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Cite As: Lovell, H & Smith, S 2010, 'Agencement in housing markets: The case of the UK construction industry' *Geoforum*, vol 41, no. 3, pp. 457-468.

DOI: 10.1016/j.geoforum.2009.11.015

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Abstract

This paper addresses a paradox in UK housing construction, namely its 'lock-in' to masonry house building – a socio-technical assemblage which endures, despite recognised shortcomings, even in the wake of government policies encouraging factory-based prefabricated alternatives. Combining theoretical inspiration from recent work on the cultural economy and material sociology of markets with empirical research on innovation in the home building industry, we weigh up the forces for inertia against the impulse for change in methods of housing construction. The analysis shows that while the case for and against innovation appears to turn on financial costs and benefits (it is a calculation debate), in practice, social, cultural and technical differences – struggles over the assemblage and *agencement* of housing construction markets – are the critical issues underpinning UK resistance to prefabrication. Practically, we argue that government needs a better appreciation of this complexity if its aim is to encourage innovation. Theoretically, we advocate a firmer distinction between the concept of assemblage - a description of markets - and that of *agencement* - a property or quality of them.

Keywords

agencement; assemblage; housing construction; masonry; prefabrication; lock-in

Introduction

This paper addresses a paradox in UK housing construction, namely its 'lock-in' to masonry methods of construction. This is the traditional method of house-building in the UK (Barlow, 2000; Ross, 2002), which accounts for most of the existing stock and as much as eighty-five per cent of new build (Building Talk, 2006). Its dominance is paradoxical because it is costly, inflexible and inefficient in a variety of ways (Barker, 2003; Ross, 2002; Williams, 1997): it is sluggish in adjusting to demand across the housing cycle (Barker, 2004; Bartlett, 2002; Williams, 1997), and is at odds with some key goals of UK housing policy including the pursuit of a ready supply of affordable and environmentally sustainable accommodation (Communities and Local Government, 2006; ODPM, 2003b). Although there are, as we shall demonstrate, barriers to directly comparing systems of housing construction, it is surprising that markets for alternative methods of construction, such as prefabrication, have been so slow to get underway (National Audit Office, 2005; The Housing Forum, 2001).

To explore this tension in UK housing construction the paper draws from, and enlarges, a conceptual toolkit developed to explore more broadly the cultural economy and material sociology of markets. One of the major intellectual achievements of the last decade has been to open up the black box of the economy to scrutiny from disciplines other than economics. This has prompted a comprehensive rethink of what markets are, as well as drawing (somewhat less) attention to how they change. Certainly scholars are beginning to recognise the diversity and particularity of markets, the practicalities of their operation, their material form, their emotional qualities, their sociality and their agency (Barry and Slater, 2002; Callon, 1998b; Hardie and Mackenzie, 2007; MacKenzie, 2006; Munro and Smith, 2008; Pryke,

2007; Smith, Munro and Christie, 2006). Two traditions of working are particularly important for this paper: cultural economy, which recognises that the creation and performation of markets is rooted partly in a struggle around ideas, for example about what the economy is (see Amin and Thrift, 2004); and material sociology, which is concerned with the assemblage of people, things, methods and mechanisms of calculation, and so on, into an economy which is lived, practised, experienced, embodied and indeed materialised, in different times and places (see Callon and Muniesa, 2005; MacKenzie, 2008).

Thinking about housing markets from a perspective that recognises markets to be 'concrete' things (Callon and Muniesa, 2005: 1229) is rather apt for this paper, since we draw attention to what is arguably the most 'concrete' of material markets, that of housing. This is in contrast to much of the existing economic sociology literature which, paradoxically, is concerned mainly with teasing out the social and material content of more abstract, virtual, financial, markets (Callon, 1998b; Hardie and Mackenzie, 2007; Pryke, 2007). It is curious that, with a few notable exceptions (Bourdieu, 2005; Munro and Smith, 2008; Smith, 2008) the most material of markets - housing – has been left out of this frame. By reporting on markets of housing construction we therefore help place a new (and rather large) piece into the jigsaw whose finished form represents a fresh, revised view of what the economy is and how it functions. Moreover by bringing housing into this frame we introduce a contribution from one of the world's largest economic markets – a system of construction, distribution and exchange whose workings themselves impact on these new understandings of economy.

We recognise that there is an extensive literature within science and technology studies (STS) on how socio-technical systems regimes or systems function, and how 'lock-in' can inhibit change (Rip and Kemp, 1998; Schot, Hoogma and Elzen, 1994; Unruh, 2002). However the majority of this socio-technical regime literature does not pay close attention to the issues of economics and finance which are so critical in understanding what drives markets for housing construction. This is why we favour innovations in cultural economy and material sociology as the starting point for our analysis here. Nevertheless, the re-conceptualisation of markets that inspires this paper itself has STS roots (consider for example Callon's (1986) early work on electric vehicle innovation and MacKenzie's (1990; 1996) previous interests in technological innovation of all kinds), and where appropriate we do refer to the links between these traditions. It should not be surprising to find some overlap between the way the terms 'market' and 'socio-technical regime' are used in these literatures, but to avoid confusion we place markets at the centre of the analysis, recognising that an actually existing market is, in its broad interdisciplinary setting, "..a many-sided diversified, evolving device" (Callon, 1998a: 55), which is "..made 'economic', through a complex interplay of cultural, legal, political and institutional arrangements" (Smith, Munro and Christie, 2006: 95).

The UK housing construction industry has not been looked at in this way before, but as a market ready for, yet ambivalent towards, change, it is an apt case study. Consider the following three paradoxes. First, although the UK has a uniquely dated housing stock with a slow replacement rate (DTLR, 2000; Leather and Morrison, 1997), housing consumers have a clear preference for older, masonry, dwellings (Young, 2002). The appeal of the masonry aesthetic together combines with the

culture of masonry craft to help perpetuate this trend (Clarke and Wall, 2000; Davis, 2006). Second, UK house prices are notoriously volatile, creating a major challenge for economic management. This could be eased by using prefabrication to boost the slow response of housing supply to increased demand. Such a move is thwarted (amongst other things) by the extent of lock-in to masonry construction (Barker, 2004). Third, there is a long tradition in the UK of prizing housing for its investment returns, and this has placed a premium for households and the construction industry on owner-occupation. Prefabrication, in contrast, has become associated with the social sector (Ross, 2002), and – thanks to it role in post-war reconstruction, and in the management of slum-clearance in the 1960s – with a presumption of transience. The fact that so many of the one million prefabricated units produced in the twentieth century were designed to be temporary may be one reason why the introduction by the UK government, in 2004 of a new policy requiring one in four publicly-funded social housing developments to be built using prefabrication (Hansard, 2003; The Housing Corporation, 2003), has not yet made much impact on the wider housing landscape. Notwithstanding skills shortages and increasing demand for faster construction, the majority of new homes built in the UK – around 85 per cent – are still constructed using traditional 'brick and block' masonry methods (Building Talk, 2006). Scotland is distinctive for the widespread use of prefabricated timber frames (in about 70 per cent of new construction according to Gibb (1999), which compares with 10 per cent for the UK as a whole).

It is, nevertheless, the introduction of this 2004 policy promoting so-called 'modern methods of construction' that forms the empirical core of the paper, which is based on a range of qualitative and quantitative evidence collated by Lovell (2005). The data

include twenty-five intensive interviews conducted in 2003 with UK government, housebuilders and consultants about the introduction of prefabrication as an element of social housing policy. The interviewees were identified initially from membership of relevant industry working groups, and subsequently using a 'snowballing' technique. The interviews were recorded, transcribed, and analysed using the qualitative software programme 'ATLAS'. Additionally we refer to a postal survey of private sector UK housebuilders, conducted in 2004 in conjunction with the UK House Builders Federation to document builders' experience of, and attitude towards, prefabrication.[1] All housebuilders registered with the UK House Builders Federation were sent the three-page survey, which comprised eleven multiple-choice and short answer questions about the quantity of dwellings built each year and the construction methods and techniques they use. Because this paper is primarily conceptual in orientation, we draw lightly on these data to illustrate the core of the argument. Nevertheless, in selecting examples and quotations we have taken measures to represent the breadth and depth of the data more broadly. That is, we have drawn systematically on the data resources, rather than adopting a more pragmatic 'note and quote' approach.

The paper proceeds as follows. In the first of the following sections, we describe the assemblage of the markets for masonry-built and prefabricated housing. Our concern here is with what those markets consist of and how they are put together; literally with their assemblage. We recognise that such markets are complex entanglements or networks of humans, materials, institutions, politics and technologies. To account for their shape we attend to the micro-structures of these markets and document their

[1] The survey was mailed to one hundred and seventy-eight technical directors of private sector housebuilders in the UK, identified from the House Builders Federation's contact database. A total of eighty-five completed surveys were returned: a response rate of forty-eight percent.

operation as ‘collective calculating devices’ (Callon and Muniesa, 2003). This exercise is pretty much in line with the approach that has become common for those engaged in the interdisciplinary project of ‘unpacking’ the black box of the market (MacKenzie, Muniesa and Siu, 2007; Mitchell, 2008; Pryke, 2007). Its novelty is in its application to markets for housing construction, and in showing how ‘calculation debates’ are implicated in the evaluation and comparison of these.

In the second section of the discussion, we consider what happens when these different market assemblages are brought into competition or confrontation. We are specifically interested in the relationships between two such assemblages: markets for housing production that are anchored, respectively, on masonry methods and prefabrication. The question of how whole systems (in this case of housing production) change through the encounter with the relatively distinct market assemblages comprising them is poorly understood. To explore it, we draw initially on the ideas in Pierre Bourdieu’s (2005) last monograph. Here, using the example of housing construction to elaborate some key principles of economic anthropology, Bourdieu talks about the ‘jostling’ that occurs among different ‘fields of force’ that surround and infuse competing market assemblages.

‘Jostling’ is an activity that helps explain how firms come and go from the wider market for housing production in a process of incremental change. But to appreciate how such turnover adds up to a trajectory (a systematic shift or a determined stasis) other concepts are needed, and to this end we attempt to add substance to Callon’s rather over-used and perhaps under-theorised idea of *agencement* (Callon, 2007). Using the example of housing production, we carefully distinguish between

assemblage as an arrangement of a specific mix of materials and meanings within an actually existing market (for pre-fabricated or masonry built homes) and *agencement* as a property of the wider economy (of housing production) which has to do with how the arrangements of markets within it changes (or not).

This is the starting point for the third section of the discussion which highlights the extent to which the problem of markets is a question of politics. On the one hand, the perspectives of material sociology and cultural economy provide the encouraging message that markets are not immutable. Their contents, values and outcomes are all amenable to change. On the other hand, the case of UK housing construction highlights the futility of government efforts to effect radical change without more clearly understanding the complexities of why a particular market – in this instance masonry housebuilding – enjoys a dominant position, or lock-in.

The assemblage of markets for masonry and prefabrication

The market for housing construction is generally depicted in rather narrow one-dimensional terms, either focusing on economic rationality or technological innovation (Bramley, Bartlett and Lambert, 1995; Clarke and Wall, 2000). To meet our first aim – that of opening such markets to scrutiny from a mix of social science perspectives – we draw inspiration from a range of new ideas about how to 'drill in' to the complex yet specific arrangements of people and things that make up actually existing markets (MacKenzie, 2008; Pryke, 2007). While there has been some interest in exploring these ideas in relation to housing markets (Munro and Smith, 2008), mainly this work has cast light on the exchange of properties between households. However, we are interested in the question of housing production and

therefore with the institutional and material micro-structures of the masonry and prefabrication market assemblages. This, in turn, may be key to understanding the pattern and dynamics of the housing system as a whole. Some key features of, and points of distinction between, masonry methods of construction and prefabrication are set out in Table 1. Most obviously, one market (masonry construction) is large and well established, while the other (prefabrication) is small and has never been more than a niche innovation. In all about 25,000 (fifteen per cent) of new homes per year are prefabricated. There are approximately thirty house building factories in the UK (Bingham, 2003), with the capacity to produce over thirty thousand prefabricated homes per year (Venables, Barlow and Gann, 2003).

Apart from size, there is a raft of important technical differences that cement the distinction between prefabrication and masonry construction markets. Prefabrication involves the manufacture of house parts such as panels and modules (ready-made rooms) away from the construction site in a specially designed factory. The house parts are then transported to the building site and assembled quickly, often within a day, with wiring and plumbing already integrated inside them. In contrast, masonry-built homes are built on-site and are craft-based: the process is slower and less precise, but also more flexible in a number of ways. For example, the exact layout and dimensions of masonry housing are not fixed until the project construction team is on-site, and therefore planners can demand relatively last minute changes, prompting one interviewee to refer to the masonry construction process as “build and design” rather than “design and build” (Interview, Housing Association Project Manager, October 2003). Indeed, in a survey of UK prefabricated manufacturers the long lead-in time for design – termed ‘design freeze’ - was seen as the main disadvantage of using

prefabrication (Venables, Barlow and Gann, 2003). It is precisely this type of varied and complex interaction within housing construction markets (comprising intersecting technical, social and institutional factors) operating at a micro-structural level that is critical in helping us to understand how markets form and function.

A characteristic of markets highlighted by micro-structural accounts such as this is that they have geographies and histories - they are embedded in particular places and evolve over time (Callon, Millo and Muniesa, 2007). We shall return to the importance of this in the next section. Here we concentrate on a theme which is critical to understanding the difference between the masonry and prefabrication assemblages, namely an interest in how particular arrangements of people, things, relationships, and devices are framed economically enabling them to operate as markets. This tradition of work in economic sociology is concerned, for example with how economic markets are separated out of the myriad connectivities in life and made into a recognisable, working mechanism of exchange (Callon, 1998b; Munro and Smith, 2008). These ideas are especially illuminating when applied to debates about the relative merits of prefabrication and masonry construction.

Discussion about whether prefabrication costs more or less than masonry construction has been highly contentious, and it is intriguing that, notwithstanding the historic role of prefabrication as a quick cost-effective solution to housing shortage or crisis, most evidence in play today points to building costs for prefabricated housing developments being approximately ten percent higher (Barker, 2003; Bingham, 2003; National Audit Office, 2005; Venables, Barlow and Gann, 2003). This figure prevails, and carries considerable weight in the ‘calculation debates’ around housing

construction, despite evidence that both its facticity and its composition are debatable. Such was the level of debate in the early years of the millennium that the government commissioned an extensive study on construction costs by the UK Audit Office. Intriguingly, this did little to clarify the situation. It revealed a big variation in costs from housing project to project – both for masonry and prefabrication housing developments. Although it concluded that most prefabricated construction methods fall within the cost range of masonry (£600 to £1000 per square metre), it also noted that prefabricated dwellings tend, on average, to be more expensive to construct (National Audit Office, 2005). The survey of private sector housebuilders conducted with the House Builders Federation also illustrates the level of uncertainty that circulates within the industry concerning the economic advantages of prefabrication relative to masonry technologies. It also shows how much of a barrier is posed by the 'facts' associated with cost. Indeed, the high costs of prefabrication (capital and construction costs) were seen as the most significant barrier to its further adoption (see Table Two). The main drivers refer to the potential for increased profits, but these are much lower in the list.

Perhaps the key aid to understanding what is happening here is Callon and Muniesa's (2003; 2005) work on the constitution of markets as collective calculating devices. This account is important partly because it makes the point that calculation is distributed widely across the people and things of the market: it is not affected through a single price mechanism or even through some form of human agency alone. So it is not surprising that quantities like 'costs' and 'price' are hard to pin down: they are things which circulate and transform as they do so (Buenza, Hardie and MacKenzie, 2006), they are practices enacted for a range of difference ends (Munro

and Smith, 2008), and indeed they are stories which, as Velthius (2005) shows, are about rather more than simply money. On the one hand, this draws attention to the importance of interrogating in detail the variety of market devices that make such calculation possible (Callon, Millo and Muniesa, 2007). Most usefully for us, it shows how the practice of making things calculable (like that of calculation itself) is an uneven, unequal and contestable process in which, in our example, it might be argued that the masonry assemblage holds the upper hand. That is, masonry is the market assemblage whose definition of financial costs and benefits – and whose view of the relative importance of financial accounting in the process of innovation – prevails. In short, the difficulty in clarifying the precise costs of prefabrication stem ultimately from a masonry-dominated framing of the construction process. The result is that, in effect, and as one interviewee suggested, trying to weigh up the financial merits of the two systems is like "comparing apples with pears" (Chair, Housing Forum Working Group on Prefabrication, December 2003).

Callon and Muniesa (2003) provide a helpful way of thinking about the asymmetries within markets that underpin circumstances like this. They refer to two kinds of asymmetry. First an imbalance in *calculative power*, reflecting the character and quality of calculating devices, the richness and competency of the networks they occupy and the extent to which buyers and sellers are informed, prepared and equipped for the transaction. Second, asymmetries flow from the degree of *autonomy and heteronomy* across different accounting systems: with the extent to which it is possible for one style of market to engage with another; with how effectively and with what resources bargaining can take place. These ideas can usefully be used to interrogate the jostling we have identified between prefabrication and masonry

construction. Masonry construction has certainly annexed the calculative power in UK housing construction markets, i.e. the power to frame the argument economically and to define costs and benefits in a particular way. Further, because of the long-standing dominance of masonry methods and the attachment this assemblage has forged with producers and consumers, masonry housing is a market that is easy to price and sell. Prefabrication has neither the autonomy from, nor the heteronomy with, masonry-build that is required to join this process. So, in terms of calculative power prefabrication remains at a disadvantage, as what is included or not in project balance sheets is defined in relation to masonry construction. This is despite the fact that prefabrication advocates frequently and plausibly argue that, although prefabricated homes may appear to cost more, householders benefit from a higher quality product with far fewer defects. As one interviewee explains:

"Cost wise prefabrication is… ten percent more expensive than traditional masonry build – that is the straight bottom-line cost. But you have to take into account the lack of defects, plus our ability to deliver for what we say it is going to cost… The [prefabrication] champions say – well let's look back at traditional [masonry] construction projects, see how the costs escalated and the defects….."
(Interview, Operations Manager at a prefabrication manufacturer, November 2003).

The costs of prefabrication are hence seen to be more inclusive: a greater proportion of costs are included 'upfront' in a quotation, such as labour costs, but there is no general acceptance or knowledge about these issues amongst housing producers and consumers. In Callon and Muniesa's words they are 'poorly equipped' for the transaction (Callon and Muniesa, 2003). A survey of UK prefabrication

manufacturers, for example, identified lack of market demand and public perception as the two most important limitations on expansion (Venables, Barlow and Gann, 2003), and the House Builders Federation survey revealed negative public attitudes about prefabricated homes to be the third most significant barrier to more widespread adoption (see Table Two). Industry concerns appear to reflect public opinion: in a 2001 MORI poll, 69% of respondents felt a brick-built home would fetch a better price (MORI, 2001). However, in another small-scale survey, all but one tenant of a new social housing prefabricated development in London said they would be willing to buy a similar home (Barker, 2003), suggesting that once residents have experience of living in a prefabricated home they feel more positive about it.

The mixed evidence about the costs of prefabrication relative to masonry discussed above allows those who are opposed to prefabrication on other grounds (technical, institutional, cultural etc.) to frame their arguments in terms of economics. One interviewee highlights this tendency, referring to two prefabricated housing developments in London that were said to have overrun their budgets:

"But Murray Grove and to some extent Raines Dairy were both criticised for being more expensive than the developer had originally thought. *Now a lot of that was anecdotal material, it was never quantified…*"
(Interview, Director of a prefabrication construction institute, November 2003);

and:

"People who look upon modular construction in a cynical light latch onto the ten percent higher cost…."
(Interview, Project Manager at a Housing Association, October 2003).

In other words, those who are not in favour of prefabrication tend to focus attention on cost. They create a rather simple calculation debate out of a more complex assemblage of activity, and use it not so much to make the entire market for housing construction 'work', as to make a bid for the dominant mode of production to remain in place. Calculation debates can thus be less a matter of fact and more a method of maintaining the status quo or 'lock in'; a discursive contribution to the actancy of, and in, markets.

More generally, examining the micro-structures of markets for housing construction focuses attention on the intricate networks of people and things that constitute the economy, thereby explaining why abstract models rarely fit the specifics of particular times and places. These approaches recognise the myriad forces in play and the hard work that goes into sustaining – for example – the construction of housing every minute of everyday. They recognise too that markets have to be made. But, notwithstanding the important beginnings laid out by Callon and Muniesa (2003; 2005) the essentially descriptive exercises are less good at accounting for what happens (or what does not happen) when completely different and competing markets, such as masonry and prefabrication, are thrown together. They are only a starting point for explaining how markets change (or not). It is this issue of how whole (housing) systems change that we turn to next.

Conceptualising change in markets: the activity of inertia

Perhaps because work on the sociology and anthropology of markets is a self-consciously 'bottom-up' affair, the focus in the last few years has been on setting out what markets consist of (Callon, Millo and Muniesa, 2007; MacKenzie, Muniesa and Siu, 2007) and not on explaining how whole systems (e.g. of housing construction) change or stay the same That is not to say that these approaches fail to document change: the whole idea of 'performing' economy, for example, which has been so dominant in this work, is precisely about the way economic ideas make themselves true as they are put into practise. However, it is probably fair to say that there is space for much more work within this tradition on the way whole systems change or transform. Interestingly, there is one area of work indebted to the same roots (that of science and technology studies) that does take on this challenge, namely theories of socio-technical regime transitions (at least in relation to change in infrastructure systems, see Geels and Schot, 2007; Smith, Stirling and Berkhout, 2005). Authors working in this tradition have elaborated in detail on the pattern of change, most typically with respect to energy systems (Graham and Marvin, 2001; Lovell, 2007; Smith, Stirling and Berkhout, 2005).

This literature on socio-technical regimes is helpful because, as with interdisciplinary theories of markets, the emphasis is the interplay between human actors and technologies. It is also innovative in its concern with the way regimes become 'locked-in' to a particular technological trajectory over time (Berkhout, 2002; Unruh, 2002). Callon too talks about lock-in, which he defines in a positive light as a progressive narrowing of options for agents to draw boundaries or 'frames' of calculation in markets as technology and institutions become more established

(Callon, 1998b). For any given 'economic market' lock-in is seen as useful because it helps with the process of calculation by reducing uncertainties for market actors. As Callon explains "Once organised and hence locked-in, the market becomes calculable by the agents." (1998b: 50). In contrast, and in our view more helpfully, the socio-technical regime literature – perhaps because of its close attention to processes of innovation and change (often in relation to policy issues, see for example Geels and Schot, 2007; Smith, Stirling and Berkhout, 2005) – presents lock-in as more problematic. It may be a condition that is vital for markets to succeed, but equally it is a position that actively inhibits change. Our work on the UK housing construction experience also points to the importance of attending to this flip side of change – to understanding not just how markets are established but also to examine the powerful forces (human and non-human) that keep them in place. After all, it is not necessary to 'buy in' to the innovation of prefabrication to be surprised that masonry lock-in has not been loosened, given the degree of policy concern with the quality and quantity of UK housing. To account more fully for this inertia, it might seem logical to build mainly on the socio-technical regimes literature. However, this is limiting, because most pathways or models of change for socio-technical regimes have conceptualized change as a fairly linear affair (Geels and Schot, 2007), and this is at odds with ideas in economic and material sociology which draw attention to the multidimensionality, multi-directionality and, above all, non-linearity of the process. We therefore stick with this latter tradition, developing and extending some core ideas in order to better illuminate the *dynamics* of housing production markets.

Jostling in a 'field of force'

The starting point for our analysis is in the ideas already discussed attending to the micro-structures and heterogeneity of markets. As we have seen, this work directs attention, above all, to the struggles and resources required to define and enact markets as 'economic'. (i.e. with the way economic markets come into being). This is essentially Michel Callon's project. Pierre Bourdieu, in contrast, attempted in his last monograph, to weigh up competing claims for space within specific markets – claims which may be framed in a variety of ways around values that may not be economic. Interestingly, Bourdieu's ideas were, like ours, based on an analysis of housing construction markets. In an empirical study of new housing construction in France, Bourdieu (2005) considered the way competing markets engage one another within what he calls a 'field of force'. Core among Bourdieu's 'principles of economic anthropology', the field of force is the setting in and through which different elements of the market assemblage (construction firms of different sizes and geographical reach, for example) jostle for position. Bourdieu states that 'the objective relations established between the different construction companies competing to win shares of this [the single-family house] market constitute between them a field of force, the structure of which, at a given moment, provides the basis for the struggles to conserve or transform that field' (ibid. 2005: 39). These struggles hinge around a mix of claims not just to economic superiority, but also to cultural, financial, technological, juridical, organization, commercial, social and symbolic capital. By profiling these heterogeneous influences 'the notion of the field breaks with the abstract logic of the automatic, mechanical and instantaneous determination of prices in markets in which unfettered competition prevails' (ibid. 2005: 196).

Again, this is a perspective with obvious application to our empirical case because it usefully accounts for the salience of a *mix* of social, institutional, cultural and technological factors impeding the take-up of prefabricated housing. For instance, a key feature of the construction process of masonry housing is the ability for construction to stop and start at relatively short notice because of its limited 'sunk costs' and by virtue of the ease with which a large casual labour force can be laid off. The net effect is that the masonry assemblage is well-placed to respond to short and long-term fluctuations in demand for new housing, which makes it difficult for other types of housing construction, such as prefabrication, to compete. The prefabrication market in contrast is an assembly of trained staff working in factories who are paid even if construction ceases. Further, a new prefabrication factory costs up to thirteen million pounds to build (Mornement, 2002): that is, it is a substantial long-term commitment for a housing producer. Crucially, once the investment is made, housing producers are committed to producing a minimum number of prefabricated dwellings each year, in order to cover costs, since the majority of factory overhead costs, for example electricity and rent, are fixed regardless of output.

Notable struggles have also taken place between masonry and prefabrication assemblages with respect to mortgage lending and the durability of homes. Masonry homes have a proven life-time of hundreds of years, and housing institutions and legislation have co-evolved with this technical characteristic. But other housing construction methods, including prefabrication, have much shorter design lives, typically in the order of sixty years. The UK housing sector is not set up to respond to these different building materials and technologies and thus, for example, a leading mortgage lender will not lend money on a third of what it defines as 'non-standard

building systems', essentially prefabricated dwellings (The Housing Forum, 2001). The Operations Manager at a steel frame prefabricated company describes what he feels to be the prejudice of mortgage lenders against prefabrication, as follows:

"The debates we've had with lenders are quite intriguing … their logic was that they were happy if I bought all the [housing] components and bolted them up on site. Then there wouldn't be an issue at all. But because I bolt them up in the factory, and deliver them on a lorry, there was an issue. Which is crazy, it doesn't make any sense whatsoever…

Interviewer: Do you feel disadvantaged because you are using different methods?

We are disadvantaged, but I can understand why because its new, and they are very very conservative people…I don't suppose they'll be happy until some of these buildings have been up a hundred years!"

(Interview, Operations Manager at a steel-frame prefabricated company, November 2003).

These comments demonstrate the interconnectedness of technical, material and social aspects of masonry and prefabrication assemblages, and also highlight the difficulties of effecting change in a sector such as housing construction where one method of construction enjoys a position of dominance, or lock-in, precisely due to its entanglements with the wider world. We see the technical, cultural and institutional bias towards the masonry assemblage in other arenas too. Negative consumer opinion about prefabricated homes stems in part from an historical link between prefabrication and social housing in the UK: as noted, it is in the social housing sector that prefabrication has typically been used, and there have been a number of highly

publicised problems with prefabricated social housing in the past, such as the Ronan Point tower block collapse in the late 1960s (Ross, 2002).

When combined with wide-ranging institutional support for masonry housing it is hard for the prefabrication assemblage to gain any ground as it jostles for position in the field of force comprising the system of housing construction. In effect, the institutions set up to support housing construction in the UK revolve around masonry products and techniques: planners, insurers, contractors, surveyors, and mortgage lenders all act in ways which create masonry lock-in. Table Three summarises the ways in which these actors have favoured the masonry assemblage over prefabrication. The situation exemplifies the complexity of creating change in a sector where one assemblage is locked-in, because opportunities for change hinge on the actions, beliefs and preferences of multiple organisations and things.

The varied social and institutional aspects of the masonry assemblage have combined to create a distinct culture in UK housing construction, which acts in often subtle ways to exclude other types of market or assemblage, as one interviewee explained:

"It's a question of looking at [prefabrication] as a philosophy. Traditional [masonry] builders will continue to build on-site in traditional ways using traditional materials… I think there are many people in the building industry who are a bit long in the tooth. And they are the ones who are saying well this is the way we've always done it, so why should we change – it will reduce our profits."
(Interview, Director of a steel frame prefabricated company, October 2003).

The interviewee's comments illustrate the jostling between the two assemblages at multiple levels: cultural, institutional as well as economic. We suggest that Bourdieu's close description of activities within a specific 'field of force' casts light on this encounter of masonry and prefabrication markets. Indeed, Bourdieu (2005) himself uses this approach to help explain why the latter do less well. Although his analysis appears to hinge on a rather old idea of competition between firms, it does help him explain, for example, how the adoption of a new technique can alter the position of particular organisations, individuals or modes of construction in the field and hence change the shape of the field itself. Bourdieu's account is perhaps most helpful in conceptualising incremental change; how firms come and go as their fortunes wax and wane through a process of jostling. There is no sense of how this might lead to the more structural shifts in the wider economy of housing construction that prefabrication might demand or enact. For this we return to Callon.

Agencement in housing construction markets

Recognising the agency within markets is also a way of recognising the capacity for change, and this is apparent in Callon and Muniesa's (2003) account of the asymmetries of power between possibly-competing market assemblages. Perhaps in an attempt to pinpoint the mechanisms required to effect change in market, Callon (2006), has developed these ideas to propose a concept – *agencement* – which collects together the forces for, and factors in, market dynamics. Our evidence on how and why housing construction markets change (or remain the same) both draws from, and helps enlarge, this idea.

Callon borrows the label '*agencement*' from Delueze and Guattari (2004), using it to refer to arrangements of people, things, materials, and their meanings and engagements, all of which, collectively, and as a matter of necessity and routine, have the capacity to act. It is tempting to think of *agencement* as a descriptive noun: another word for the arrangement of people and things into 'assemblages' or networks for example. There is an extent to which this is implied in Callon's own use of the word: it appeals to him partly because 'it conveys the idea of a combination of heterogeneous elements that have been carefully adjusted to one another' (Callon, 2007: 319). Like the term 'assemblage' (at least in its common usages) this use of *agencement* also implies – and perhaps makes more explicit than before – the salience of agency. As Callon (2007) goes on to say, *agencements* are arrangements whose capacity to act depends on their configuration, and this gesture towards the *animation* of assemblages is probably why the term is used by Muniesa, Millo and Callon. (2007) when they talk about market devices as *agencements* and by Hardie and Mackenzie (2007) when they refer to the *agencement* (the technical as well as social arrangements and interconnections that constitute and make possible the economic actancy) of a hedge fund.

In contrast, when Munro and Smith (2008) talk about *agencement* in housing markets, they refer to the subjects, objects and practices implicated in the actualisation and animation (or not) of the entire system; i.e. of the entire collection of assemblages and devices that engage with the dynamics of housing, or housing construction, markets. This is more consistent with the third point Callon makes in his discussion of *agencement* when he says 'there is nothing left outside'; there is, he says 'no need of further explanation' (2007: 337). This implies that to understand *agencement* is to

understand the entirety of a market: its varied assemblages, its many fields of force, everything that gives life to, for example, the production of housing.

Building on the subtle distinction between *agencement* as a common noun, versus its use as an abstract noun, we have found it useful to think of *agencement* not (as it has become in common usage) as a term that is more or less interchangeable with assemblage, but rather as a *property* of the economy, or a quality in markets. Like MacKenzie we favour *agencement* "because the term's usual English rendering as 'assemblage'… has somewhat too passive a connotation." (MacKenzie, 2008: 21). Perhaps in contrast to MacKenzie, however, we use the term *agencement* not as an alternative (semantically more correct) word for 'assemblage', but as a notion that is conceptually different. The distinction is useful and important. *Agencement* captures a sense of how whole systems (of housing construction) change, either incrementally through a process of ongoing 'jostling', or more radically as completely different modes of construction (for example) are forced together. It is an apposite way to account for why the dominant mode of housing construction – the socio-technical system that comprises the market for masonry building – is enacted, re-formatted and made to prevail; it is in that sense already a useful way of re-casting the discussion. However, it is a particularly salient idea when considering whether and to what extent an alternative mode of operation, such as prefabrication, can be brought into effect. This important distinction between assemblage (as description of what markets are, or consist of in particular places and times) and *agencement* (as an active property or quality of markets – the quality by which they change, or remain the same) focuses our attention towards masonry lock-in as an active process. There are parallels here with Graham and Marvin's (2001: 182) conceptualisation of infrastructure systems:

"Instead of being static material artefacts to be relied on without much thought, [infrastructure systems] are, in effect, processes that have to be worked towards... they are, in short, precarious achievements."

Although Graham and Marvin's comments are directed at analysis of change in infrastructure systems (energy, telecommunications etc.) they are ideas that can nevertheless usefully be applied to markets. It reminds us that *agencements* are made up of a continual jostling not just within, but also between, between assemblages; and this jostling is a messy, unpredictable process. In the case of UK housing construction, the outcome of the jostling between masonry and prefabrication has been notable for the extent to which, despite significant differences in masonry and prefabrication assemblages, the initial adoption of prefabrication by UK housing producers has resulted in a hybrid strategy blurring the boundaries of the two assemblages. In other words, housing producers have used prefabrication in conjunction with masonry. The House Builders Federation survey revealed that 71% of housebuilders are typically mixing prefabrication with masonry construction methods (see Table Four). What is curious is that they have created this hybrid with minimal adjustment to the process of construction. As a result, the survey indicates that 64% of private sector housebuilders constructing prefabricated dwellings purchase their components from an external manufacturer via short-term contracts of less than two years; we identified only one company with their own prefabrication factory (see Table Four).

Using contractors to supply prefabricated dwellings is perhaps an understandable reaction to the uncertainty of adopting a new technology (an attempt to reduce risk) but some problems have resulted. For instance, many of the prefabrication manufacturers in the UK from whom housebuilders are purchasing are not housing specialists. Rather, their experience is in commercial buildings, including hotels, restaurant chains, and office buildings (Yorkon, 2004). Interviews highlighted how insufficient consideration has been given by these manufacturers to adapting their construction methods to the residential sector. For example, issues such as poor acoustic performance within steel frame buildings have been given little attention. Whilst noise transference is generally not important within offices, it certainly is for high density residential flats, because noisy neighbours can create significant disturbance (Harris, 2004; Jones, 2003). More critically, in some instances manufacturers have claimed their prefabrication technologies have independent buildings accreditation, which is important in gaining a mortgage. However, on closer examination housebuilders purchasing their products have discovered that the accreditation relates only to commercial prefabricated buildings, and not to housing (Harris, 2004).

The hybrid outcome of the jostling between masonry and prefabrication also runs into difficulties in relation to other technical construction issues. Because masonry homes are craft-based (i.e. individuals build the houses with inevitable minor discrepancies), it is difficult to mix masonry construction with other more precisely engineered, high-technology construction methods, such as prefabrication. The operations manager at a leading prefabricated steel-frame manufacturer explains as follows:

> "the problems are [at] the interfaces between the different work packages… our [steel prefabricated] construction is very accurate, and we deliver to site with fixed dimensions… with traditional masonry construction… people actually stand on site and say let's do this, or let's do that."
> (Interview, Operations Manager at a steel-frame prefabricated company, November 2003).

It might be thought that hybrid housing construction markets would be a step on the path to greater diversity in housing production, creating a space for prefabrication to co-exist with traditional methods (and perhaps success then in some settings). However, the hybrid formula is in practice a variant of traditional masonry methods and is generally less satisfactory than the original (Lovell, 2005; Ross, 2002). The fact that there is little risk of systemic technical failure is, for example, a positive feature of masonry heavily promoted by those with interests in this type of construction. Although individual masonry homes may have so-called 'snagging' problems post-occupancy, because they are all built individually, these types of problems are not going to manifest in all homes. In this respect masonry differs significantly from prefabrication, where house parts are built on a construction line using the same technology. With prefabrication it is likely that if a defect found, then it will be common to all dwellings built using that particular technology. This so-called 'systemic failure' has occurred with prefabricated housing in the past, and negative consumer and industry attitudes about prefabricated housing – based on this historical experience - are a continuing influence. For example, the Housing Forum, a government-sponsored organization encouraging innovation in the UK housing sector, concludes in a report on the potential for prefabrication in the UK:

"Talking with various stakeholders in the industry has revealed much scepticism about offsite [prefabrication] manufacture, *mainly because of previous experience with system or 'non-traditional' housing*. Failures in these historic systems have made many - in particular surveyors and lenders - cautious about embracing the new generation of systems."
(The Housing Forum 2001: 17, emphasis added).

Indeed, as discussed, because of the risk of systemic failure UK mortgage lenders have been reluctant to lend money on contemporary prefabricated homes, and this has had significant repercussions for the viability of prefabrication. This issue demonstrates the ability of assemblages to remain stable over time – in effect historical social and institutional issues have been carried forward with the prefabrication technology even as, as proponents of 'modern' prefabrication would claim, concerns about systemic failure are now unfounded.

Another revealing hybrid strategy adopted by UK housebuilders to counteract the negative public associations between prefabrication and poor quality low-income housing has been to build prefabricated dwellings with a brick outer layer so they resemble masonry-built homes (Brinkley, 2001; Edge, 2002; Smit, 2002). The House Builders Federation survey revealed that eighty-one percent of the companies constructing prefabricated dwellings have designed them in traditional masonry styles. One housebuilder explained their reasons for doing so as follows:

“One of the main problems we perceive in the marketplace is perception of modular or offsite manufacture. People still think back to little boxes of the 1960s. We are really trying to make a statement in the marketplace that it can really look like whatever you want it to. What that means is that we have developed a module that requires [masonry] cladding on the outside.”
(Interview, Operations Manager at steel-frame prefabrication company, November 2003).

Similarly, in discussing a new social housing prefabricated development it is observed by an industry journalist that:

> "When the initial prototype [prefabricated] houses were unveiled…they came in for some criticism for the ordinariness of their design and their resemblance to a housebuilders standard house type. That is now part of the appeal for the occupants. ‘People look at them and think they are private houses', says [a local resident] ‘from the outside you wouldn't believe it's a modular [prefabricated] house.’"
> (Smit, 2002: 12).

In this use of masonry cladding we see an attempt by prefabrication housing producers to respond to masonry lock-in by a strategy of alignment rather than distinction. In other words, prefabricated homes are being built which closely resemble those produced by masonry methods, whereas an alternative strategy would be to use the technological capabilities of prefabricated homes to build dwellings with a very different appearance, and, whilst this approach has been taken in some

prefabricated housing developments (see Greenwich Millennium Village, 2003; Hyde Housing Association, 2004) it is not the industry norm.

More could be said about the jostling of assemblages in the agencement of the economy of housing construction. However, two things are already clear from this brief overview of the social, technical and institutional melée that constitute such markets. First, the financial bottom line is a powerful tool, which dominates key debates in a way which itself testifies to how masonry as a market assemblage retains the balance of power. Second, however, the lock-in to masonry build is sealed by much more than a calculation debate. Even if masonry's claim to cost-effectiveness were unsettled through (say) incentives or other cost-adjusting innovations, the sociality, technicality and institutionalization of the market for housing construction is a powerful force which – in this case – makes for limited innovation in the *agencement* of the system as a whole.

The governance of markets and the role of the state

Having illustrated how the masonry construction market maintains its position of 'lock-in' through activity rather than inertia, in this final section of the paper we consider more explicitly what human agency can do within this. The 'performative' turn that underpins the conceptualisation of markets we are working with recognises that if the economy has to be made, then it could potentially be made differently (Callon, 2006; MacKenzie, 2006; Smith, Munro and Christie, 2006). Here, therefore, we consider the politics and policies which enact or hinder change, showing what the UK government has done to encourage prefabrication and assessing its likely success.

One major reason behind the current government's interest in promoting prefabricated housing is a growth in the number of households in the UK: the demand for affordable housing exceeds supply. The number of households is predicted to rise by 3 million by 2016, on average 230,000 per year, driven primarily by changing lifestyles as more people live on their own. The Treasury's Barker Review of Housing Supply warned of the consequences of poor housing supply in the UK, including fluctuations in the economy and affordability problems (Barker, 2004). The reasons for persistent under-supply of new housing are complex, but some commentators believe that greater use of prefabrication could help rectify the problem, for example because prefabrication can increase the speed of house building, reducing the time spent on the construction site by approximately half (Bingham, 2003; The Housing Forum, 2001). Other reasons for government interest in encouraging prefabrication as an alternative to masonry construction include: prefabricated dwellings typically have fewer defects, there may be fewer workplace accidents and less impact on local residents during construction, and the dwellings are typically more energy efficient, involve less transport of materials, and produce less waste (Gorgolewski, Milner and Ross, 2001; National Audit Office, 2005; Taylor, 2003; The Housing Forum, 2001). There is also some evidence to suggest that the government has an interest in prefabrication as a way of changing the culture of UK housebuilding. Housebuilders are typically perceived of as slow to innovate and often delivering a poor quality product (DTI, ODPM and DEFRA, 2003; Hetherington, 2002; ODPM, 2003a). The government for example has described prefabrication as vital in "… *achieving a step change* in the construction industry to produce the quantity and also the quality of housing we need." (ODPM, 2003a: 10, emphasis added).

Among the sociologists of the market, Bourdieu (2005) is the one who – using housing construction – makes the most concerted and specific reference to the role of politics and the state, as he explains: "the economic field is, more than any other, inhabited by the state which contributes at every moment to its existence and persistence and also to the structure of the relations of force that characterise it' (2005: 12). Thinking about market *agencements* as a process – an active changeable property or quality of markets - rather than a description of them (an assemblage), has important implications for considering the role of the state in markets. Viewing the economy as performative highlights how markets are potentially open to change – including that effected (deliberately or inadvertently, and with unintended as well as intended consequences) through government intervention. Markets are not immutable, and there is hence the possibility of government constructing and reworking almost any element of how they operate. More problematically, however, it raises questions about precisely how to enact different markets. There is a requirement here for a state wishing to effect change to conceive of markets and intervene in them using more subtle approaches than those typically employed by policy makers. For instance, the introduction of the 2004 social housing policy requiring a quarter of new publicly-funded social housing to adopt prefabrication in England and Wales has in retrospect been rather a blunt tool to encourage uptake in light of the lock-in of masonry construction discussed here. Prefabrication is so effectively 'locked out' that what seems like a concerted attempt to intervene by government appears to have failed (Building, 2002; Mornement, 2002; Weaver, 2003). There is evidence, moreover, of a hands-off approach by government in its implementation of the target, illustrated by comments from the senior manager at the

Housing Corporation responsible for the government's prefabrication target who commented:

> "…at the end of the day, all the government can do is provide the right circumstances for it [prefabrication] to blossom. And it will either blossom, or it won't."
> (Interview, Head of Procurement, The Housing Corporation, October 2003).

But a second approach adopted by the UK government to help promote prefabrication – implemented in conjunction with the 25% social housing target - suggests more positively that government does have an appreciation of the cultural aspects of markets. This is the attempt to change the discourse about factory-based housing technologies: there has been a government-driven effort to avoid use of the term 'prefabrication' and refer to factory-based construction instead as 'modern methods of construction', largely in an effort to dissociate contemporary factory-produced housing from its historical technical problems. For example, an industry interviewee explains the government's desire to change the terminology of factory-based housing as follows:

"… there is too much stigma attached to prefab… or anything with the word system building. The stigma of the 1960s is still very strong."
(Interview, Director of a prefabrication construction institute, November 2003);

and a statement by the government-sponsored organisation, the Housing Forum, who has been promoting prefabrication also clearly illustrates the importance of discourse:

"Prefabrication, at least as far as housebuilding in this country is concerned, is a term that implies criticism, because of its connections with temporary housing in the past. *It is in the interests of the building industry to avoid using the term 'prefabrication'*" (The Housing Forum, 2001: 53, emphasis added).

Since the late 1990s, therefore, various new terms for factory-based housing have been promoted by government, in conjunction with a number of housebuilders and manufacturing companies, with 'modern methods of construction' as the latest incarnation (see Figure One). The discursive strategy has involved stressing the high quality construction of modern prefabricated dwellings, as an (implicit) contrast to historical prefabricated housing, as well as to contemporary masonry methods (Gorgolewski, Milner and Ross, 2001; Hansard, 2003; ODPM, 2003a; The Housing Forum, 2001).

The government's approach of trying to change the discourse of prefabrication may be well-founded, recognising as it does that cultural and institutional issues are hampering uptake of prefabrication, and understanding that these often complex factors have a profound influence on the economics of prefabrication. But arguably this is the tip of the iceberg. Government intervention is unlikely to succeed without tackling the more fundamental (and even less obviously political) aspects of market framing, for instance the politics of calculation, that is determining what is inside and outside of project accounts. There is also a need to recognise the sociality and materiality – the complexity and interconnectedness – of markets; how costs, prices

and values are constituted through a hybrid combination of economics, social, political, cultural, technical and institutional factors.

Summary and conclusions

In this paper we have, by way of one empirical example, offered an account of how markets change and why – sometimes – they do not. Combining theoretical inspiration from recent work on the cultural economy and material sociology of markets, with empirical research on innovation in the home building industry, the analysis confronts a paradox in UK housing construction, namely its 'lock-in' to masonry methods. The market for masonry housing construction is a socio-technical assemblage which endures, despite recognised shortcomings and notwithstanding a political steer towards other construction techniques with apparent technical and economic advantages. To explain this, the three sections of the paper weigh up the forces for inertia against the impulse for change in UK housing construction.

First, we described the assemblage of two kinds of market for housing construction: craft-based masonry methods, and factory-based prefabrication. We argued that these market assemblages may, following Callon and Muniesa (2003; 2005), usefully be conceptualised as collective calculating devices, whose economic content – whose workings as markets – has to be actively made. In the case of housing construction markets, the resulting calculation debate is key to the differentiation of the two styles of market. We suggest that in this very visible debate the case for and against innovation hinges on financial costs and benefits. Although the balance is by no means clear cut, the tendency to frame the encounter between two styles of market as a struggle for economy is one whose tone and terms favours masonry methods.

Second, however, we turned more explicitly to the question of how systems of housing production change, or do not, when faced with innovation. Two sets of ideas proved helpful here. First, Bourdieu's conception of firms jostling within a 'field of force' offers a way of understanding how one assemblage (e.g. prefabrication) might incrementally displace another (e.g. masonry methods). Second, Callon's notion of *agencement* provides a framework with which to account for what happens when markets collide. Although there is a tendency in the wider literature to use the term *agencement* interchangeably with 'assemblage', we regard it rather distinctly as a way of understanding how whole (housing) economies (and the market assemblages comprising them) do or do not change. Using this framework we were able to identify forces for change in the technical, material and cultural economy; but equally we showed that these are the arenas in which the effort to keep things the same is most firmly rooted. So this part of the analysis not only illustrates how inertia is achieved, but also highlights the sheer effort required to keep things the same. UK housing construction markets may appear to be in steady state; but such inertia is an active process by which the masonry assemblage invests a great deal of power and resources in resisting change and maintaining its dominance.

Callon's notion of an agencement is helpful in understanding the multiple components that constitute whole market systems; but its usage to date has been less helpful in conceptualizing the way markets change over time, with or without the impulse of policy and politics. We find in Callon's work only the beginnings of an explanation of why masonry lock-in has not been loosened; indeed, as noted Callon sees lock-in as a largely positive feature of markets – the endpoint of a process of 'becoming

economic' rather than a position in the midst of struggle and change. There is an obvious tension here in the role of lock-in within markets, for although there is a need to have some degree of order and stability in markets so that they are workable and understandable to market actors (Callon's approach), this then becomes problematic for governments and others trying to effect innovation and change (the socio-technical regime approach). We suggest this tension over lock-in is really at the heart of the notion of *agencement*: whereas assemblage is focused on the internal constitution of markets – their structures, framings and the mapping of relations - *agencement* is a more dynamic and outward-looking concept which concentrates on the processes, agency and mutability of markets.

Finally, we turned to the politics of markets, acknowledging that if markets have to be made – instituted, practiced and performed – then this could itself be an active process. The analysis however shows that one reason that politicians have hitherto favoured prefabrication to rather little avail is that interventions have been based on a partial understanding of how markets change. A firmer conceptual distinction between the terms assemblage and *agencement* might make for new insight into the complexity of how markets work. And this, without offering policy makers the key to a 'quick fix', may at least provide governments with a sense of the size and subtlety of the challenge they seek to address.

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