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Tax Systems Analysis

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TRANSACTION-TAX EVASION IN THE HOUSING MARKET *

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ABSTRACT: We model the behaviour of a buyer trying to evade the real estate transfer tax. We identify over-appraisal as a key, easily-observable element that is inversely related with tax evasion. We conclude that the tax authority could focus auditing efforts on low-appraisal transactions. We include 'behavioural' components (shame and stigma) allowing to introduce buyers' (education) and societal (social capital) characteristics that explain individual and idiosyncratic variations.

Our empirical analysis confirms the predictions using a unique database, where we directly observe: real payment, value declared to the authority, appraisal, buyers' educational level and local levels of corruption and trust.

JEL Codes: G21, H26, R21

Keywords: Transfer tax, tax evasion, second-hand housing market, overappraisal, Loan-To-Value, corruption, social capital, stigma, shame, education

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1 Introduction

Real estate transfer taxes are common in most OECD countries and yet they remain understudied (Best & Kleven 2018). Similarly, the empirical literature on tax evasion has advanced slowly, mainly due to the challenge of obtaining reliable data.[1] Difficulty understanding and observing fraud has obvious consequences on the effectiveness of audits performed by tax authorities. This work aims to help fill these gaps by focusing on home buyers' strategic behaviour, whereby we test our prediction and provide some policy recommendations.

To this end, we present a model where an agent decides their housing expenditure, together with the share of the latter they declare to the tax authority. The model embeds elements of behavioural economics identified by the most recent literature on tax evasion as potentially crucial to explaining tax evasion decisions. In particular, we introduce what we denote as 'stigma', reflecting the dis-utility or unease that an agent may feel when other people become aware of a fraudulent behaviour; stigma is only suffered when an agent is caught cheating. In parallel, we also include 'shame', which corresponds here to the feeling of guilt that an agent may suffer, regardless of whether their fraudulent behaviour is discovered. Both elements depend on social norms, trust and social capital. Furthermore, shame varies with individual characteristics such as level of education.

The model uncovers the relation between tax evasion, access to cash (or other untraceable payment systems) and housing over-appraisal.[2] Our result has an interesting policy implication: as over-appraisal is much easier to observe than possession of cash or other proxies for fraudulent behaviour, the tax authority could use it to determine which transactions to audit.

Our paper is thus related to the literature on over-appraisal. This literature suggests that over-appraisal was a generalised practice during the real estate bubble of the mid-2000s in the U.S. (Nakamura et al. 2010, Ben-David 2011) and in Spain (Montalvo & Raya 2012, Akin et al. 2014, Montalvo & Raya 2018).[3] Nakamura et al. (2010) suggest that appraisals were subject to

[1] Alm (2012), Scheneider & Enste (2000), Slemrod & Yitzhaki (2002), Esteller-Moré et al. (2018) provide extended surveys of the rich literature. Slemrod & Weber (2012) presents an analysis of the limits to the empirical study of tax evasion.

[2] Agents inflate the price of the real estate transaction and expand its scope by adding items such as appliances, transaction or other costs.

[3] Cho & Megbolugbe (1996) and Loebs (2005) provide evidence that in the U.S. the appraised price is (weakly) above the selling price more than 95% of the time. The figures in the Spanish market are even higher (Akin et al. 2014). The institutional setting may play a crucial role relative to both the accuracy of appraisal and incentives to evade the transfer tax. The U.K. possibly represents the most extreme case documented in the literature in terms of compliance: appraisal tends to reflect the true value of the property

an upward bias, such that borrowers were able to obtain larger mortgages, driving excessively risky mortgage loans.[4] In theory, this behaviour should not be possible, as the (formally independent) appraiser should value homes objectively (Mae 2007). However, appraisers' incentives were distorted in that their clients (money lenders) were often the ones pressuring them to overstate the value of the property.[5] Analogously, in Spain during the housing boom, most agents underestimated the risks of granting overly generous mortgages, assuming that house prices would grow without limits. Financial institutions were prone to open the market to borrowers with financial constraints. Meanwhile, appraisers were encouraged to upward bias their valuations, in turn used to produce artificially low LTVs, which ostensibly kept the credit risk of the mortgage portfolio under control (Montalvo & Raya 2018). Over-appraisal in Spain reached as high as 29% (Montalvo & Raya 2012), explained in part by the additional perverse incentive that more than half of the appraisals were performed by companies directly owned by financial institutions.

Using a novel dataset, which includes second-hand private housing transactions that occurred in Spain between 2005 and 2011, we test the model's results empirically. The data at our disposal is unique in that it includes both the real transaction price and that declared to the tax authority. Furthermore, for a subset of transactions, we also observe the socioeconomic characteristics of the buyer and some information about their mortgage. Furthermore, we are able to observe the level of tax evasion without noise, and to identify several strong patterns. In particular, we detect a very robust negative effect of over-appraisal on tax evasion, as predicted by our theoretical model. We are also able to identify sources of heterogeneity in tax evasion both at the individual and the geographical level. Indeed, both stigma and shame seem to matter. We show that tax evasion decreases as the buyer's level of education rises while it varies depending on the local level of law compliance and trust, measured using different indicators of corruption and trust.

(Cloyne et al. In press), and evasion of the *Stamp Duty Land Tax* is minimal (Best & Kleven 2018). In the U.S., an increase in inflated transactions was observed between 2000 and 2006 (Ben-David 2011).

[4]The underlying mechanism was the belief that housing prices would continue to grow strongly, reducing the risk of default. In this scenario, appraisal prices lost validity as a risk assessment of the mortgage loan and gained validity as an element to be used for mortgage lending, since a higher appraisal price reduced the LTV ratio. LaCour-Little & Malpezzi (2003) find a positive association between the quality of appraisals and mortgage defaults. In a previous study, Lang & Nakamura (1993) note that, in this case, the bank would require a larger down-payment.

[5]The experiment in Freybote et al. (2014) suggests that appraisers were influenced in their valuation. Although in the U.S., the deviation of the price from the real economic value was relatively small (6,6% in Ben-David 2011).

The theoretical model is in line with the long-standing literature that follows the seminal papers of Allingham & Sandmo (1972) and Yitzhaki (1974), where evasion has been modelled as a decision made under risk by expected utility maximising agents. The probability of being audited may depend both on the level of evasion and other idiosyncratic characteristics.[6] However, standard models of tax evasion have failed to explain certain empirical regularities. Behavioural economists have consequently augmented the standard model in different ways.[7] The introduction of pro-social behaviours, the 'warm-glow effect' and feelings of stigma have proved extremely helpful in efforts to reconcile theoretical predictions and data.[8] Our model, as mentioned, follows this approach and includes both stigma and shame, which are meant to account for the different possible 'behavioural' components.

Studying the Spanish case is particularly interesting for at least three reasons. First, the empirical literature places Spain amongst the European Union countries with the highest levels of tax evasion, with estimates that range between approximately 20 to 25% of the GDP (Sardá 2014, Scheneider 2005, Medina & Scheneider 2017). Second, across the EU, urban development and construction are sectors where corruption vulnerabilities are usually high (Commission 2014). In Spain, a number of corruption cases related to these sectors have been investigated and prosecuted in recent years. Fraud has been closely related to the housing market, particularly during the boom years. Perhaps the most common form of tax evasion in the housing market in Spain is under-declaring the purchase price to the tax authority. In this way, buyers reduce the burden of the real estate transfer tax, while sellers pay less taxes on capital gains. Finally, the strong ties between financial institutions and appraising firms and the volatility of the economy during the analysed period potentially leave more room for variation and thus allow to better identify different behavioural patterns.

The remainder of the paper is organised as follows. Section 2 presents the theoretical model that explains the evasion of the real estate transfer tax. The model's predictions are tested in Section 3 using a unique dataset on Spain that includes observations on real estate transactions from 2005 to 2011. We begin by describing the institutional setting in Section 3.1, then

[6] We abstract from the analysis of how the tax authority optimally sets the probability of audit. For more on this, see Reinganum & Wilde (1985), Macho-Stadler & Pérez-Castrillo (1997), Chander & Wilde (1998), Di Porto et al. (2013), Piolatto & Trotin (2016).

[7] A broad literature has developed around the idea of agents who follow the tenets of prospect theory. See, for example, Bruhin et al. (2010), Alm (2012), Hashimzade et al. (2013), Engström et al. (2015), Piolatto & Rablen (2017).

[8] Such additions may include aspects such as stigma (Gordon 1989, Kim 2003), social norms (Traxler 2010), intrinsic motivation like duty or tax morale (Dwenger et al. 2016), equity, fairness or trust (Bordignon 1993, Falkinger 1995, Schildberg-Hörisch & Strassmair 2012).

present the data in Section 3.2, followed by our results in Section 3.3. Finally, Section 4 concludes. Proofs can be found in Appendix A, while several complementary tables are included in Appendix B.

2 Model

We consider a representative consumer, who cares about the consumption of housing and of a numeraire good. When purchasing a house, the agent is obligated to declare it to the tax administration and to pay an *ad valorem* transfer tax. However, the agent may under-declare the value of the transaction in order to reduce their tax liability. In doing so, the agent may incur an administrative sanction. Moreover, she may suffer some disutility from misbehaving.

The expected utility function of the agent is defined as

$$\mathbb{E}(U) = h(H) + \mathbb{E}(C) - \pi\left(H^u, e\right) s - \mu\left(H^u, \theta, n\right), \tag{1}$$

where H represents the value of the housing.[9] $\mathbb{E}(C)$ is the expected value of consumption of the numeraire good. π is the (perceived) probability of getting caught by the tax administration and is an increasing function of the amount H^u that is hidden from the tax administration and of the idiosyncratic enforcement level e, while s represents the stigma that the agent suffers when caught. Finally, μ represents individual moral shame/guilt suffered regardless of whether one is caught, which is a function of the level of evasion H^u, of individual characteristics θ (education) and of how socially unacceptable is to evade n. We assume that $h(H)$ is increasing and concave in H and that the probability of getting caught π is increasing and concave in the amount evaded: $h'(H) > 0$, $h''(H) < 0$, $\pi'_u > 0$, $\pi''_u < 0$. We also assume moral shame to be increasing in the amount evaded, $\mu'_u > 0$, and that $\frac{\partial^2 \mu}{\partial H^u \partial \theta} > 0$ and $\frac{\partial^2 \mu}{\partial H^u \partial n} > 0$. These two assumptions on the crossed derivative are quite natural (we expect both more educated people to be more respectful of the law and shame to increase in environments where society doesn't tolerate evasion), and are fully supported by the empirical analysis.

The agent has some 'liquid' savings L, where liquidity is interpreted as money that can be hidden from the tax authority (for example, cash or bitcoins). We normalise to 0 the amount of savings that the agent is unable

[9] For notation convenience, H is the monetary value of the house. If we denote by q the per square-metre price and by $\hat{H}$ the number of square-metres, then $H = q\hat{H}$. For the purposes of this analysis, note that we can directly work with H without consequences, as long as we do the same with H^d (the value that is declared to the tax authority) and with H^u (the value that is hidden from the tax authority). This simplification is possible because we don't study the consequences of market prices.

to hide. The agent is able to borrow an amount B against some value I that can be interpreted as the net present value of future income or some collateral. Then, $\mathbb{E}(C) = I - (1+i)B - \pi f H^u$, where i is the interest rate on borrowing, while f is the fine rate that is paid if caught cheating.

By construction $H = H^d + H^u$; H^d is the part of the housing value that is declared. Furthermore, we impose that $H^u \leq L$, that is, borrowed money cannot be hidden from the tax authority. Finally, denoting t as the transfer tax on the declared housing value, restriction $(1+t)H^d + H^u \leq L + B$ guarantees that the agent spends on housing at most all their savings plus borrowing. Since borrowing money is costly, it is never optimal to borrow more than what is needed to purchase the house, therefore we can rewrite the previous restriction as $B = (1+t)H^d + H^u - L$. Notice that, at any interior solution, this model is isomorphic to a two-period model in which the agent in period 1 borrows from period 2 and purchases the house, while in period 2 they pay back the debt and consume the numeraire good.

Using $H = H^d + H^u$, we can rewrite $B = (1+t)H - tH^u - L$. We assume the interest rate to be an increasing convex function of the loan to value. In particular, we assume $i\left(\frac{B}{H^d}\right) = i\left(\frac{(1+t)H - tH^u - L}{H - H^u}\right)$, with $i' > 0$ and $i'' > 0$.

The maximisation problem of the agent is then

$$\max_{H, H^u} h(H) + I - (1+i)\left((1+t)H - tH^u - L\right) - \pi(fH^u + s) - \mu, \tag{2}$$

which yields to the first order conditions (FOCs):

$$h'(H) = i' \frac{(L - H^u)\left((1+t)H - tH^u - L\right)}{(H - H^u)^2} + (1+i)(1+t) \tag{3}$$

$$(1+i)t = i' \frac{(H - L)\left((1+t)H - tH^u - L\right)}{(H - H^u)^2} + \pi'_u(fH^u + s) + \pi f + \mu'_u \tag{4}$$

The FOCs represent the maximum of the objective function if the problem is well-behaved. The following lemma defines the conditions under which this is the case.

Lemma 1 (Second order conditions)**.** *The second order conditions (SOCs) are satisfied if and only if* $\psi > \underline{\psi}$*, where* $\psi = \pi''_u(fH^u + s) + 2\pi'_u f + \mu''_u$*,* $\underline{\psi} = \frac{h''(H)(H-L)^2\phi}{(L-H^u)^2\phi - h''(H)(H-H^u)^3}$ *and* $\phi = i''\frac{B}{H^d} + 2i'$*.*

Proof. See appendix A. □

Eqs. (3) and (4) together define implicitly the optimal level for the two control variables H and H^u. Applying the implicit function theorem on the system of equations, we can study how the parameters of the model influence

the control variables. For this, we denote the first order conditions, Eqs. (3) and (4), respectively as $F_1 = 0$ and $F_2 = 0$.

We start by looking at the impact of liquid savings L and obtain that

$$\frac{\partial H}{\partial L} = \frac{\frac{\partial F_1}{\partial H^u}\frac{\partial F_2}{\partial L} - \frac{\partial F_1}{\partial L}\frac{\partial F_2}{\partial H^u}}{D(H, H^u)} \tag{5}$$

and

$$\frac{\partial H^u}{\partial L} = \frac{-\frac{\partial F_1}{\partial H}\frac{\partial F_2}{\partial L} + \frac{\partial F_1}{\partial L}\frac{\partial F_2}{\partial H}}{D(H, H^u)} \tag{6}$$

where $D(H, H^u) > 0$ is the determinant of the Hessian matrix.[10] The previous equations simplify to

$$\frac{\partial H}{\partial L} = \frac{(L - H^u)(H - H^u)\phi\psi}{D(H, H^u)} \tag{7}$$

and

$$\frac{\partial H^u}{\partial L} = \frac{-h''(H)}{D(H, H^u)} > 0 \tag{8}$$

Notice that the sign of Eq. (7) depends on the sign of ψ, which could admit both positive and negative values. When the theoretical analysis remains ambiguous about the sign of the derivative, we must check the data to clarify the impact of L on the total consumption of housing. Our empirical analysis thus helps to answer this question, as well as confirms the result that an increase in liquidity, as expected, leads unequivocally to an increase in evasion.

At this point in the analysis, it becomes convenient to introduce two new variables: V and $\tilde{V} = \frac{V}{H^d}$. The former denotes the appraisal value, that is, the estimation of the value of the property realised by the financial institution that provides the loan. The latter is instead a measure of over-appraisal, which takes values above 1 when the financial institution appraises the property higher than its declared value. It is interesting to use over-appraisal for several reasons. First of all, there is an empirical literature suggesting a relation between over-appraisal and tax evasion. Second, over-appraisal is a measure that is easily observable by the tax authority, as opposed to evasion and liquid savings, which are harder to detect. Should we be able to identify a link between over-appraisal and evasion, the tax authority could use this as a proxy to identify cases where it is more likely that some evasion took place. Finally, there are often restrictions on how much an agent can borrow, which depend on the appraisal value. Since the appraisal is, in many countries, directly computed by the financial institution, there is an incentive to distort the value V, if need be.

[10] The explicit expression for $D(H, H^u)$ is provided within the proof of Lemma 1.

Assume that the financial institution can lend at most a percentage α of V, which is often the case. The agent will then push the financial institution to set V such that $B = \alpha V$, hence $V = \frac{(1+t)H - tH^u - L}{\alpha}$. Then, α becomes a measure of how much an agent will be allowed to borrow, which may depend on the legal setting, on individual characteristics and also possibly on some exogenous macroeconomic factors (e.g. GDP or unemployment).

$$\frac{\partial \tilde{V}}{\partial L} = \frac{(H - H^u)h''(H)}{D(H, H^u)} \left(L(H - H^u)^2 + (H - L)^2\phi + (H - H^u)^3\psi \right) \quad (9)$$

It is simple to check that $\frac{\partial \tilde{V}}{\partial L} < 0$ if and only if $\psi > -\frac{(H-L)^2\phi + l(H-H^u)^2}{(H-H^u)^3}$, which is always the case under the regularity condition that $\psi > \underline{\psi}$.

The following proposition puts together the results on the impact of a change in L, leading to our first policy implication and empirical question.

Proposition 1. *An increase of the liquid savings L induces an increase in the amount of undeclared housing, $\frac{\partial H^u}{\partial L} > 0$, and a decrease in the observed over-appraisal, $\frac{\partial \tilde{V}}{\partial L} < 0$. The effect of L on the total amount of housing, $\frac{\partial H}{\partial L}$, is instead unclear and must be tested empirically.*

Proof. See appendix A. □

Corollary 1. *An increase in the amount of savings that can be hidden from the tax authority (which is usually not observable) has opposite effects on tax evasion and over-appraisal. Therefore, the data should show a negative correlation between the level of evasion and over-appraisal. Since the latter is usually much easier to observe, this correlation can be used as an indicator of a possible fraud. Our empirical analysis indeed confirms the negative correlation between evasion and over-appraisal.*

Corollary 2. *In order to assess how liquid savings affect the total expenditure on housing H, we can also look at whether housing H and over-appraisal $\tilde{V}$ are positively or negatively correlated. This allows to uncover the sign of $\frac{\partial H}{\partial L}$. If and only if H and $\tilde{V}$ are negatively correlated, we conclude that $\frac{\partial H}{\partial L} > 0$.*

The logic behind Proposition 1 and Corollary 1 is straightforward: the amount of available liquid savings is crucial to determine how much an agent is able to evade. Meanwhile, any liquidity constraint has an impact on the amount that an agent needs to borrow. As a consequence, an agent with access to liquid savings can afford to evade and doesn't need to push for over-appraisal, whereas a liquidity-constrained agent is unable to evade and must furthermore ask for an over-appraisal. It consequently follows that the level of evasion and over-appraisal are negatively correlated. This has

a clear and important policy implication: tax authorities should focus their efforts on preventing evasion by auditing transactions that show low levels of over-appraisal.

In the literature on tax evasion, there has appeared a growing interest in the role of behavioural components, such as stigma, in the decision to evade taxes (see the introduction for references). In our model, we introduced two distinct behavioural features. We denoted as stigma the dis-utility that an agent suffers when they are caught cheating.[11] We also consider the moral shame that an individual feels when they cheat. This element differs from stigma in that an individual is always aware of having cheated and hence a sentiment of guilt is present regardless of whether she is caught. Shame is imposed by society and, as such, depends on the latter's level of morality. It is, in addition, agent-specific, and thus also depends on individual characteristics (e.g. education). Finally, stigma is a binary variable, in the sense that people will mostly remember the scandal but not the details. Shame, being an individual feeling, depends on the level of evasion: an individual's guilt will grow with the amount evaded.

Proposition 2. *In this model, at any interior solution, stigma plays a role on the level evaded only as long as the probability of getting caught depends on the amount evaded. When* $\frac{\partial \pi}{\partial H^u} = 0$ *stigma may deter evasion (corner solution) but it does not affect the level of evasion, conditional on evading. As expected, the level of evasion is negatively affected by stigma:* $\frac{\partial H^u}{\partial s} < 0$.

Proof. See appendix A. □

Proposition 2 suggests that the role of stigma, as defined here, is limited to when the probability of being caught depends on the level of evasion. The intuition is that stigma only matters if one gets caught. If the probability of being caught is orthogonal to the agent's behaviour, then stigma will only determine the extensive margin (the probability of evading) but not the intensive margin (how much to evade).

The decision to evade taxes is certainly affected by both the surrounding environment (e.g. the level of tax enforcement and the moral code of a society) and by individual characteristics (e.g. the level of education). In this model, the environment may enter through two channels (on top of stigma, which has already been discussed): it may directly affect the probability of being caught, through the level of enforcement e, or it may affect the level of shame, through n. Individual characteristics θ, instead only affect the model through shame. Proposition 3 discusses both of these elements.

Proposition 3. *The housing value that is hidden from the tax authority may vary locally, depending on the level of enforcement e and, through shame,*

[11] The idea being that society cannot stigmatise a tax evader if the latter is not caught.

on how much tax evasion is socially disapproved of n. As one may expect, both factors negatively affect the level of evasion: $\frac{\partial H^u}{\partial e} < 0$ *and* $\frac{\partial H^u}{\partial n} < 0$. *Furthermore, law compliance varies at the individual level, through shame, due to individual characteristics* θ *(such as education), so that* $\frac{\partial H^u}{\partial \theta} < 0$.

Proof. See appendix A. □

Proposition 3 confirms that society has an impact on the individuals' decision to evade. Indeed, the perceived enforcement affects the decision of a rational individual. Furthermore, living in a society that is less tolerant towards illegal behaviour produces more shame, which reduces the level of evasion. The empirical analysis confirms this result, showing that more evasion is observed in regions with higher levels of corruption and where social values are lower. Individual characteristics also matter: when the parameter θ increases, the level of evasion decreases. We also test this in our empirical analysis, where we observe that more educated agents are less prone to evasion.

The empirical analysis allows us to relate evasion with changes in macro-economic factors such as GDP or unemployment. While such parameters are not directly present in our theoretical model, we could expect some of our variables to be affected by them. In particular, a decrease in GDP or an increase in unemployment may affect, on average, our variable L. Should this be the case, we would expect a decrease in GDP to reduce the level of evasion H^u. Macro-economic factors such as GDP and unemployment may also have an impact on the availability of credit, which in turn could affect the variable α (the share of the valuation that an agent can borrow). Notice that $\tilde{V} = \frac{B}{\alpha H^d}$, thus, $\frac{\partial \tilde{V}}{\partial \alpha} = -\frac{B}{\alpha^2 H^d} < 0$. Therefore, since α is negatively correlated with over-appraisal, a credit restriction would tend to increase the tendency to over-appraise properties.

3 Empirical analysis

In this section, we test the previous results using a novel dataset on about 1,500 real estate transactions that occurred in Spain during the period 2005-2011. The dataset is particularly unique in that it includes both the value declared to the tax authority and the amount effectively paid. In what follows, we begin by presenting the institutional framework, we then describe our data and finally, report the results.

3.1 Institutional framework

Over the first decade of the twenty-first century, Spain experienced one of the largest housing booms of any developed economy.[12] The construction sector alone was responsible for approximately 20% of the GDP growth. This housing boom led to a housing price bubble (housing prices tripled between 1998 and 2008) that began to burst in 2008. At the time, an average of approximately 1.1 million mortgages per year were approved.[13]

The lending market was extremely competitive. Spanish financial institutions offered the lowest mortgage rates of the Euro area. In fact, over the 2003-06 period, the average mortgage rate in the Euro zone was 21% higher than in Spain. Financial institutions attempted to compensate for the reduced per-mortgage margin with an increasing number of transactions, which contributed to the sharp increase in the number of mortgages. The excessive dependence of the Spanish economy on the real estate market, together with loose credit standards (Akin et al. 2014), largely explain why the financial crisis hit Spain more severely than most other economies.

The attempt to increase the number of transactions led to a softening of credit standards. Yet financial institutions were constrained by internal policies on the LTV ratio. These constraints were relaxed by pushing appraisers to over-value properties whenever the borrower did not have sufficient resources for the down-payment or preferred to borrow more for a different reason. Montalvo & Raya (2018) find evidence consistent with financial intermediaries encouraging appraisal firms, most of them owned by banks themselves, to introduce an upward-bias in their valuations by approximately 30% to meet the LTV recommendations, so as to be able to use them as collateral for covered bonds (the limit LTV for this pool of collaterals is 80%) and to reduce their capital requirements. Indeed, 40% of mortgages in the researchers' sample are bunched at the LTV threshold.

It is important to note that Spain has only been a democracy since 1975. Young democracies are particularly vulnerable to illegal activities (Treisman 2000) and it is well known that different kinds of criminal behaviour, from tax evasion to black markets and corruption, are positively correlated (Fortin et al. 2000). It is perhaps not surprising then that Spain ranks third in Europe in terms of the percentage of citizens (95%) who believe that corruption is widespread (Commission 2014). Various cases of corruption have,

[12] During this period, more dwellings were built in Spain than in Germany, France and Italy put together. According to the official statistics of the Department of Public Works, housing initiations reached as high as 860,000 dwellings in 2006.

[13] Note that there were approximately 15.5 million households in Spain. Over the considered period, the average number of transactions realised per year and region was approximately 20,000, with a standard deviation of about 14,700.

in fact, recently been uncovered, many of which relate to the real estate sector and involve politicians at all levels.[14] Real estate transfer taxes in Spain are at the order of magnitude of 10% of the declared value.[15] The most common way to reduce the tax burden related to real estate transactions is to under-declare the transaction value to the tax authority. The seller may also occasionally benefit if the sale is classified as speculative and, therefore, subject to the capital gain tax.

3.2 Our data

Data on either on the Spanish housing boom or related aspects is scant. One of the main reasons is a lack of reliable statistical information on housing values. Indeed, prior to 2007, the Spanish house price index was computed based on appraisals, which were highly unreliable, as mentioned earlier. Since 2007, the price index has been based on the Property Registry values, that is, the transaction value declared by the tax payer. As we will show, this does not correspond to the actual market price either.

Our dataset is the first to include actual market prices. For one-fourth of the dwellings in the sample, we also have individual characteristics of the mortgagor. This unique dataset was obtained from a real estate intermediary[16] that operates across most Spanish provinces and that also runs its own mortgage brokerage business. The intermediary has a 3-5% market proportion of realised sales (depending on the year).[17]

We merged the dataset obtained from the real estate intermediary with information from other sources. Data from the intermediary include the actual transaction price (i.e. the amount effectively paid by the buyer, and on which the intermediary computed their fees), and the characteristics of the properties from a random sample of their sales. We obtained information on the amount of the mortgage, the appraisal value and the buying price declared to the tax authority from the Property Registry (*Registro de la Propiedad*). To guarantee the correct matching of data, we also obtained the cadastral reference (*referencia catastral*, a unique identifier for

[14] Corruption and illicit practices are common in urban planning and spatial development in Spanish cities. Benito et al. (2015) cite 676 cases of urban corruption that have been documented in the media. Of the corruption cases that occurred during the period of analysis, some relate to the illicit funding of political parties, or tax fraud and embezzlement by members of the government.

[15] Contrary to the U.K., where the tax rate increases with the value of the property (Best & Kleven 2018), in Spain the tax rate is flat.

[16] We signed a non-disclosure agreement prohibiting the disclosure of the company's name.

[17] Notice that most of the existing home sales in Spain are sold directly by the owner.

each property) from the cadastre (*catastro*).[18] The sample period runs from 2005 to 2011. The merged data allow to compute the amount that was not declared for 1,445 transactions of existing housing units (apartments). We refer to this set of data as the 'whole sample'.

For a subset of 430 observations, we were able to merge previous data with information provided by financial intermediaries. Thus, this subset includes individual characteristics of the buyer, such as the number of owners of the property and their respective levels of education. We refer to this subset as the 'sample with individual characteristics'. For these 430 observations, certain financial information (e.g. appraisal prices or the amount of the mortgage) was present in several different datasets. We used such redundant information as a further check of the reliability of the merging process.

Nearly half of the transactions included some undeclared money, with a mean value for the percentage of undeclared money of 7.64%. Conditional on fraudulent behaviour, this percentage rises to 15.1%. Figure 1 presents a histogram of the percentage of undeclared money, including and excluding zeros. The percentage of undeclared money over the actual selling price was lower than 20% in 76.03% of the fraudulent transactions.

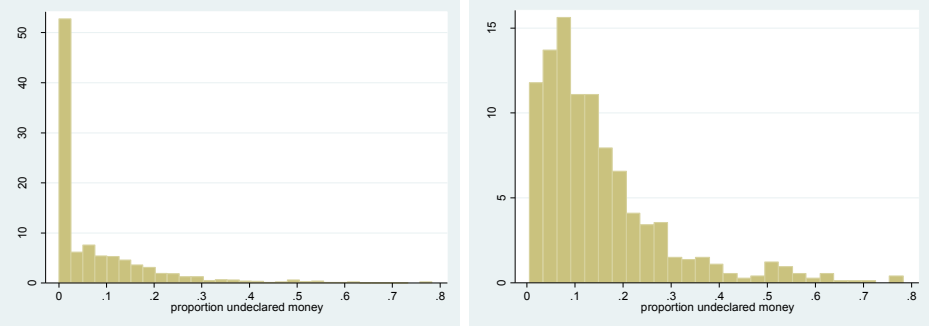

Figure 1: Histogram of the proportion of undeclared money

The period we analyse saw both a bubble and a burst in the housing market, which also had an impact on GDP, unemployment and the economy in general. Table 1 shows the evolution of tax evasion from 2005 to 2011. The share of fraudulent transactions steadily decreased over the considered period. However, note that around 2008 and conditional on fraud, the share that remained undeclared begins to increase. One possible interpretation,

[18] Difficulties matching the data unfortunately caused the loss of some information. Indeed, the Spanish registry is organised in the format of a 'continuous roll': successive owners of a given property are sequentially added on a single document recorded by the original address at the time of building. However, due to many political upheavals (including two dictatorships, the republic and two monarchies), street names have changed several times over the last century. In order to match the data, it was necessary to match the address of the estate at the moment of construction with that when it was sold.

consistent with the discussion at the end of Section 2, is self-selection. When the crisis hit, many citizens were impoverished. The decrease in GDP and the increase in unemployment resulted in less buyers having some liquid savings to use for purchasing. The probability of having sufficient savings to make any cash side-payments decreased. Meanwhile, the decline in housing prices that followed the bubble burst meant that agents who had access to liquid savings could use them to pay a larger share of the total value. To this regard, Section 3.3 shows how the share of fraudulent transactions is decreasing in unemployment, while the share that is undeclared (conditional on fraud) is increasing in unemployment.

Year	Transactions with undeclared money (share)	Undeclared money (share)	Undeclared money, conditional on fraud (share)
2005	80.89%	12.59%	14.17%
2006	66.07%	9.58%	14.50%
2007	59.77%	7.91%	13.23%
2008	48.24%	7.34%	15.21%
2009	38.67%	6.13%	15.86%
2010	34.72%	6.24%	17.97%
2011	31.15%	6.73%	21.62%

Source: Own elaboration.

Table 1: Evolution of the undeclared money over time.

Agents' behaviour proved to be very heterogeneous across the country. Table 2 presents these differences among the regions most represented in the sample. We immediately observe a spread of up to 23 percentage points in terms of the share of illegal transactions carried out. Similarly, conditional on fraud, the share of the price that remains undeclared varies from about 10% (Aragon) to about 19% (Valencian C.).
Table 10, in appendix B displays the descriptive statistics of our dataset both for the 'whole sample' and for the 'sub-sample with individual characteristics'. The 'average buyer' in the sample is employed, has attained a primary education, buys on their own and obtains a mortgage that is over-appraised by approximately 30%, with a spread of 0.86.

3.3 Results

In this section, we test the predictions of the theoretical model. For each specification, we estimate a Probit model for the determinants of the probability of a fraudulent transaction (that is, under-declaring money to the tax

Region	Transactions with fraud (share)	Undeclared money (share)	Undeclared €, condit. on fraud (share)
Andalusia	59.36%	10.90%	18.36%
Aragon	44.07%	4.53%	10.27%
C. La Mancha	41.86%	6.38%	15.23%
C. León	41.38%	7.26%	17.54%
Catalonia	37.59%	5.27%	14.01%
C. Madrid	53.51%	6.97%	13.03%
Valencian C.	61.80%	11.84%	19.15%

Source: Own elaboration.

Table 2: Distribution of the undeclared money across regions.

authority), as well as a Tobit model for the determinants of the proportion of undeclared money (that is, the percentage of the total transaction value that is hidden from the authority).

Proposition 1, together with Corollaries 1 and 2, predicts that over-appraisal (or LTV) and tax evasion are inversely related. It is left to the empirical analysis to clarify whether total house spending is positively or negatively correlated with over-appraisal, which would allow to infer the underlying relation between liquid savings and house spending. Table 3 confirms the prediction of the theoretical model and shows that tax evasion and over-appraisal are strongly, negatively related.

Indeed, we observe in Table 3 that increasing over-appraisal by one point (that is, the appraisal value doubles the selling price) decreases the probability of fraud by 20.94% and decreases the proportion that remains undeclared by 15.9 points. Using the 29% mean over-appraisal in Spain computed in Akin et al. (2014), our results suggest that over-appraisal is responsible for a reduction of 4.6 points in the amount that is hidden from the tax authority.

Complementing the discussion following Proposition 1, buyers try to minimise over-appraisal and the amount that they borrow. The use of over-appraisal to increase the amount that can be borrowed is a last recourse for a buyer, used only when they have no other alternative. Over-appraisal becomes a signal of liquidity constraint, which is unlikely to occur for agents who have liquid savings that can be used for side-payments. Table 3 thus confirms the model's prediction and, accordingly, has a strong policy implication. Since over-appraisal is much easier to assess and observe than access to liquid savings or fraud, it should be used as an indicator for the likelihood of fraud. In particular, the tax authority should focus their audit efforts on transactions where the appraisal is relatively low. Results using the sub-sample with individual characteristics reinforce the argument that

	Whole sample		Sample with individual characteristics	
	Probit	Tobit	Probit	Tobit
Overappraisal	-0.838***	-0.159***	-1.787***	-0.246***
Transactions (thousand)	0.020**	0.001		
Spread			-0.260	-0.043
Educational level (ref: Primary)				
Secondary			-0.491*	-0.076***
Graduate			-0.732**	-0.076**
Number of holders (ref: One)				
Two			0.207	0.031
Three or more			1.696***	0.057
Employment (ref: Non-Occupied)				
Occupied in private sector			-0.410	-0.087*
Occupied in public sector			0.033	-0.055
Self-employed			0.056	-0.005
Intercept	-0.623	0.092	2.206**	0.446***
N. Obs.	1.445		430	
Year F.E.	Yes		Yes	
Region F.E.	Yes		Yes	
* p <0.10. ** p <0.05. *** p <0.01				

Table 3: Estimated models.

liquidity constraints matter. Indeed, when the purchase is made by three or more buyers, the probability of fraud increases significantly.

Corollary 2 raises uncertainty over the relation between liquidity and house spending. A negative relation between total spending and over-appraisal would suggest that access to more liquidity leads to greater spending on housing. We observe that the two variables are, in fact, negatively correlated, with a correlation of -0.35, confirming our expectation. Fig. 2 presents the scatter-plot of the relation between total spending and over-appraisal.

3.3.1 Shame and stigma: idiosyncratic versus individual differences

The theoretical model distinguishes between what we call stigma and shame. According to our definitions, the difference between these two is that an agent suffers stigma conditional on being caught, whereas shame is a feeling of guilt that is independent of being exposed. Thus while stigma is the result of being judged by others, shame is an individual perception, although it may also be affected by idiosyncratic elements such as societal tolerance of illegal behaviour. Proposition 2 suggests that stigma depends on audit

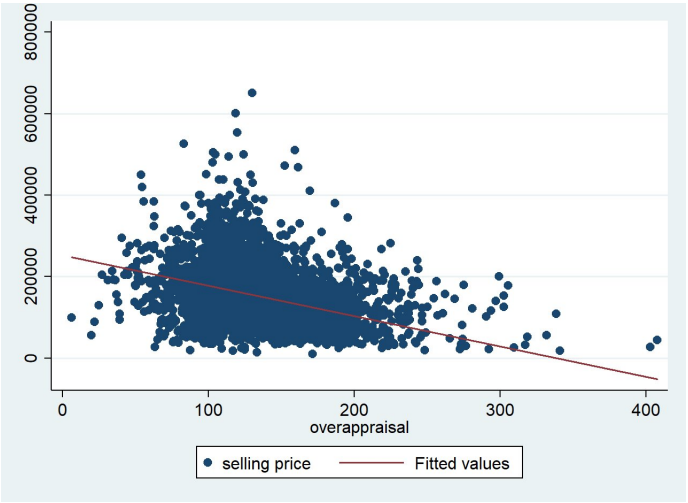

Figure 2: Correlation between Total Spending and Over-Appraisal

probabilities. As we do not, unfortunately, have access to such data, it is not possible test this prediction, which could explain part of the regional differences in levels of evasion.

It has been well documented[19] that a social component that involves information, trust, social capital, and that we identify here as a stigma, is responsible for people restraining themselves from acting illegally. To this regard, our data allows to explain idiosyncratic differences by showing that the environment and social values indeed explain part of the variance in fraudulent behaviour. That said, we are unable to distinguish between the different channels identified in Propositions 2 and 3, namely stigma, audit probability and shame.

Table 4 shows how evasion varies from one region to another. We observe that Andalusia and the Valencian Community are the regions with the highest probability of fraud. Moreover, in these two regions, the proportion of the amount undeclared is also higher than elsewhere.[20] The quantitative interpretation of the Probit results originates from marginal effects; for these two regions, the probability of under-declaring money increases by 0.34 and 0.29 points, respectively.[21] In addition, in Andalusia and the Valencian Community, the proportion of undeclared money is 14 points

[19]See, for example, (Alesina & La Ferrara 2000, Alesina & Ferrara 2002, Boffa et al. 2016) and the literature therein.

[20]Note that in the estimation using the sample with individual characteristics, the Community of Madrid presents a probability of fraud that is significantly higher than the mean, as is the proportion of the total value that is hidden from the tax authority.

[21]Considering a mean probability of 51%, these effects represent an increase close to 70% and 60%, respectively.

	Whole sample		Sample with individual characteristics	
	Probit	Tobit	Probit	Tobit
Region				
Andalusia	1.479***	0.142***	1.099**	0.122**
Aragon	0.360	-0.005	0.629	0.067
Castile La Mancha	0.756	0.062		
Castile and León	0.328	0.040		
Catalonia	-0.216	-0.014	0.640	0.064
Community of Madrid	0.473	0.042	1.001**	0.105**
Valencian Community	1.316**	0.139**	2.770***	0.350***
Overappraisal	-0.838***	-0.159***	-1.787***	-0.246***
Transactions (thousand)	0.020**	0.001		
Spread			-0.260	-0.043
Intercept	-0.623	0.092	2.206**	0.446***
N. Obs.	1.445		430	
Year F.E.	Yes		Yes	
Individual controls	No		Yes	

* p <0.10. ** p <0.05. *** p <0.01

Individual controls: Education, Number of holders, Employment

Table 4: Estimated models.

higher (meaning that, in these regions, the proportion more than doubled).

In order to better understand whether moral values and the social environment actually affect the amount of fraud observed, we used several indicators of social values, trust in government and feelings of reciprocity. Our argument being that people in regions with higher perceived corruption have a greater probability of both committing fraud and hiding a larger percentage of the price.

To formally test this argument, we identified municipalities where politicians in power have been accused of corrupt behaviour. Following the definition of corruption in Fernández-Vázquez et al. (2016), our corruption dummy takes value 1 when four conditions are simultaneously met at the municipal level: 1) the mayor or another member of the municipal executive branch is involved in the scandal; 2) the accusation involves criminal charges related to corruption and abuse of public office; 3) charges are brought by a non-partisan actor and 4) claims about misbehaviour were in the press between 2004 and 2010. We combined several databases on corruption scandals reported in local, regional and national newspapers, as well as in reports written by non-governmental organisations, think tanks and public advocacy groups. We focus on the 26 municipalities for which we have 10 or more observations, resulting in a sample size of 1,233 observations. In 14 muni-

cipalities, we identified at least one case of corruption. We considered only the 'whole sample' and replaced regional dummies with municipal ones. The first two columns in Table 5 summarise our results.

	Corruption index	
	(1)	(2)
	Probit	Tobit
Corruption	0.823***	0.091***
Overappraisal	-0.810***	-0.159***
Year (ref: 2011)		
2005	2.630**	0.131*
2006	1.547***	0.113***
2007	1.113***	0.064*
2008	0.705**	0.046
2009	0.210	-0.005
2010	0.040	-0.008
Transactions (Thousand)	0.005	-0.007
Intercept	-0.118	0.120***
N. obs	1.233	
* p <0.10. ** p <0.05. *** p <0.01		

Table 5: Estimated model using the corruption index.

Corruption has a significant and positive effect on the probability of undeclared money and on the percentage of undeclared money with respect to the appraisal price. Using our measure of corruption, the model suggests that dishonesty at the local level significantly increases the probability of engaging in a fraudulent transaction. Moreover, the proportion of value that remains undeclared increases by 9.1 points.

For robustness, in Table 11 (in appendix B) we replaced our corruption measure with the Global Transparency Index (GTI), published by Transparency International. For Spain, this is computed at the city level for the 110 main municipalities. Generally, the GTI measures the level of transparency of public institutions through an evaluation of data and information available on the organisation's website, and ranges from 0 (minimum transparency) to 100 (maximum transparency). It includes five sub-indexes: information, relation with citizens, economic transparency, transparency in contracting services and transparency in urban planning and public works.[22] Of the

[22]To make the results using the GTI easier to compare with those using our corruption index, we adjusted the GTI by computing 100-GTI. Thus, the index still ranges from 0 to 100, but it is increasing in opacity: 0 corresponds to maximum transparency, 100 to its minimum. Within our sample, the most transparent municipality has a score of 2.5 (Gijón), while the most opaque has a score of 80 (Vélez Málaga).

1,445 observations in our 'whole sample', 1,115 overlap with a municipality covered by the GTI. This robustness test[23] confirms our results: we observe more fraudulent transactions (both on the extensive and intensive margin) in more corrupt areas. In particular, an increase in one point of either the GTI or the GTI-Urban index reduces the proportion of the value that is undeclared by 0.2 points.[24]

The level of trust and morality of a society is, of course, more than a reflection of the degree of corruption of its politicians. We consequently tested our prediction using other indicators of social capital. More specifically, we used two other indicators of social transparency, corruption or cheating behaviour: Table 6 summarises the results. Columns 1-2 are computed using the Quality of Government (QoG) data from the Quality of Government Institute; in particular, we used the corruption variable (data available at the regional level). Columns 3-4 use the European Social Value (ESV) index. The European Values Study is a large-scale, cross-national, longitudinal survey research programme on basic human values. The study provides insights into the ideas, beliefs, preferences, attitudes, values and opinions of citizens across Europe. Specifically, we exploit the question 'justify cheating on tax' and compiled this information for every Spanish region for both the 1999 and 2008 waves. We use their difference as a proxy for the changes in tax evasion behaviour. In all columns, a higher index value means less social values (columns 1-2)[25], or that tax evasion is more tolerated (columns 3-4). Again, the results are significant and their sign is that predicted by the theoretical model and in accordance with those obtained using different proxies for stigma and shame.

Alm et al. (2004) and Alm & Torgler (2006) find a negative correlation between tax morale and the size of the shadow economy. We use data from Sardá (2014)[26] on the mean shadow economy in Spain from 2004 to 2011 at the province level, merging the latter with our dataset. For 1,432 of the observations in our 'whole sample',[27] we use the estimated percentage

[23]Columns 1-2 of Table 11 depict the results using the adjusted GTI as the measure of corruption, while columns 3-4 depict the results using the adjusted GTI sub-index 'transparency in urban planning and public works' (GTI-Urban).

[24]Results are robust to transparency and corruption data aggregation at the provincial level.

[25]In this case, we used the inverse of the original index in the estimation.

[26]To measure the size and development of the shadow economy, we adopt a 'Multiple Indicators Multiple Causes' (MIMIC) approach (Weck-Hanneman & Frey 1985), a special case of the general LISREL model. A MIMIC model consists of two parts, the structural equation and the measurement equation system. The structural model examines the relationships between the latent variable (output of the shadow economy) and the causes, while the measurement model links indicators and the latent variable.

[27]Sardá (2014) do not report the estimation of the shadow economy for Vizcaya

	QoG		Euro. Social Values	
	(1)	(2)	(3)	(4)
	Logit	Tobit	Logit	Tobit
Absence of Social values	0.005	0.0012***	0.0084**	0.0005
Overappraisal	-0.714**	-0.151***	-0.714**	-0.151***
Transactions	0.00604	0.000417	0.00466	-0.000337
2005	2.650*	0.132	2.564*	0.133
2006	1.261***	0.0785*	1.306***	0.0935**
2007	1.057***	0.0609	1.022**	0.0599
2008	0.686*	0.0432	0.638*	0.0397
2009	0.288	0.00509	0.247	0.00237
2010	0.0826	-0.0118	0.0944	-0.00578
Intercept	0.439	0.214***	0.126	0.153***
Constant		0.194***		0.195***
N. obs	1.440		1.445	
* p <0.10. ** p <0.05. *** p <0.01				

Table 6: Estimated model using Quality of Government, and European Social Values indexes.

of the shadow economy at the province level over the 2004-2011 period.[28] Table 7 summarises the results, which again confirm our expectations. A larger shadow economy has a positive effect on the probability of underdeclaring the value of the transaction to the tax authority, as well as on the proportion of undeclared money. In particular, a rise of one percentage point of the shadow economy increases the proportion of the selling price that remains undeclared by 0.012 points.

Proposition 3 also predicts that individual characteristics matter. Our data include socio-economic information for the subset of agents for whom we have individual characteristics collected by the financing institution. We can test the level of evasion for these agents, discriminating for data such as education and type of employment. While most characteristics in our possession have little explanatory power, education appears to be strongly connected to the level of evasion, both on the extensive and intensive margin.

Columns 3 and 4 of Table 8 correspond to the probit and tobit analyses using the sub-sample with individual characteristics. We immediately observe that education plays a major role. Indeed, the higher the educational attainment, the lower the probability of fraud and the proportion of the transaction's

Province.

[28]The mean value of the shadow economy in Spain during these years is 19.63%. The maximum value is 23.3% (Zamora), while the minimum is 13.8% (Madrid).

	Probit	Tobit
Shadow economy (%)	0.069***	0.012***
Overappraisal	-0.735***	-0.153***
Year (ref: 2011)		
2005	2.586**	0.121*
2006	1.236***	0.074**
2007	1.117***	0.064*
2008	0.681**	0.040
2009	0.268	0.001
2010	0.044	-0.017
Transactions (1.000)	0.008	0.001
Intercept	-1.059	-0.088
N. obs	1.432	
* p <0.10. ** p <0.05. *** p <0.01		

Table 7: Results using the estimated size of the shadow economy.

value that remains undeclared (18.1 and 7.6 points respectively). This result confirms the prediction of the theoretical model and is in line with theories of pro-social behaviour: better educated citizens are more affected by shame, and are therefore more compliant and engage in less tax evasion.

Table 8 also clearly shows that in the pre-crisis period (2005-2007), the proportion of value that is hidden is significantly positive (although decreasing over time), while in the bust period, it is not significantly different from zero. In particular, the probability of fraudulent transactions was 8.7 points higher in 2006 and 5.8 points higher in 2007. This analysis thus captures the effect of market dynamics.[29]

We surmised at the end of Section 2 that macro-economic variables, such as unemployment, may affect liquidity andhence, evasion. We test this conjecture in Table 9. On the extensive margin (column 1), an increase in unemployment induces a reduction in the number of fraudulent transactions. Interestingly, unemployment instead has the opposite effect when it comes to the intensive margin (column 2). Indeed, when unemployment increases, the share of the final price that is hidden to the tax authority increases, conditional on fraud. Our interpretation of these results is that the economic crisis affected most people, and this meant a reduction in the share of agents that were able to evade (due to liquidity constraints). It is, however, common to observe in periods of crisis an increase in inequality, with some people suffering more than others. Meanwhile, prices are more likely

[29]Controlling for either the selling price, dwelling characteristics or the price reduction, we obtain similar results.

	Whole sample		Sample with individual characteristics	
	Probit	Tobit	Probit	Tobit
Overappraisal	-0.838***	-0.159***	-1.787***	-0.246***
Transactions (thousand)	0.020**	0.001		
Year (ref: 2011)				
2005	2.422**	0.109	0.000	-0.008
2006	1.301***	0.087**	1.406**	-0.005
2007	1.090***	0.058*	0.295	-0.134**
2008	0.732**	0.041	0.315	-0.055
2009	0.305	0.000	-0.013	-0.068
2010	-0.115	-0.033	-0.772	-0.163***
Spread			-0.260	-0.043
Educational level (ref: Primary)				
Secondary			-0.491*	-0.076***
Graduate			-0.732**	-0.076**
Number of holders (ref: One)				
Two			0.207	0.031
Three or more			1.696***	0.057
Labour situation (ref: Non-Occupied)				
Occupied in private sector			-0.410	-0.087*
Occupied in public sector			0.033	-0.055
Self-employed			0.056	-0.005
Intercept	-0.623	0.092	2.206**	0.446***
Region F.E.	Yes		Yes	
N. Obs.	1.445		430	
* p <0.10. ** p <0.05. *** p <0.01				

Table 8: Estimated models.

to decrease in those markets where unemployment is most severe. Taken together, these two effects may mean that those who are not constrained, and hence are able to commit fraud, can actually evade a larger share of the total price. This result is in line with Carozzi (In press), who shows that the 2008 crisis in the UK affected the housing market more relative to the units at the lower end of the market. The reason being the tightening of the credit market, which made the liquidity constraint more stringent for younger or financially weaker potential buyers.

4 Final remarks

This paper contributes to the existing literature on tax evasion by modelling and estimating the determinants of the undeclared money in home

	Fraud Extensive margin	Fraud Intensive margin
	(1)	(2)
Unemployment	-0.033***	0.003***
	(0.007)	(0.001)
Intercept	0.439***	0.111***
	(0.107)	(0.009)
N. obs	1445	730
* p <0.10. ** p <0.05. *** p <0.01		

Table 9: Tax evasion and Unemployment

purchases. Because tax evasion is usually not observable, the empirical literature has typically relied on imperfect proxies for the level of evasion. We were able to construct a unique dataset, in which we combine the true transaction price with that declared to the tax authority for sales that occurred in Spain between 2005 and 2011. The results elucidate the determinants of a previously undocumented type of tax evasion: declaring a purchase price below that actually paid in order to avoid the real estate transfer tax. This kind of tax evasion is of particular interest in countries (such as Spain) where this levy is especially heavy and the real estate sector represents a large proportion of the total economy. And where, furthermore, urban development and construction are characterised by a high level of corruption, money embezzlement, illegal workers and other sorts of misconduct.

In contrast to other types of fraud, Akin et al. (2014) suggests that undeclared money is negatively correlated with both the economic crisis and the over-appraisal mechanism used during the boom years in Spain to allow financial institutions to extend borrowing to agents with a low credit score. Indeed, as we show through our analysis, agents who want to evade the transfer tax need access to some 'liquid' savings (i.e. that can be hidden from the tax authority); over-appraisal is instead used by agents who have severe liquidity constraints, in order to be able to borrow larger sums of money. Our model, then, explains how over-appraisal and tax evasion are negatively related. Moreover, in highlighting that agents who resort to over-appraisal are those who are less likely to engage in fraudulent activities, our results have an important policy implication. It is advisable that tax authorities target transactions with low appraisal values if they wish to increase their auditing performance. This approach is also advantageous in that appraisals are much easier to observe than any other element, such as access to cash or fraudulent behaviour itself.

Our empirical analysis shows that over-appraisal is indeed strongly signific-

ant in explaining tax evasion. Previous literature on household borrowing and mortgages has shown that LTV is a crucial element that heavily affects constrained borrowers (Di Maggio et al. 2017, Ganong & Noel 2018, Cloyne et al. In press). Yet, to the best of our knowledge, this is the first paper that estimates its impact on tax evasion. Interestingly, tax evasion reduces the effective tax rate and, according to our interpretation of the results, less constrained borrowers are those who are more likely to evade. Evading the transfer tax thus has a clear regressive effect in terms of inequality and redistribution, going against what would be desirable. As shown in Best & Kleven (2018), ideally the tax should be lower for constrained households.

Our theoretical model suggests that differences in the level of fraud may originate from various attitudes towards illegality both at the societal and individual levels. Hence, geographical and individual idiosyncrasies in the share of fraudulent transactions (extensive margin) and in the proportion of the transaction value that is hidden from the tax authority (intensive margin) may be due to a different impact of stigma and shame, which are, in turn, affected by the level of social capital and individual characteristics (education). To this regard, the data show two types of heterogeneity. At the individual level, we observe that education matters, and that behaviour differs across regions. We conclude, for extensive margins, that less educated citizens are more prone to tax fraud, as are agents who live in areas with lower social values (high corruption, low transparency and a larger informal economy). Furthermore, for intensive margins, these same agents are also prone to evade more in terms of the proportion of value that is hidden from the tax authority. These results have two policy implications. On the one hand, increasing trust in society (through greater transparency and strictness towards corrupt prominent people) has a positive effect on the level of fraud committed by citizens; prominence may hence become a criterion for auditing when the tax agency has limited resources. On the other hand, education plays an important role in terms of the level of fraud; hence, long-run policies could also use this channel to increase compliance.

Results are robust to several definitions of corruption at the municipal level or to the use of transparency indices at the province or regional level. Corruption is 'contagious' between municipalities (González López-Valcárcel et al. 2015), and also affects citizens. The 'guilty feeling' and the loss of reputation of a defrauder decrease when corruption is widespread. This link between individual and collective reputation also helps to explain long-run tax fraud. A short-run increase in corruption due to a housing bubble, as in Spain, may hurt the collective reputation as well as have long-lasting effects in terms of tax fraud. Once again, there are clear policy implications: governments should promote anti-corruption policies,[30] but also educate their

[30]According to Rose-Ackerman (1996) any policy that improves competition is a recipe

citizens. Well-educated citizens who observe responsible governments are less prone to engage in tax evasion.

To the best of our knowledge, this paper is the first to document this phenomenon in such depth, in part made possible by the richness of the available database. Further research is needed to fully understand this type of tax fraud and its determinants. For instance, corruption cases are not equally perceived by voters, and information circulates better in some environments than in others, as observed by Fernández-Vázquez et al. (2016). Time and geographical differences would be better understood with greater knowledge of how different types of illicit behaviours produce externalities on the surrounding community. Data availability remains, however, a considerable hurdle.

for reducing rents and leads to less corruption. Other anti-corruption policies should also be implemented because, although firms are price-takers, corruption generates its own rents. Burguet et al. (2016) classifies anti-corruption policies into two groups: bureaucratic incentives (e.g. punishment, monitoring, compensation and selection) and other policies (e.g. reducing intermediaries, incentivising wrong-doing reports or facilitating job rotation).

Appendix A Proofs

Proof of Lemma 1 . Denote the first order conditions, Eqs. (3) and (4), respectively as $F_1 = 0$ and $F_2 = 0$. The second order conditions require $\frac{\partial F_1}{\partial H} < 0$, $\frac{\partial F_2}{\partial H^u} < 0$ and the determinant of the Hessian matrix is positive: $D(H, H^u) = \frac{\partial F_1}{\partial H}\frac{\partial F_2}{\partial H^u} - \frac{\partial F_1}{\partial H^u}\frac{\partial F_2}{\partial H} > 0$.

Define $\phi = i''\frac{B}{H^d} + 2i'$, $\psi = \pi_u''(fH^u + s) + 2\pi_u' f + \mu_u''$ and $\underline{\psi} = \frac{h''(H)(H-L)^2\phi}{(L-H^u)^2\phi - h''(H)(H-H^u)^3}$.

Then, it is immediate to obtain that:

$$\frac{\partial F_1}{\partial H} = h''(H) - \frac{(L-H^u)^2}{(H-H^u)^3}\phi < 0 \tag{10}$$

$$\frac{\partial F_2}{\partial H^u} = -\frac{(H-L)^2}{(H-H^u)^3}\phi - \psi \tag{11}$$

$$\frac{\partial F_1}{\partial H^u} = \frac{\partial F_2}{\partial H} = -\frac{(H-L)(L-H^u)}{(H-H^u)^3}\phi \tag{12}$$

It is a matter of simple algebra to show that

$$\frac{\partial F_1}{\partial H}\frac{\partial F_2}{\partial H^u} - \frac{\partial F_1}{\partial H^u}\frac{\partial F_2}{\partial H} = \frac{(L-H^u)^2}{(H-H^u)^3}\phi\psi - h''(H)\left(\frac{(H-L)^2}{(H-H^u)^3}\phi + \psi\right) > 0 \tag{13}$$

if and only if $\psi > \underline{\psi}$. Furthermore, $\psi > \underline{\psi}$ implies that $\frac{\partial F_2}{\partial H^u} < 0$.

□

Proof of Proposition 1 . Eqs. (5) and (6) are a direct application of the implicit function theorem, applied to a system of two FOCs. For the problem to be well-behaved, the SOCs impose $D(H, H^u) > 0$.

As for the numerator, notice that:

$$\frac{\partial F_1}{\partial L} = \frac{(L-H^u)}{(H-H^u)^2}\phi \tag{14}$$

$$\frac{\partial F_2}{\partial L} = \frac{(H-L)}{(H-H^u)^2}\phi. \tag{15}$$

Eqs. (7) and (8) immediately follow. Since, by assumption, $h''(H) < 0$, the sign of Eq. (8) is unambiguous. However, in the case of Eq. (7) the sign entirely depends on the sign of ψ. Since the only restriction on ψ is that $\psi > \underline{\psi}$ and because $\underline{\psi} < 0$, some admissible values for ψ are negative, while others are positive. There are no economic reasons to impose a sign

on ψ, which implies that only an empirical analysis can possibly resolve the doubts.

□

Proof of Proposition 2 . We apply again the implicit function theorem to the system of FOCs and have:

$$\frac{\partial H^u}{\partial s} = -\frac{\frac{\partial F_1}{\partial H}\frac{\partial F_2}{\partial s}}{D(H, H^u)} = \frac{-\frac{\partial F_1}{\partial H}}{D(H, H^u)}(-\pi'_u). \tag{16}$$

It immediately follows that $\frac{\partial H^u}{\partial s} < 0$ as long as $\pi'_u > 0$, while $\frac{\partial H^u}{\partial s} = 0$ as long as $\pi'_u = 0$. □

Proof of Proposition 3 . We apply again the implicit function theorem to the system of FOCs and have:

$$\frac{\partial H^u}{\partial e} = -\frac{\frac{\partial F_1}{\partial H}\frac{\partial F_2}{\partial e}}{D(H, H^u)} = \frac{-\frac{\partial F_1}{\partial H}}{D(H, H^u)}\left(-\frac{\partial^2 \pi}{\partial H^u \partial e}(fH^u + s) - \frac{\partial \pi}{\partial e}\right) < 0 \tag{17}$$

$$\frac{\partial H^u}{\partial n} = -\frac{\frac{\partial F_1}{\partial H}\frac{\partial F_2}{\partial n}}{D(H, H^u)} = \frac{-\frac{\partial F_1}{\partial H}}{D(H, H^u)}\left(-\frac{\partial^2 \mu}{\partial H^u \partial n}\right) < 0 \tag{18}$$

$$\frac{\partial H^u}{\partial \theta} = -\frac{\frac{\partial F_1}{\partial H}\frac{\partial F_2}{\partial \theta}}{D(H, H^u)} = \frac{-\frac{\partial F_1}{\partial H}}{D(H, H^u)}\left(-\frac{\partial^2 \mu}{\partial H^u \partial \theta}\right) < 0 \tag{19}$$

□

Appendix B Tables

	Whole sample		Sample with individual charact.	
	Mean	Std. Dev.	Mean	Std. Dev.
Fraudulent transactions	0.51	0.50	0.53	0.50
Undeclared money (share)	0.08	0.12	0.09	0.15
Year				
2006	0.27	0.44	0.12	0.33
2007	0.18	0.39	0.20	0.40
2008	0.14	0.34	0.12	0.32
2009	0.18	0.38	0.26	0.44
2010	0.18	0.39	0.30	0.46
2011	0.04	0.15	-	-
Region				
Andalusia	0.26	0.44	0.30	0.46
Aragon	0.12	0.33	0.09	0.29
Castile La Mancha	0.03	0.17	0.04	0.18
Castile and León	0.02	0.14	0.02	0.14
Catalonia	0.19	0.39	0.13	0.33
Community of Madrid	0.31	0.46	0.36	0.48
Valencian Community	0.06	0.24	0.05	0.22
Others	0.01	0.10	0.01	0.10
Overappraisal	1.29	0.25	1.31	0.25
Spread			0.86	0.45
Educational level				
Primary			0.45	0.54
Secondary			0.40	0.49
Graduate			0.15	0.35
Number of holders				
One			0.53	0.55
Two			0.41	0.49
Three or more			0.06	0.24
Labour situation				
Non-Occupied			0.07	0.25
Occupied in private sector			0.73	0.44
Occupied in public sector			0.14	0.34
Self-employed			0.06	0.24
N. obs	1445		430	

Source: Own elaboration.

Table 10: Descriptive statistics.

	GTI		GTI-Urban	
	(1)	(2)	(3)	(4)
	Probit	Tobit	Probit	Tobit
Corruption	0.015***	0.002***	0.014***	0.001***
Overappraisal	-0.712***	-0.152***	-0.733***	-0.155***
Year (ref: 2011)				
2005	2.752**	0.130*	2.851**	0.141*
2006	1.324***	0.079**	1.424***	0.091***
2007	1.167***	0.061*	1.210***	0.066*
2008	0.736**	0.037	0.736**	0.035
2009	0.354	-0.004	0.345	-0.005
2010	0.071	-0.024	0.097	-0.021
Transactions (Thousand)	0.004	0.001**	0.000	0.000
Intercept	1.301**	0.318***	1.409***	0.337***
N. obs	1.115		1.115	
* p <0.10. ** p <0.05. *** p <0.01				

Table 11: Estimated model using the GTI corruption index.

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Tax Systems Analysis

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