of residence	Amount invested in £M	Number transactions
United Arab Emirates	59	52
South Africa	35	66
United Kingdom	27	50
Israel	17	18
Zimbabwe	13	19
Saudi Arabia	12	11
India	9	8
Qatar	8	2
Lebanon	8	11
Jordan	7	11

Table 16: Properties purchased through company shares

Notes: This table displays information on properties purchased indirectly, via the shares of the company owning the property. We give the number of properties purchased and the amount invested for the 10 most frequent countries involved in such investment schemes. For simplicity, we do not take into account split ownership here. So, if a property is bought by two investors from two different countries, one transaction will be recorded for each country, and the total price of the property will be attributed to each country. If a property is bought through the shares of the holding company in 2014 and again in 2016, this will appear as two transactions.

A8. Additional elements

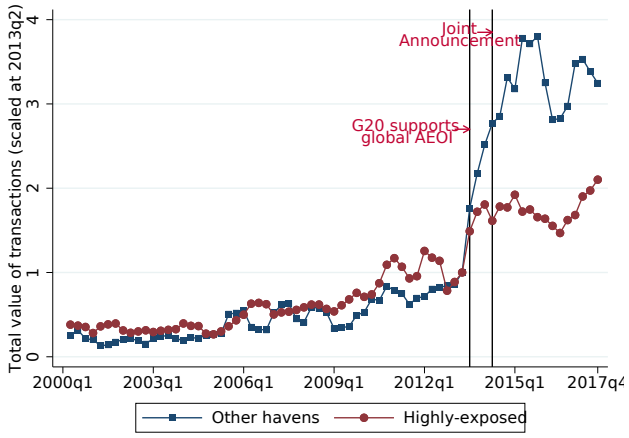


Figure 24: Total value of transactions from companies incorporated in "highly-exposed" tax havens vs other havens, scaled by investments during the second quarter of 2013.

Notes: This figure presents the aggregated amounts invested in England and Wales by companies incorporated in tax havens vs. companies incorporated in non-havens, normalized by their value in 2013q2. It is based on the Overseas Companies Ownership Dataset.

Country	Amount - Direct	Amount - Indirect	Amount - Total	Amount - Direct London	Amount - Indirect London	Amount - Total London
United Arab Emirates	4.27	21.84	26.11	2.39	14.99	17.38
United Kingdom	0	21.34	21.34	0	9.61	9.61
United States	5.19	6.09	11.28	2.85	2.67	5.52
Saudi Arabia	2.94	6.55	9.49	1.17	5.44	6.62
Israel	.58	7.46	8.04	.43	6.21	6.64
Malaysia	4.25	1.83	6.08	2.39	1.58	3.98
Qatar	1.16	4.16	5.32	.34	3.59	3.94
Kuwait	3.45	1.49	4.94	.64	1.25	1.89
Ireland	4.23	.69	4.92	1.85	.4	2.25
South Africa	1.86	2.92	4.79	.78	1.98	2.76
Italy	1.96	2.37	4.33	1.65	1.53	3.19
France	2.59	1.69	4.28	1.03	1.43	2.46
Jordan	.16	3.9	4.06	.12	3	3.12
Australia	3.06	.29	3.34	1.44	.21	1.65
Slovakia	.02	3.22	3.24	.01	2.79	2.8
Russia	.55	2.66	3.21	.4	2.26	2.65
Spain	1.57	1.31	2.88	.61	1.03	1.64
Lebanon	.21	2.54	2.75	.18	1.39	1.57
Oman	.34	2.25	2.59	.09	1.95	2.04
Nigeria	.58	1.87	2.45	.45	1.33	1.78
Bahrain	1.19	.97	2.16	.43	.84	1.27
India	.44	1.49	1.93	.3	1.19	1.5
China	1.73	.15	1.88	1.33	.11	1.44
Sweden	.3	1.46	1.77	.2	.85	1.05
Portugal	.33	1.23	1.56	.18	.07	.25
Canada	1.03	.38	1.41	.46	.33	.79
Kenya	.26	1.06	1.32	.17	.69	.86
Egypt	.35	.9	1.25	.28	.57	.85
Thailand	.58	.61	1.19	.38	.14	.52
Netherlands	1.12	.05	1.17	.74	.02	.75
Germany	1.11	.02	1.14	.56	.01	.57
Greece	.64	.28	.92	.5	.23	.73
New Zealand	.83	.09	.91	.35	.01	.36
Pakistan	.46	.43	.89	.31	.35	.66
Belgium	.56	.07	.63	.31	.06	.36
Turkey	.46	.15	.61	.4	.13	.53
Japan	.54	.01	.56	.32	.01	.33
Ukraine	.06	.45	.51	.04	.39	.43
Brazil	.11	.31	.41	.07	.25	.33
Brunei	.16	.15	.31	.08	.11	.19
Taiwan	.3	.02	.31	.11	.01	.12
Austria	.21	.04	.25	.13	.03	.16
Denmark	.15	.09	.24	.07	.08	.15
Botswana	.04	.2	.23	.01	.07	.08
Azerbaijan	.03	.19	.22	.02	.17	.19
Morocco	.03	.18	.21	.02	.15	.17
Serbia	.03	.17	.21	.03	.15	.18
Indonesia	.12	.09	.2	.08	.07	.16
Norway	.19	0	.19	.1	0	.1
Czechia	.09	.09	.18	.05	.05	.11
Eswatini	.01	.17	.18	0	.14	.14
Albania	0	.15	.15	0	.13	.13
Kazakhstan	.09	.05	.14	.07	.04	.12
Philippines	.07	.05	.12	.04	.01	.05
Zimbabwe	.05	.07	.12	.02	.03	.04
Zambia	.04	.08	.12	.02	.04	.05
Malawi	.02	.1	.12	0	.07	.07
Sri Lanka	.06	.05	.12	.05	.05	.09
Bulgaria	.04	.07	.11	.02	.06	.08
Yemen	0	.11	.11	0	.09	.1
Poland	.1	0	.1	.07	0	.07
Libya	.01	.08	.1	.01	.07	.08
Lithuania	.01	.08	.1	.01	.07	.08
South Korea	.04	.05	.09	.02	.04	.06
Uzbekistan	.01	.07	.08	.01	.06	.07
Argentina	.03	.04	.07	.02	.03	.06
Ghana	.04	.02	.06	.03	.02	.05
Iran	.06	0	.06	.04	0	.04
Finland	.06	0	.06	.04	0	.04
Hungary	.04	.02	.06	.03	.02	.05
Tanzania	.04	.02	.06	.02	0	.02
Syria	.01	.05	.05	0	.04	.05
Vietnam	.05	0	.05	.03	0	.03
Mexico	.04	.01	.05	.02	.01	.03
Bangladesh	.05	0	.05	.04	0	.04

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Continued from previous page

Country	Amount - Direct	Amount - Indirect	Amount - Total	Amount - Direct London	Amount - Indirect London	Amount - Total London
Liberia	.04	0	.04	.04	0	.04
Sudan	.04	0	.04	.03	0	.03
Latvia	.02	.02	.04	.01	0	.01
Croatia	.04	0	.04	.03	0	.03
Gabon	0	.03	.03	0	0	0
Chile	.03	0	.03	.01	0	.01
Uganda	.03	0	.03	.02	0	.02
Sierra Leone	.01	.02	.03	.01	.02	.03
Romania	.02	.01	.03	.01	.01	.02
Namibia	.01	.02	.03	0	.02	.02
Iceland	.03	0	.03	.01	0	.01
Jamaica	.02	0	.02	.02	0	.02
Venezuela	.01	.01	.02	.01	.01	.02
Tunisia	.02	0	.02	.02	0	.02
Estonia	.01	.01	.02	.01	.01	.02
Algeria	.02	0	.02	.01	0	.01
Georgia	.01	0	.01	.01	0	.01
Guatemala	0	.01	.01	0	.01	.01
Cameroon	0	.01	.01	0	.01	.01
Costa Rica	.01	0	.01	.01	0	.01
Kyrgyzstan	0	.01	.01	0	.01	.01
North Korea	.01	0	.01	.01	0	.01
Nepal	0	.01	.01	0	0	0
Somalia	0	.01	.01	0	.01	.01
Haiti	0	.01	.01	0	.01	.01
Iraq	.01	0	.01	0	0	0
Uruguay	.01	0	.01	.01	0	.01
Colombia	.01	0	.01	.01	0	.01
Mozambique	.01	0	.01	.01	0	.01
Cambodia	.01	0	.01	0	0	0
Slovenia	.01	0	.01	0	0	0
Peru	.01	0	.01	0	0	0
Angola	0	0	.01	0	0	0
Ethiopia	.01	0	.01	0	0	0
All	110.09	109.32	219.42	69.39	72.93	142.32

Table 17: Offshore Real Estate in England and Wales, by Country of Owner

Notes: This table shows how ownership of real estate in England and Wales and in London is distributed across countries in January 2018. Values are in 2015 billion Pounds. Column "Amount - Direct" refers to direct ownership of properties in England and Wales. The information comes from recently published data by the Centre for Public Data - CFPD.[a] Prices are imputed based on mean prices paid for residential properties in England and Wales, by local authority and for the first quarter of 2018 (computed by the Office for National Statistics). We only show direct ownership for countries that are not tax havens, but the row "All" aggregates the total value of foreign owned properties - including those owned from haven countries. Values in columns "Amount - Indirect" are inferred using the following method: we match the stock of OCOD properties in January 2018 to our tax-related data leaks in order to have information on the country of residence for some owners. We identify the owner of 3.31% of the properties owned at that date, which represents 4.28% of the total in value. Then we simply multiply the total value owned from each country in the identified sample by 1/0.0428 in order to allocate the ownership of all properties appearing in the OCOD to one country. So, the assumption we make here is that the distribution of ownership in the matched sample is similar to the distribution in the full stock of properties owned by foreign companies in January 2018. Columns "Amount Total" is simply the sum of "Amount - Direct" and "Amount - Indirect". For buyers from the United Kingdom, we put a zero in columns "Amount - Direct" as direct ownership of a UK property would not be considered as offshore real estate in that case. Columns 2-5 show these computations for the whole of England and Wales, while columns 6-8 show them for London only.

[a] The data are available at https://www.centreforpublicdata.org/property-data-overseas-individuals.

Paper	Estimates	Wealth decrease (billion Pounds)	Shifting - lower bound	Shifting - upper bound
O' Reilly et al. (2021)	11%	334	24%	27%
Casi et al. (2020)	11.5%	352	23%	26%
Menkhoff and Miethe (2019)	31.8%	966	8%	9%
Beer et al. (2019)	29.6%	899	9%	10%

Table 18: Estimation of asset shifting responses to the CRS

Notes: this table compares the effect of the CRS on real estate investments we estimate in our paper to the amount of offshore financial wealth that left tax havens due to the transparency shock, as estimated in several papers from the literature. Column "Estimates" gives estimates of the CRS effect in terms of reduction in offshore wealth. The estimate for Casi et al. (2020) comes from column 1, table 4 from their paper, for Menkhoff and Miethe (2019), from column 2, table 5 and for Beer et al. (2019), from column "Model 4", table 3. Column "Wealth decrease" refers to the stock of offshore financial wealth owned by early adopters in 2013 that fled tax havens because of the CRS (it depends on the column "Estimates" and on the total stock of offshore wealth). Column "Shifting - lower bound" computes the ratio of our real estate effect over offshore wealth decrease, taking the lower bound of the real estate effect (£82 billion). Column "Shifting - upper bound" does the same with the upper bound of the real estate effect (£94 billion).

Country	Menkhoff and Miethe (2019)	Hines and Rice (1994))	Consensus list
Andorra	x	x	
Anguilla	x	x	
Antigua and Barbuda	x	x	x
Aruba	x		
Austria	x		
Bahamas	x	x	x
Bahrain	x	x	x
Barbados	x	x	x
Belgium	x		
Belize	x	x	x
Bermuda	x	x	x
British Virgin Islands	x	x	x
Cayman Islands	x	x	x
Chile	x		
Cook Islands	x	x	x
Costa Rica	x		
Curacao	x	x	x
Cyprus	x	x	x
Dominica	x	x	
Gibraltar	x	x	x
Grenada	x	x	x
Guernsey	x	x	x
Hong Kong SAR China	x	x	x
Ireland	x	x	
Isle of Man	x	x	x
Jersey	x	x	x
Jordan	x	x	
Lebanon	x	x	
Liberia	x	x	x
Liechtenstein	x	x	x
Luxembourg	x	x	x
Macao SAR China	x	x	
Malaysia	x		
Maldives	x	x	
Malta	x	x	
Marshall Islands	x	x	
Mauritius	x		
Monaco	x	x	
Montserrat	x	x	x
Nauru	x		
Netherlands Antilles	x	x	x
Niue	x		
Panama	x	x	x
Samoa	x		
San Marino	x		
Seychelles	x		
Singapore	x	x	x
Sint Maarten	x	x	x
St. Kitts and Nevis	x	x	x
St. Lucia	x	x	
St. Vincent and Grenadines	x	x	x
Switzerland	x	x	x
Tonga	x		
Trinidad and Tobago	x		
Turks and Caicos Islands	x	x	x
U.S. Virgin Islands	x		
Uruguay	x		
Vanuatu	x	x	x

Table 19: Lists of tax havens used in the analysis.

Notes: This table shows the lists of tax havens we use in our analysis. Our main list is the one of Menkhoff and Miethe (2019) in column (1), used in their analysis of the CRS on financial assets, held in and by tax havens. They obtain it by combining the lists of different sources, and it counts 58 countries. Column (2) shows the list used by Hines and Rice (1994), which excludes 18 countries categorized as tax havens by Menkhoff and Miethe (2019). Column (3) shows a "consensus" list of tax havens. This list is compiled by Menkhoff and Miethe (2019) by choosing the 29 countries that appear in most recent studies on tax evasion (see Menkhoff and Miethe (2019), appendix A.2).

Assets and ownership type	Solution to avoid reporting under CRS	Loophole that prevents the information from being reported	Literature
Direct ownership of financial assets	Moving deposits to a non-participating country (the U.S.)	Some countries are not part of the CRS (the U.S.)	- CRS: Casi et al. (2020) - IoR: Johannesen and Zucman (2014)
Direct ownership of financial assets	Selling equities for real estate in any country	Not reporting of real estate assets under the CRS	De Simone et al., 2020: effect on house prices for FATCA
Indirect ownership (through company) of financial assets	Switching from passive to active non-financial entity (NFE) (less than 50% of passive income and less than 50% of assets are used to produce passive income)	Controlling persons are identified only for Passive NFEs	No
Financial assets held in a trust managed by a financial institution (FI)	Switch to an individual trustee (as opposed to a financial institution)	Only a trust managed by an FI would be considered a reporting FI	No
Indirect ownership (through company) of financial assets	Splitting the ownership of the company such that no owner has more than 25% of the shares	The threshold to define a person ad "controlling person" of a company is typically 25% (even though this threshold might vary)	No
Direct ownership of financial assets	Holding assets via a discretionary trust with no distribution of income during the reporting period	A beneficiary from a discretionary trust will be treated as a beneficiary of the trust if such person receives a distribution in the appropriate reporting period.	No
Direct or indirect ownership of financial assets	Acquiring a residence certificate from a secrecy jurisdiction	Some tax havens refuse that any data is ever collected about their tax residents. Becoming a (fake) resident of such a tax haven would prevent any reporting	No

Table 20: Some loopholes in the CRS

A9. Do property buyers bunch at different stamp duty tax thresholds?

The UK Stamp Duty and Land Tax (SDLT) is imposed on the purchase value of land and any construction on the land. The rate is progressive and has increased over time as new thresholds have been introduced. Until December 2014, the rate of stamp duty is applied on the whole amount of the purchase, meaning that the stamp duty schedule exhibits notches - discrete jumps in tax liabilities - at thresholds of property prices. Best and Kleven (2018) show that buyers in the UK react strongly to these notches by "bunching" at different thresholds of the stamp duty schedule. After December 2014, the general stamp duty tax schedule evolves and the tax applies on increasing portions of the property price, i.e. a rate of 0% applies on the portion of the price up to £125,000, then a rate of 2% applies on the portion from £125,001 to £250,000 etc. The rate faced by investors purchasing UK real estate through offshore companies starts to differ from the standard rates from 2012 onward. Finance Act 2012 introduces a 15% rate of SDLT on the acquisition by certain non-natural persons - including foreign companies - of dwellings costing more than £2 million. In 2014, the threshold is reduced to £500,000.

We estimate bunching responses to the stamp duty tax based on transactions for which the price is available. We also exclude transactions when a bundle of properties are purchased at the same time.[56] We first look at bunching behaviors around the £250,000 threshold (figure 25). Until 2014, the *proportional* tax rate for residential properties jumps from 1% to 3% at this cutoff. From December 2014, the notch is replaced by a kink, so the incentives to bunch at the threshold decrease. Second, we estimate bunching around the £500,000 threshold (figure 26). Until 2014, the proportional tax rate jumps from 3% to 4% at this cutoff. From March 2014 onward, the proportional tax rate reaches 15% beyond this threshold - as opposed to a *marginal* tax rate of 2% below. We do not study bunching responses around other thresholds of the stamp duty schedule for sample size reasons. The lower notch takes several values ranging from £60,000 to £175,000 during the period, we thus would have too few observations to estimate bunching responses at this cutoff. Moreover, we cannot estimate bunching responses at the £2 million threshold because the 15% rate only applies from 2012 to 2014 and thus we observe too few transactions around that price during this short period.

We follow a similar method to the one used by Best and Kleven (2018) in their paper. The counterfactual distribution used to compute the excess mass at the notch (or kink) points is estimated by fitting a flexible polynomial of order 7 to the empirical distribution of purchased prices excluding data in a range around the thresholds. We allow for round-number fixed effects for prices that are multiple of 25,000 and 50,000 in order to capture rounding in the price data. We group transactions into price bins of £5000. The regression used to estimate the counterfactual distribution around the threshold $\bar{v}$ is the same as equation (11) in Best

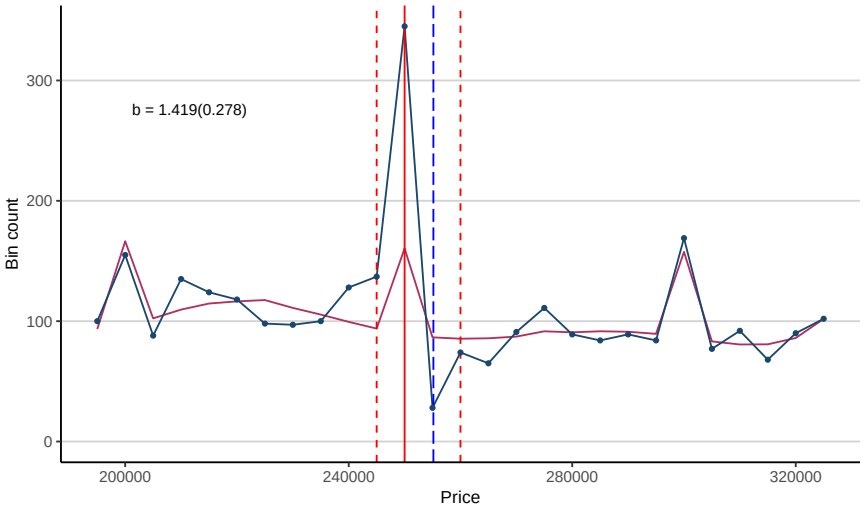
[56] In this case, the price is only available for the total amount invested and not for each individual property bought.

and Kleven (2018) and is the following:

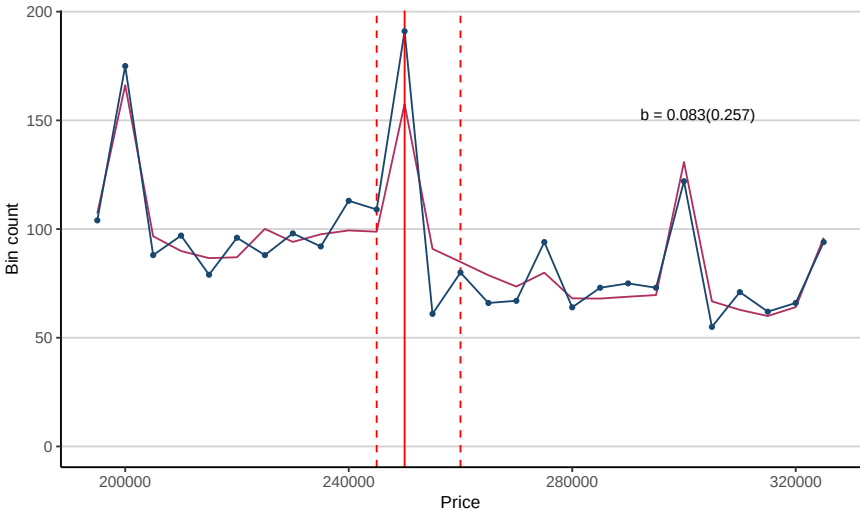
$$c_i = \sum_{j=0}^{q} \beta_j (z_i)^j + \sum_{r \in R} \eta_r I\{\frac{\bar{v} + z_i}{r} \in \mathbb{N}\} + \sum_{k=h_v^-}^{h_v^+} \gamma_k I\{i = k\} + \mu_i \tag{5}$$

where c_i is the number of transactions in price bin i, z_i the distance between price bin i and the cutoff $\bar{v}$ and q is the order of the polynomial ($q = 7$ in our estimation). The second term of the equation accounts for round-numbers bunching, with $R = \{25,000; 50,000\}$, $\mathbb{N}$ the set of natural numbers and $I\{.\}$ is an indicator function. The third term excludes a region $\{h_v^-, h_v^+\}$ around the threshold that is distorted by responses to the tax. The estimate of the counterfactual distribution is defined as the predicted bin counts $\hat{c_i}$ omitting the contribution of the dummies in the excluded range. The excess bunching is estimated as the difference between the observed and counterfactual bin counts in the part of the excluded range below the threshold. Standard errors are obtained by bootstrapping the procedure 200 times.

Overall, our results suggest that property buyers do respond to the stamp duty tax. Looking at figures 25 and 26, panel (a), there are clear and statistically significant responses to the notch in the 2000-2014 period, which is roughly the same sample period as in Best and Kleven (2018). Figure 25, panel (b) suggests that responses to the £250,000 threshold are much more modest once the notch is removed and replaced by a kink. What is surprising is the absence of strong bunching responses to the 15% threshold (figure 26, panel (b)). Note that this top rate only applies to residential properties and that we do not know whether a purchase is residential or commercial in our sample, in most of the cases.



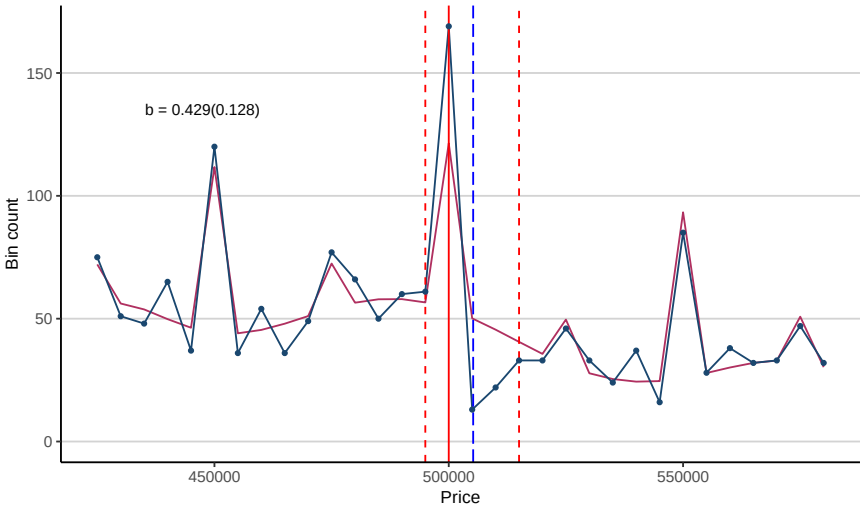
(a) Notch (2000-2014)



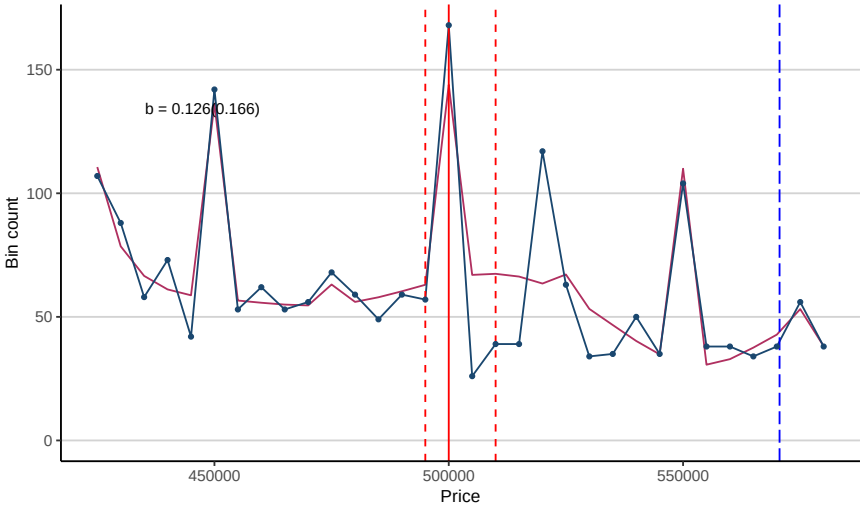
(b) Kink (2014-2020)

Figure 25: Bunching responses to stamp duty taxes, £250,000 threshold

Notes: The red dashed lines denote the upper and lower bounds of the excluded region around the threshold. The blue dashed line in the graphs estimating responses to a notch marks the upper bound of the dominated region. Absent optimization frictions, optimization theory predicts an empty hole between the cutoff and the blue line. b is our estimate of the excess mass just below the threshold scaled by average counterfactual frequency in the excluded range (standard errors in parentheses). Graphs and estimates built using the *bunching* package in R.



(a) Notch (2000-2014)



(b) Notch (2014-2020)

FIGURE 26: BUNCHING RESPONSES TO STAMP DUTY TAXES, £500,000 THRESHOLD

Notes: The red dashed lines denote the upper and lower bounds of the excluded region around the threshold. The blue dashed line in the graphs estimating responses to a notch marks the upper bound of the dominated region. Absent optimization frictions, optimization theory predicts an empty hole between the cutoff and the blue line. b is our estimate of the excess mass just below the threshold scaled by average counterfactual frequency in the excluded range (standard errors in parentheses). Graphs and estimates built using the *bunching* package in R.