

RATIONAL BUBBLES IN UK HOUSING MARKETS: COMMENT ON “NO-BUBBLE CONDITION: MODEL-FREE TESTS IN HOUSING MARKETS”

DAVID DOMEIJ

Department of Economics, Stockholm School of Economics

TORE ELLINGSEN

Department of Economics, Stockholm School of Economics

Giglio, Maggiori, and Stroebe (2016) show that there is no significant price difference between freeholds and ultra-long leaseholds in the UK housing market. They claim that this finding precludes the presence of large rational bubbles, as these can only attach to the price of freeholds. But the conclusion presumes that leaseholders cannot acquire bubbles through enfranchisement at favorable prices. We find that the presumption is violated. Enfranchisement rights are comprehensive and cheap to exercise. We also dispute the counter-argument that cheap enfranchisement proves that market participants, if they have rational expectations, must have explicitly concluded that freehold prices are bubbleless.

KEYWORDS: Asset pricing, real estate, rational bubbles, transversality condition.

1. INTRODUCTION

GIGLIO, MAGGIORI, AND STROEBEL (2016) (GMS) PROPOSE A NOVEL TEST for the presence of rational bubbles. The idea is to exploit the difference in price between closely similar assets with finite and infinite lives. Under seemingly plausible assumptions, the latter prices can contain rational bubbles, but the former cannot.

Specifically, GMS compare the prices of residential property in the form of freeholds (infinite-duration ownership) and leaseholds (finite-duration ownership) in UK and Singapore. Under the assumption that assets are freely traded and traders have rational expectations, the leasehold only delivers a stream of housing services, whereas the freehold potentially also serves as an indefinite store of value. To be precise, suppose the quality of housing services is the same and that there is a finite time t such that the net present value of the freehold's housing services after time t is negligible. Then, if agents have rational expectations, the difference in price between a freehold and a leasehold with duration t constitutes a rational bubble.

The data set is richer for the UK, and GMS's main conclusions are based on precise estimates from these data. GMS focus on ultra-long (700–999 years) leases and carefully control for differences in properties' characteristics. Based on transaction data for the period 1995–2013, they conclude that there are no economically significant price differences between freeholds and these leaseholds, and thus that there are no rational bubbles in these residential property markets.

In this paper, we argue that GMS's conclusion is not warranted for the UK market, as it does not fully account for the prevailing legal rights of leaseholders.

David Domeij: david.domeij@hhs.se

Tore Ellingsen: tore.ellingsen@hhs.se

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2. LEASEHOLD ENFRANCHISEMENT

The crucial assumption for the validity of GMS's test is that leaseholders cannot cheaply acquire the bubble on the freehold; they must be unable to expropriate the landlord. In real estate jargon, leasehold enfranchisement (purchase of the indefinite freehold interest) must occur at market prices.

GMS are aware of this point, and discuss it most extensively in Section 3.3.3 (pages 1079–1080). They argue, and we agree, that the landlord would always be compensated for any bubble value in a rational expectations equilibrium of a *laissez-faire* market (for ease of reference, we enumerate our direct quotes from GMS):

enfranchisements would occur at a price that equals the value of the bubble, because by acquiring the infinite-maturity freehold interest, the leaseholder would obtain the bubble that is attached to it. (Quote 1: page 1080)

However, GMS argue that it is also plausible to make the assumption that landlords are fully compensated in practice:

Since these are private market transactions among willing participants, we would expect them to happen at market values: the freeholder receives a mutually-agreed compensation for the sale of part or all of the residual value of the freehold. (Quote 2: page 1079)

But for the UK, enfranchisement transactions are not voluntary like normal market transactions, because the leaseholder can insist on trading even if the landlord is unwilling. The Leasehold Reform Act 1967, extended in 1993 and culminating in the Commonhold and Leasehold Reform Act 2002, gives leaseholders the unilateral right to buy.

On the next page, GMS mention the leasehold enfranchisement legislation. They acknowledge that the leaseholder may sometimes unilaterally enfranchise, but they imply that the opportunity to enfranchise is an exception rather than the rule:

In the U.K., but not in Singapore, leaseholders of houses in some cases have the statutory right to enfranchise or extend the lease by 50 years (Leasehold Reform Act 1967). The law stipulates that, while such rights are granted, the freeholder needs to be compensated for any loss of value at market prices. (Quote 3: page 1080)

It is true that the 1967 Act only applied to “houses in some cases” as GMS write. However, GMS fail to note that the scope of the law was extended through Leasehold Reform, Housing and Urban Development Act 1993. For houses, which are the focus of GMS's empirical analysis, the key change comes in Part I, Chapter III, Section 63, which lifts the previous restrictions on the house's value. After 1993, only a few special leaseholds cannot be enfranchised, for example if the freehold is owned by the National Trust or the Crown, or it is located in the cartilage of a cathedral. Since GMS confine attention to the post-1995 period, a good approximation is that the enfranchisement legislation applies to *all* the UK leasehold transactions on which GMS base their analysis.

None of this is to say that the law itself intends to tip the scales in favor of the leaseholder, away from the hypothetical market outcome. To the contrary, the law intends to emulate voluntary transactions. It instructs that compensation should reflect market value as follows: “the value of the freeholder's interest in the specified premises is the amount which at the valuation date that interest might be expected to realise if sold on the open market by a willing seller” (Leasehold Reform, Housing and Urban Development Act 1993, Schedule 6, Part II (1)).¹ In other words, the landlord's compensation should equal

¹For an extensive treatment of UK compulsory purchase law, see Denyer-Green (2014). For a recent discussion, see Law Commission (2018), especially Chapter 14.

the compensation the landlord could have obtained from voluntary enfranchisement in a world where the tenant does not have the unilateral right to enfranchise, the so-called “no-act world.”

However, our analysis suggests that, despite the intention of the law, full compensation is not guaranteed in practice. More precisely, while the landlord *is* fully compensated if the price of freeholds contains no bubble, the landlord *is not* fully compensated if the market price of freeholds contains a bubble. Indeed, for ultra-long leases, the present practice effectively grants the buyer ownership for free of the entire rational bubble that is attached to the property. Therefore, the present value of the bubble at leasehold expiration should be incorporated already in the leasehold price, eliminating the price difference between such long leaseholds and freeholds. To summarize:

CLAIM: Under post-1993 UK legal practice, if there had existed rational bubbles in the residential property market, the statistical test proposed by GMS would fail to detect them.

The main part of our paper lays out the theory and evidence supporting this claim. Section 3 briefly summarizes rational bubble theory and highlights a critical assumption that GMS make in their formal analysis, namely that agents discount fundamental and non-fundamental returns at the same rate and that this rate is smaller than the economy’s growth rate. Section 4 provides evidence that this assumption is incorrect, as courts uniformly apply much higher discount rates, thereby effectively granting the value of any rational bubble to the leaseholder. We also discuss the magnitude of other impediments to enfranchisement and find them to be smaller than indicated by GMS. Section 5 discusses, and ultimately rejects, the counter-argument that courts only uniformly apply these higher discount rates because market participants have consciously dismissed the possibility that freehold values include a rational bubble. Section 6 is a conclusion.

3. THEORY

According to the theory of rational asset pricing, an asset has market value

$$v = f + b, \tag{1}$$

where f and b satisfy the following conditions. The first component, f , is the asset’s fundamental value. It equals the expected value of future dividends (here, mostly housing services) when discounted at some appropriate rate, say, r_f .² The second component, $b \geq 0$ is the asset’s non-fundamental value, or bubble.³ The bubble component is expected to grow indefinitely at some average rate r_b , which coincides with the discount rate that investors apply to asset returns with the bubble component’s risk characteristics.⁴ Since the

²In general, this discount rate may be state-contingent, but for simplicity we treat all discount rates as being constant.

³We refer to Tirole (1985), Santos and Woodford (1997), and Domeij and Ellingsen (2018) for discussions of whether $b > 0$ is plausible on a priori grounds.

⁴If anything, our use of the term rational bubble is narrower than that used by GMS. Their boundaries are described in the second paragraph on page 1051:

The takeaway is that we can rule out any bubble associated with a failure of the transversality condition. The most prominent such bubble is the classic rational bubble described above, but failures of the transversality condition can also arise, for example, in the myopic-rational-expectations equilibrium of Tirole (1982), and in economies with differences in beliefs à la Harrison and Kreps (1978).

bubble component is not associated with any dividends, only the price of indefinitely-lived assets may possess positive bubbles. Finally, if g is the average growth rate of the economy, $r_b \leq g$; otherwise, the bubble's value explodes relative to the value of the economy's output. The interest rate r_f , on the other hand, should not be so low; indeed, the opposite inequality may need to hold. To see this, let g_f denote a constant growth rate of dividends. Then, the fundamental value f is only finite if investors discount these dividends at a rate $r_f > g_f$. If $g_f = g$, we therefore need $r_b \leq g < r_f$ in order for both the bubble component and the fundamental component to be positive and finite.

By contrast, in the formal part of their analysis, GMS assume that the two discount rates are the same. To be precise, their Equation (1) assumes that the dividend component and the capital gains (market price) component are discounted at the same rate. A uniform discount rate is arguably the only reasonable assumption in a frictionless market, where there is no substantial difference between dividends and capital gains, but it is not an innocuous assumption for housing, where transaction costs are large. Unless they intend to make a large vertical move, owners of houses are not much affected by aggregate house price swings, while they are inevitably affected by more or less idiosyncratic changes in the subjective value of their particular home, caused for example by changes in household size, work-proximity, and local amenities. In other words, variance in dividends is likely to matter more than variance in price. Note, moreover, that the uniform interest rate of GMS's model must be below the growth rate g for there to be a rational bubble.

As it happens, like GMS, British courts also apply only a single interest rate for discounting the returns to housing, but they have consistently concluded that the real interest rate applicable to the UK housing market is substantially *above* the growth rate. As we shall now see, *the empirical test of GMS is severely biased when British courts discount bubble returns at such a high rate*. Below, we shall refer to this single market interest rate as r_m when it is not adjusted for growth and r when it is adjusted for growth.

Consider a property that is currently (year 0) a leasehold. If there is no enfranchisement, the property reverts to the landlord (freeholder) in, say, t years. If the tenant seeks to enfranchise today, the landlord must be compensated not only for the loss of rental payments—ground rents—but also for the value of the freehold upon the lease's expiration. Since this value of vacant possession cannot be directly observed, there must be a procedure for determining it.

Before describing the actual procedure that has developed, we note that the theoretically correct net present value of the right to vacant possession is

$$\begin{aligned} c^* &= \frac{f_t}{(1+r_f)^t} + \frac{b_t}{(1+r_b)^t} \\ &= \frac{f_t}{(1+r_f)^t} + b, \end{aligned} \tag{2}$$

where f_t and b_t are the estimated fundamental and bubble values of the freehold at the expiration date t , and the second equality follows from the condition that the bubble grows at the yearly rate r_b .

All our interpretations of rational equilibrium with bubbles apply to the "classic rational bubble" models in which agents have rational expectations, such as Samuelson (1958) and Tirole (1985); they do not invoke the assumption that agents are myopic, as in parts of Tirole (1982) or have different beliefs, as allowed by Harrison and Kreps (1978).

Instead, UK legal practice stipulates that the right to free possession is estimated as

$$c = \frac{v_t}{(1 + r_m)^t}, \quad (3)$$

where v_t is the estimated market value at the lease's expiration and r_m is a market discount rate, typically referred to as the deferment rate or reversion rate. Since the rate of growth of the economy is considered to affect v_t and $(1 + r_m)^t$ in equal measure, the UK legal convention has furthermore been to replace v_t by the current market value, call it v , and to replace the relevant market interest rate r_m by the growth-adjusted rate, call it r .⁵ That is, the authorities compute the reversion value as

$$\begin{aligned} c &= \frac{v}{(1 + r)^t} \\ &= \frac{f + b}{(1 + r)^t}, \end{aligned} \quad (4)$$

where the second line uses the identity $v = f + b$ in order to facilitate comparison with (2). Observe that (4) coincides with (2) if $r_m = r_f$ and $b = 0$. If there is no bubble, and the court's discount rate coincides with the correct growth-adjusted rate for fundamental value, the legal practice emulates the fair price. If, on the other hand, $r_m = r_f$ and $b > 0$, then $c < c^*$. That is, because positive bubble value is discounted at a positive rate, the right to free possession is transferred at too low a price.

4. DISCOUNTING RULES IN PRACTICE

GMS argue that, in practice, the leaseholder will at least have to pay a part of the bubble's value, and that the incentive to enfranchise at any rate is dulled by transaction costs:

For the U.K., the statutory rights can only adversely bias our test if enfranchisements and extensions are underpriced; but even in this case, the statutory rights could not explain our finding of a zero price difference between contracts estimated with very tight standard errors. *For this to happen in the presence of a bubble, leaseholders must expect to be able to get the freehold for free and with certainty, in effect expropriating the freeholder. This runs contrary to the evidence in Giglio, Maggiori, and Stroebel (2015), who showed that the private market and the courts impose compensation that is negatively related to remaining maturity for shorter-maturity leaseholds (between 80 and 300 years).* Finally, lease extensions and enfranchisement involve significant transaction costs for the leaseholder, thus reducing the possible price impact of the statutory rights. [Followed by footnote 33, which reads: The leaseholder has to pay the cost of valuation services, legal counseling, and legal expenses, and has to bear the uncertainty associated with possible court proceedings.] (Quote 4: page 1080, *emphasis added*)

The quote begins by making two important observations, with which we agree. First, if they were to exist, underpriced enfranchisements might bias the test. Second, if it were to occur, full expropriation of the bubble might create a near-zero price difference between ultra-long leaseholds and freeholds. Following these observations of principle, the quote makes two arguments about practice. The first concerns court-imposed compensation and the other concerns transaction costs. Let us begin by discussing the compensation issue.

⁵For leases with less than 80 years to expiration, the value is adjusted to take account of the lift in value that is caused by the conversion from leasehold to freehold (the so-called marriage value); this adjustment does not apply to the ultra-long leases considered by GMS.

4.1. UK Legal Principles

GMS correctly note that the courts, in practice, impose compensations that are negatively related to remaining maturity for the shorter-maturity leaseholds (80–300 years) considered in GMS’s *companion* paper. However, this observation does not help to assess the bubble’s size. Whatever non-zero discount rate courts apply, compensation will always be somewhat sensitive to maturity (see Equation (4)), and when maturity is not too far into the future, the effect will be detectable. The critical question for assessing whether long leaseholders might have obtained a bubble for free is whether the compensation c granted by the courts would still be noticeably sensitive for the ultra-long maturities (700+ years) under consideration in GMS’s *present* paper. That squarely depends on the discount rate.

The critical question can thus be formulated more sharply: Does the reversion value c become approximately zero for the discount rates that apply in practice? Quote 4, which appears in the article’s body, argues that enfranchisement does *not* come for free. Therefore, it is somewhat confusing to read GMS’s footnote 32, on the same page:

Court decisions, even if clearly special in many dimensions, different from market transactions, and related to a selected sample of market participants, have at least been consistent with our empirical result that there is no difference in value between extremely-long leaseholds and freeholds. *If compensation was awarded to the freeholder, it was unrelated to the future value of the contract, that is, the possible bubble, and instead connected to the loss of immediately payable ground rents.* In none of the many court decisions we investigated did any participant raise the possibility of a classic rational bubble and the related resale option value of the freehold contract. (Quote 5: page 1080, *emphasis added*)

The emphasized text in Quote 5 appears to say that enfranchisement is virtually free. This would imply that leaseholders’ statutory rights *can* explain the zero price difference, contradicting the direct message of Quote 4 and the indirect message of Quote 3.⁶

Is enfranchisement free or is it not? Since GMS do not unequivocally answer this key question, let us now investigate the actual interest rates applied in leasehold enfranchisement transactions. Since 2007, the real growth-adjusted deferment rate r has almost uniformly been 4.75 percent for the enfranchisement of houses and 5 percent for the enfranchisement of flats (the extra 0.25 percent reflecting perceived greater management problems for flats). These deferment rates were determined by the Lands Tribunal in the case *Earl Cadogan v Sportelli*. A full account of the Lands Tribunal’s reasoning is detailed in [Lands Tribunal \(2006\)](#). A key paragraph is number 79, whose last sentence is:

Overall, therefore, we would take a risk premium of 4.5% in combination with a risk-free rate of 2.25% and a real growth rate of 2%, producing a generic deferment rate of 4.75%.

It is noteworthy that the Tribunal accepts the point of view that the risk premium for housing investments is in the same ballpark as for equities.

Note, moreover, that if we accept the tribunal’s estimates of a risk-free rate of 2.25% and a growth rate of 2%, the risk premium applying to the bubble component of the price ought to be no larger than -0.25% (because we need $r_b \leq g$). That is, any risk associated with rational bubbles must be negatively correlated with aggregate risk.

As we have seen, a uniform deferment rate $r > 0$ implies that leaseholders get a rebate on the bubble when they enfranchise. Let us now compute the extent of this rebate. The

⁶The last sentence of Quote 5 is potentially important in case the “easy enfranchisement” message of Quote 5 is accepted to dominate the “difficult enfranchisement” message of Quotes 3 and 4. We return to this issue in Section 5.

component of c that corresponds to the implicit price for the bubble is $c_b = b/(1+r)^t$, so the rate of rebate is

$$x = 1 - \frac{1}{(1+r)^t}.$$

After year 2007, courts have quite consistently applied the *Sportelli* rates $r = 0.0475$ for houses and $r = 0.05$ for flats. When t is large, c_b becomes a minuscule fraction of the true bubble value. For example, with $t = 700$ and $r = 0.0475$, the rate of rebate x is virtually 1. Even if b exceeds 100 million pounds, the price c_b is less than a penny.

It is easy to check that reversion values are indeed computed as described. There are thousands of leasehold enfranchisement transactions every year. While most of the transactions are private, many are in the public domain. The reason is that the Ministry of Housing, Communities & Local Government publishes the outcome of all cases involving a legal dispute or in which the courts need to intervene because the leaseholder has not been able to obtain a response from the freeholder.⁷

Supplemental Material (Domeij and Ellingsen (2020)) Appendix 1 considers a recent court case. The ground-floor flat had a 999 year long lease starting 30 June 2006 (yielding 989 years to expiration). Accordingly, the reversion value is indeed set to zero. The 112 years lease for the first-floor flat is set to about 0.4 percent of the value. The case is entirely typical for how courts compute the reversion value; in all the court cases concerning central London that we have sampled for the period 2009 to 2016, we never saw a single instance of a lower discount rate for flats than 5 percent, and the vast majority of cases applied exactly the *Sportelli* rate for flats of 5 percent. In a data set covering 460 decisions of this kind from the decade prior to *Sportelli* (1995–2006), Badarinza and Ramadorai (2014) documented reversion discount rates in the interval 5.3 percent to 13 percent, with a mean of 8.7 percent. Thus, our conclusions apply even more strongly for the earlier period in GMS's data set than for the later period.

4.2. Transaction Costs

Let us now address the issue of transaction costs. Recall GMS's argument, in Quote 4, that "lease extensions and enfranchisement involve significant transaction costs for the leaseholder" who "has to bear the uncertainty associated with possible court proceedings." We would describe the transaction costs differently. To us, it appears that enfranchisement costs are predictable and easily available to market participants, also those without prior knowledge of the law. In Supplemental Material Appendix 2, we give a screenshot from an online service called Freehold Calculator.⁸ A similar online resource is available from the Ministry of Housing, Communities & Local Government. The latter calculator adds a fixed cost of 1000 pounds to any calculation, as a warning that the leaseholder must pay the freeholder's legal expenses, but otherwise returns the same cost estimate.⁹ There is little uncertainty about these legal costs, since they are purely administrative. Nor is there any recognizable uncertainty associated with court proceedings, since there is no possible issue for the landlord to litigate. The cases involving long leases that go to court, which we have described above, do so as a matter of routine when landlords

⁷See <https://decisions.lease-advice.org/> for electronic copies of the courts' judgments.

⁸It is available for free at <https://www.freeholdcalculator.com>.

⁹See <https://www.lease-advice.org/calculator/>.

are absent or do not respond to the leaseholder's query, not because of material arguments.¹⁰ For ultra-long leaseholds worth several hundred thousand pounds, we hold that transaction costs in the vicinity of 1000 pounds are more accurately described as "low" than "significant." More importantly for our argument, for most properties these costs are low enough to justify enfranchisement even in the presence of rational bubbles constituting less than one percent of the property's market value. In other words, it is the leaseholder that effectively owns the bubble.

5. HAVE MARKET PARTICIPANTS DISMISSED RATIONAL BUBBLES?

A counter-argument to our Claim runs as follows: If there had existed rational bubbles in the residential property market, someone would have already understood that landlords are being expropriated by leaseholders and made a legal challenge on these grounds. By this reasoning, the lack of a legal challenge (which GMS explicitly noted; see last sentence of Quote 5), already proves that rational bubbles are absent.

Let us explain why we find this "dismissal-argument" unpersuasive.

5.1. *What Does Silence Mean?*

According to the dismissal-argument, the use of a high discount rate in enfranchisement cases does not imply that fundamental and non-fundamental returns are being discounted at the same rate, but merely that market participants themselves consider that there is no non-fundamental return.

Three observations count in favor of the dismissal-argument. First, the law mandates that the landlord should be fully compensated. That is, the transaction ought to take place at price that would have prevailed if a willing landlord offered enfranchisement in the absence of the law. Second, lawyers and judges are acutely aware of the law's letter and intent, and they strive to implement the law correctly. Third, landlords have never complained about having rational bubble values being expropriated.

However, these observations do not demonstrate that market participants consciously dismiss the presence of rational bubbles. Staying silent about rational bubbles would not be an immediate consequence of the landlords' own personal belief that rational bubbles are absent. If they believe that there is even a small probability that arguing for the existence of a bubble would convince the court, stakes are so large that at least some (current or prospective) landlords have an incentive to make the case.

Our own favored interpretation is that nobody possessed the necessary expertise to even conceive of a plausible court case. Being able to make rational purchasing and selling decisions in the residential real estate market is an altogether different task from navigating economic and legal theory. Building a court case requires both intimate knowledge of enfranchisement law and intimate knowledge of rational bubble theory. Over the last decades, following the publication of influential assessments by [Abel, Mankiw, Summers, and Zeckhauser \(1989\)](#) and [Santos and Woodford \(1997\)](#) that rational bubbles are unlikely to exist in practice, rational bubble theory has come to constitute a tiny niche of asset pricing theory.¹¹ Moreover, as we have shown, a credible legal case would require

¹⁰Legal matters are more complicated than reported above for leases with less than 80 years to expiration, and that even for leases with time to expiration in the interval 80–150 years, there may be cases in which the judgment of valuers differ and legal costs could thus run at more than 1000 pounds.

¹¹We refer to [Domeij and Ellingsen \(2018\)](#) for counter-arguments to Santos and Woodford as well as references to other recent work on rational bubble theory.

going beyond the conventional rational bubble model that GMS themselves analyze: The notion that landlords might have been expropriated rests squarely on the insight that an asset's dividends can be fairly discounted at a higher rate than the same asset's capital gains, in contrast to the presumption embodied in GMS's Equation (1) that all returns from an asset are discounted at the same rate.¹²

In principle, the dismissal-argument might still be right. Perhaps market participants have consciously considered and rejected the possibility of rational bubbles in UK housing markets. But then, why is there no trace of these deliberations in court documents? Precedent is central to British courts. Consider, for example, the case of *Sportelli*, which set an influential precedent. (After *Sportelli*, legal disputes typically concern the valuation v ; it is only in exceptional cases that discounting departs from the *Sportelli* benchmark. Before 2006, on the other hand, many disputes also concerned the relevant discount rate, as documented by [Badarinza and Ramadorai \(2014\)](#).) While it is conceivable that the court considered that there existed no rational bubble at the time, we find it unlikely that the court, anticipating that it was setting precedent, would (a) consciously take the position that there could *never* be a rational bubble in the future and (b) fail to mention that it has taken such a position.

5.2. *What Do Rational Expectations Entail?*

Another closely related objection might be summarized as follows: If there is a bubble and no landlord protests about expropriation, then market participants—existing and potential—are too unsophisticated for the bubble to deserve the label “rational.” That is, the absence of legal action may be consistent with an asset bubble, but not with a classic rational bubble of the kind devised by [Samuelson \(1958\)](#) and [Tirole \(1985\)](#). Let us consider this argument in view of standard definitions and their conventional interpretations.

Formally, a bubbly rational expectations equilibrium is an allocation and a supporting sequence of prices such that the price of some asset at some time t has a non-fundamental value component, and all agents in the economy pursue a portfolio strategy that maximizes their utility (in addition to these universal requirements, each application typically imposes additional conditions on the allocations and price paths; see e.g., [Tirole \(1985, Definitions 1 and 2\)](#), or [Domeij and Ellingsen \(2018, page 115\)](#)). For there to be a rational expectations equilibrium—with or without bubbles—it is unnecessary that agents understand and solve the underlying model, decomposing the asset's value into a fundamental component and a bubble component. To the contrary, what characterizes a rational expectations equilibrium is not the internal thought processes of the agents but the property that an agent with rational expectations cannot obtain greater utility by changing her portfolio strategy.

Indeed, it is widely agreed among economic theorists that rational expectations equilibrium is best interpreted as an outcome of learning or selection (“adaption”), not as an outcome of agents' comprehensive reasoning about their environment (“eduction”).

¹²Note that this is less a statement about GMS's shortcomings, than about the lack of relevant formal analysis. In the entire literature on rational bubbles, we have failed to find any model in which an asset's fundamental returns are discounted at a different rate than the same asset's bubble returns. The seminal models of rational bubbles by [Samuelson \(1958\)](#) and [Tirole \(1985\)](#) admit only a single interest rate. [Samuelson \(1958\)](#) only considered one type of durable asset, money. [Tirole \(1985\)](#) considered multiple types of durable assets, but either they all yield the same expected rate of return, or some asset is more liquid than other assets and therefore yields lower expected returns (as conventionally measured). When other authors have admitted multiple discount rates, as did [Bertocchi \(1994\)](#), the different rates likewise apply to returns from different assets.

Agents act *as if* they understand their environment and have correct expectations. The literature on interpreting rational expectations equilibria goes back at least to [Alchian \(1950\)](#), and it comprises a wide range of arguments, some focusing on the inability of global reasoning to support equilibrium (e.g., [Aumann and Dreze \(2008\)](#)), others focusing on the ability of local learning and evolution to do so (e.g., [Weibull \(1995\)](#)).

The upshot of the literature on adaptive foundations of economic behavior is that equilibrium theory is typically justified when players have time to learn the game, either from own experience or from the experience of others (e.g., [Weibull \(1995\)](#)). If the rules governing a particular housing market have been sufficiently stable to allow full adaptation to take place with respect to buying and selling decisions, the theory implies that markets for freeholds as well as markets for leaseholds will satisfy rational expectations equilibrium conditions. Rational expectations equilibrium implies absence of any kind of bubble on finite maturity assets. Thus, the theory does not permit any bubbles on leaseholds, rational or irrational, if enfranchisement is impossible or must compensate fully for bubbles, but it does allow rational bubbles on leaseholds if enfranchisement does not compensate fully.

However, adaptive reasoning does not justify the assumption that players are capable of creating new games or even immediately to be playing an equilibrium of such a new game after it has been created. We think that learning effective buying and selling decisions among the millions of traders in the UK housing market is likely to be substantially quicker than learning effective legal actions among the few players that determine legal practice. In the UK, leasehold enfranchisement legislation has only been broadly applicable since 1993. Potential housing bubbles only became a serious issue a decade later. Under the adaptive view, it would not be too surprising if legal practice has failed to fully adjust to these circumstances.

5.3. *A Test for Irrational Bubbles?*

Suppose, for the sake of argument, we were nonetheless to accept the view that absence of a legal challenge implies absence of a rational bubble. In this case, it suffices to inspect the publicly available information about court-determined discount rates to evaluate the magnitude of rational bubbles. GMS's statistical test cannot itself be informative about the presence of rational bubbles. When courts deem rational bubbles to be absent, any difference between the price of ultra-long leases and otherwise identical freeholds would not be a measure of the size of a rational bubble, but instead indicate that the size of *irrational* bubbles (or other sorts of mispricing) would have to differ between the two kinds of housing contract.

6. CONCLUSION

In their Section 3.3.3, GMS acknowledge that their test for rational bubbles might be compromised if statutory rights to leasehold enfranchisement are widely held and underpriced. However, they also claim that the test is not compromised in practice. In the case of UK, we disagree. Virtually all holders of ultra-long leases can cheaply enfranchise. We therefore conclude that, regardless of the size of the rational bubble, after the enactment of extensive leasehold enfranchisement legislation in 1993, GMS's test will fail to detect it.

GMS might argue that cheap enfranchisement in the UK merely constitutes evidence that market participants actively dismiss the possibility of rational bubbles. But, as we have

demonstrated, this argument relies on the less conventional eductive interpretation of rational expectations equilibria that agents' understanding of their environment coincides with that of the modeler. Such an eductive interpretation also diminishes the value of GMS's test in the UK setting. The test has no power to independently identify rational bubbles if the magnitude of the bubble has already been established in openly available legal records from leasehold enfranchisement cases.

Of course, we do not argue that GMS's test could never be informative. The test would still be useful for assessing the presence of bubbles under circumstances where leasehold enfranchisement is restricted, such as Singapore, which GMS also study. It might also be useful for the UK market if there are enough unenfranchisable leases to admit a statistically reliable comparison with freeholds. Applying the GMS test to UK transaction prices prior to 1993 would be interesting, too. Under the assumption that the 1993 law was totally unforeseen, the GMS test would yield an unbiased measure of the bubble's size; if the law was partly anticipated, the measure would be biased downwards. In fact, a small-scale test of this kind already exists, as helpfully pointed out by a referee: According to Bracke, Pinchbeck, and Wyatt (2016, Table 1, column 1), ultra-long leaseholds in the UK traded at an 8 percent discount during the period 1987–1992, suggesting the presence of a rational bubble in this period.¹³

Finally, we stress that none of our analysis here constitutes evidence in favor of a rational bubble in UK housing markets in the period 1995–2013. It merely shows that GMS's arguments against such a bubble are weaker than they first appear.

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¹³This table is not part of the published version, Bracke, Pinchbeck, and Wyatt (2018), and although the estimated coefficient is large it is only marginally statistically different from zero, because the data set is considerably smaller than that of GMS.

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