Social Influence and Household Decision-Making: A Behavioural Analysis of Household Demand

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SOCIAL INFLUENCE AND HOUSEHOLD DECISION-MAKING: A BEHAVIOURAL ANALYSIS OF HOUSING DEMAND[1]

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Abstract

Housing markets are subject to many interrelated sources of instability on both a microeconomic and macroeconomic scale. Housing decisions of different individuals will be interdependent, generating non-linearities, discontinuities and feedback effects. This paper focuses in on some behavioural factors that contribute to complexity in housing demand. In particular, the impact of herding and social influence is captured using a model incorporating the impact of social information on willingness to pay. This model is tested in an experimental context and this experimental evidence confirms first, that social information has a statistically significant impact and, second, this impact is determined by a person's individual characteristics including gender and personality traits.

Key words: Housing markets, herding, social influence, behavioural economics
JEL codes: D70, D83, D85, R21

1.   Introduction

In a perfectly competitive world populated by homogenous and rational agents, housing decisions will be determined by objective factors and housing market instability will be propelled only by exogenous shocks. In such a setting, principles of certainty equivalence apply and house-buyers respond to the objective factors affecting their housing investment / consumption decisions in a methodical and independent atomistic way, discounting the benefits of future housing consumption relative to current housing investment and consumption. Given the expected future consumption stream allowed by current ownership of housing, house buyers will use

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owner occupation as a hedge again rent rises and the consumption component of housing decisions will be a function of the discounted stream of imputed rents, affected by expectations of capital gains and losses in housing assets and interactions between the discount rate and the real interest rate. Models assuming these types of relationships have been analysed empirically, e.g. by Meen (2002), Pain and Westaway (1997) and Sinai and Souleles 2005. These analyses abstract from many of the factors that contribute to the inherently unstable characteristics of housing markets.

Some sources of complexity are implicit in the housing assets themselves and, to some extent, can be embedded into the perfect world model outlined above. Houses are heterogenous reflecting a mixture of old and new properties, some renovated some not. Housing assets are lumpy and neither divisible nor fungible. Inelastic supply will amplify the impact on house prices of shifts in demand. Transactions costs add to complexity too - the fact that buyers face large and lumpy transactions costs e.g. legal fees, survey / property search costs, property taxes and credit searches generates threshold effects, contributing to housing market instability, particularly if owner occupiers economise on transactions costs by limiting the frequency of housing transactions. Housing activity will take place in bursts when conditions are favourable in terms of house prices, taxes and other transactions costs and/or fiscal incentives. This all means that housing decisions cannot be captured as a smooth, continuous function of the rates of return on housing even if perfect rationality is assumed.

In addition, uncertainty plays a particular role in adding to the complexity surrounding housing decisions in the real world. In a Minskian world of financial fragility, financing constraints, speculative forces and institutional changes will generate destabilizing and volatile patterns in housing demand (Earl *et al.* 2007, Baddeley 2005*b*, Minsky 1978). Buyers and sellers will have incentives to wait for more information about the state of the market before deciding to buy housing assets. Option theories of investment focus on the fact that uncertainty affects not only the volume but also the timing of investment decisions, as captured in options theories of investment (see Pindyck 1993, Dixit and Pindyck 1994) and the same principles may operate for housing purchases. In times of instability, first time buyers will have raised incentives to 'wait-and-see' before making a decision exacerbating the

jumpiness and discontinuity in housing decisions. It will also lead to a faltering of housing demand during times of uncertainty. The asset market effects of general uncertainty may be compounded by asymmetric information, agency problems and risk shifting behaviours (Allen and Gale, 2000). Buyers and sellers have limited information about the real intentions of transacting parties; the probabilities of reneging and gazumping (particularly at peaks and troughs of the housing cycle) increase the riskiness of housing decisions. These risks, for both buyer and seller, are particularly high in England and Wales because there may be a long lag between decisions to buy/sell a house and the signing of a legally binding agreement. Instability may reflect interactions between gearing and interest rates (Muellbauer and Murphy 1997) Further limits emerge because sellers and mortgage lenders have limited information about the financial background of potential buyers / borrowers. Overall, overcoming information asymmetries is costly and increases the transactions costs involved in the buying and selling of houses, again contributing to instability.

Whilst all these sources of instability and uncertainty are crucial (for a fuller discussion see Baddeley 2005*a*, 2005*b*), this paper is a behavioural analysis of housing markets and so focuses on the microeconomic factors that incubate instability in a world of bounded rationality. Housing decisions will be made in different ways in different contexts (e.g. see Gayer *et al.* 2007 on rule-based versus case-based housing decisions). Impacts of uncertainty and instability will be magnified in a world in which decisions are made, not atomistically, but regarding the decisions of others and so housing market trends will be affected by herding and social influence. A behavioural housing model is constructed which allows that the housing decisions of owner occupiers are the outcome of interactions between objective analysis and subjective behavioural factors. Specifically, the influence of others will have an impact reflecting an objective process of social learning and/or the more subjective influence of social pressure, and the relative importance of these will be affected by individuals' predispositions and susceptibilities which in turn will be determined by individual differences.

In exploring these themes, some of the behavioural factors affecting housing demand are explored in section 2. In section 3, a behavioural model of housing

demand is constructed which incorporates the actions of others into the household's information set. To capture the relative impact of objective versus subjective factors, results from a laboratory experiment are analysed econometrically to show the extent to which individuals are affected by the housing decisions of others. Susceptibility to social influence is conditioned on data about individual differences, including age, gender, cognitive ability and psychological traits. Conclusions and policy implications are outlined in section 5.

2. Behavioural Factors and Endogenous Complexity

As noted above, instability in housing demand may have its origins in a number of objective and/or exogenous sources. Sources of instability, such as frenzy effects, may arise from the boundedly rational decisions of atomistic representative agents in response to incomplete or asymmetric information and/or transactions costs. Additional sources of complexity may emerge from the endogenous or behavioural instability that emerges because it is not possible to operate as an atomistic agent in real-world housing markets, particularly when uncertainty and/or cognitive constraints limit strictly rational behaviour and subjective factors endogenously generate instability.

2.1   Rational Herding and Informational Influence

Herding is a form of behavioural complexity that can be used as an explanation for instability in housing markets. There is a range of experimental evidence confirming that people are affected by decisions of others (e.g. Anderson and Holt 1996, 1997; Baddeley *et al.* 2007, 2010; Alevy *et al.* 2007 - amongst others) and, following Sornette who makes a distinction between objective and interpretative social decision-making (Sornette 2003, p. 91), the two broad categories of explanation can be separated into (Bayes) rational and non-rational herding motivators.

The term 'herding' is often used as a broadly descriptive term that captures the phenomenon of people's tendency to follow others, but in understanding herding, it is important not only to describe the phenomenon but also to explain how it emerges. Herding may have rational origins, stemming from social learning for example or, alternatively, may arise from subjective, heterogeneous and/or idiosyncratic social behaviour. Following Keynes (1930, 1936, 1937) herding emerges from three not

unrelated sets of motivators: social learning, reputation and 'beauty contests' (iterative thinking). In a world of uncertainty, we follow others because others may be better informed; because it is better for reputation to be conventionally wrong, along with the rest of a crowd, than unconventionally right and/or because of payoff externalities / strategic complementarities - for example in financial markets, profits are expected from following a group's decision when the group is driving prices upwards e.g. as seen in speculative bubbles. This generates beauty contests and iterative thinking: with decisions focussed on forecasting average opinion of average opinion than from judging the long-term fundamental value of assets.

Empirically, it is difficult to distinguish between independent behaviours that are correlated by coincidence versus deliberate decisions to copy others and Devenow and Welch (1996) define herding as systematically erroneous decision-making by groups; they emphasise that herding requires a coordination mechanism, e.g. a rule to trigger herding based on some signal or by observing others. Scharfstein and Stein (1990) abstract from issues of optimality by defining herding more broadly - as occurring when individuals go against substantive private information in imitating others. Avery and Zemsky (1998) similarly define herding 'herd behavior as a trade by an informed agent which follows the trend in past trades even though that trend is counter to his initial information about the asset value', so herding is any history-induced switch of individual opinion (behavior) in the direction of a crowd: This can occur sequentially or simultaneously though most of the rational choice analysis focuses on herding as the outcome of sequential decision-making.

In explaining the phenomena of herding, the explanations for rational herding focus on social learning, reputation effects and strategic complementarities.

Social learning

For social learning explanations, apart from the impact of uncertainty on the objective facets of decision-making - in a world of uncertainty, judgments about future benefits and costs of housing will be probabilistic and/or ordinal rather than an absolute and precise. A world of uncertainty generates "a society of individuals each of whom is endeavouring to copy the others [because] knowing that our own individual judgement is worthless, we endeavour to fall back on the judgement of the rest of the

world which is perhaps better informed" (Keynes, 1937, p. 214). There is evidence that animals use social information in monitoring the actions of other individuals to provide information about resource availability and mating potential (Danchin *et al* 2004). This idea can be extended to a social learning model of humans looking to others when seeking housing resources.

Models of Bayes rational herding assert that decisions are nonetheless made in an objective and systematic way using Bayes's rule. Bayes rational herding involves a systematic process and can be justified as rational if the actions of others can be incorporated into individual's utility functions and/or information sets. Models of herding as a Bayes rational process of learning from the actions of others are developed by Chamley (2007), Banerjee (1992) and Bikhchandandi, Hirschleifer and Welch (1992, 1998), who describe herding as a social learning device by which the actions of others is valuable information in a world of imperfect information. Scharfstein and Stein (1990) develop similar models of Bayes rational herding - but as a response to reputational motivations rather than learning - following Keynes's insight that 'worldly wisdom teaches that it is better for reputation to fail conventionally than to succeed unconventionally' (Keynes, 1936, p. 158). Scharfstein and Stein (1990)

Generally, Bayesian herding theories focus on rational learning as a sequential and convergent process but herding nonetheless engenders convergence onto equilibria in which herding externalities are created; what is privately rational does not necessarily generate the best social solution for efficient use of information. If in a sequential herding scenario, private information is ignored then the cascade ceases to be informative. Learning from others' actions will stop and valuable private information will be lost. Once private information is ignored, the cascades may be unstable and may generate a range of 'pathological' outcomes.Smith and Sorensen (2000) for example present different types of outcomes in sequential decisions as counterfactuals to the convergence results from early models of Bikhchandani *et al.* (1992) and Banerjee (1992) which show that herding externalities can also create a pooling equilibrium where important social information is ignored and people rely forever on private information – also a sub-optimal outcome.

However, Bayesian herding is not always sub-optimal. It is possible to reconcile these stronger assumptions about independent agents and market efficiency with the existence of herding, e.g. Park and Sabourian (2006) show that rational herding and informational efficiency are not inconsistent in the short-term given noisy conditions and expectations of extreme outcomes. But generally the existence of herding suggests that prices are diverging systematically and persistently from their fundamental values (as determined by exogenous, objective factors) and so by definition information is not being processed efficiently by markets. This can be explained by adopting a weaker view of rationality adopting the assumption that, in a world of uncertainty and bounded rationality, individuals' information sets will include the actions or beliefs of others. Thus social learning is not inconsistent with rational behaviour.

The insight from the Bayesian microeconomic literature about herding as a manifestation of learning can be linked to macroeconomic models of learning and signal extraction in response to outcomes of others' actions, e.g. Acemoglu (1993). Similarly in the macroeconomic literature, rational and non-rational herding are to an extent reconciled in Topol (1991) – who presents a general model of herding, which he describes as the outcome of mimetic contagion. He captures the impact of differing assumptions about rationality on mimetic contagion: with strong rationality, mimetic contagion disappears; with weak rationality, mimetic contagion dominates.

Experimental evidence is generally consistent with Bayesian learning models (e.g. see Anderson and Holt 1996, 1997) though without proper controls, this evidence does not preclude alternative explanations for the herding phenomenon. Some interesting insights from the experimental evidence include that herding may serve a social purpose in aggregating information; in Bayesian herding experiments a herd was right 30% of the time, which was greater than individuals' independent decision-making accuracy (Hung and Plott 2001). When rewards were allocated on the basis of the accuracy of group choices, the experimental subjects were less likely to discount individuals' private information suggesting that they recognize that collective decisions can be wise if they incorporate lots of information (Hung and Plott 2001, Surowiecki 2004). Gale and Kariv (2003) and Celen and Kariv (2004) develop the

experimental approach in analysing herding-as-learning behaviour within a continuous signal / discrete action framework, also incorporating a belief elicitation method into their experimental design, allowing them to separate general herding (general copying behaviour) from more specific reasons for herding i.e. information cascades from social learning. Their evidence supports the hypothesis that information cascades emerge as a Bayes rational learning process. This generates an informational source of social influence – others' actions provide information to guide decision-making in an uncertain world. This aspect of decision-making can be described as rational in the sense that it is objective and is unaffected by an individual psychological traits and/or susceptibility to social pressure.

Reputation and Status

Another aspect of social influence is normative influence – when an individual's decisions are affected by social norms and the individual's perception of attitudes and responses of others. Consumption of certain goods may enhance status and social standing (Veblen 1899). There is also a link with Keynes's insights about reputational herding: if you are wrong alongside others then reputation is untarnished. But unconventional choices are more risky; failure becomes more public and inescapable and mistakes seem less defensible if others didn't make them too. In a world in which reputation matters, it is better to be conventionally wrong than unconventionally right - 'wordly wisdom teaches us that it is better for reputation to fail conventionally than to succeed unconventionally (Keynes 1936, p. 158). Bernheim (1994) argues that approaches focusing on rational herding as social learning give only a limited explanation and neglect other important social influences. Social factors such as status and reputation can be embedded into individuals' preferences, and it is also rational to follow others if your social groups penalises deviations from accepted norms (see also Akerlof 1980, Jones 1984, Becker and Murphy 2000). Bikchandani *et al.* (1992) also outline other reasons for social conformity that might generate herding patterns, for example sanctions, positive payoff externalities, conformity preference and communication.

Strategic Complementarities and Payoff Externalities

Devenow and Welch (1996) emphasise the importance of positive payoff externalities, emerging not only as a function of social learning but also when returns accumulate at an increasing rate as the number of agents acting the same way increases and this approach links herding with the phenomena of bubbles. Housing markets are susceptible to bubbles and cycles of boom-bust, as are other asset markets (probably more so) They are also consistent with Bayesian reasoning processes (for experimental evidence on Bayesian reasoning in beauty contests see Duffy & Nagel 1997).

Payoff externalities are particularly important in financial markets where speculators are more interested in tracking short-term judgements about average opinions of average opinion because they rationally judge that this is a better way to make short-term profits than worrying about fundamental values based on the long-term prospects of assets. In highly liquid markets, speculators need not waste energy developing their private knowledge of the long-term fundamental value of assets if they are aiming to trade assets quickly. To make money out of speculation in fast moving markets, the information that is important is what other people are prepared to pay. So it makes sense to judge what the crowd is thinking in the very short-term and to follow it when you think that market valuations of assets are going to increase in value (even though you may privately think that they are over-priced). These influences may play a role in housing decisions though the impacts will be dampened by the fact that houses are not liquid assets and the transactions costs for owner occupiers are large.

2.2 **Non-rational herding and behavioural influences**

In a world of bounded rationality, imitation can be a useful rule of thumb. Intelligent imitation embeds stopping rules, for example Boyd and Richerson (2001, 2002) assert that social learning with cultural transmission allows sensible norms to spread, including norms that resolve self-control problems and time inconsistency and use computer simulation to illustrate the social benefits from imitation. If social motivations dictate decisions, then sources of instability may become endogenised with unstable decisions and actions spreading through a group magnifying negative

effects. Herding will have a particularly strong impact in the context of irrational behaviour: small amounts of individual irrationality can generate large aggregate effects under strategic complementarity though small amounts of rationality can generate large aggregate effects under strategic substitutability (Fehr and Tyran 2005). Camerer and Weigelt (1991) present experimental evidence that traders mistakenly infer information from uninformative trades, causing other traders to overreact and generating information 'mirages'.

Non-rational herding may emerge as the outcome of psychological motivations and limitations, for example because of social pressures and forces (Baddeley 2010). Festinger *et al* (1950) and Gibler and Nelson (2003) argue that social pressure has distinct impacts on real-estate and housing decisions (Gibler and Nelson 2003, p.71). There is evidence that people will follow the majority opinion in spite of their own individual and accurate judgments about a situation (Asch, 1952, 1958). This may reflect the influence of social conventions (Levine and Resnick 1993; Shiller 1995, 2000, 2003). Alternatively, herding may be the outcome of social pressure and therefore must be distinguished from the social learning models based on Bayes rational behaviour outlined above.

There is also evidence that socialised instincts to imitate are hard-wired into human responses. Whilst there is little research so far on applying these hypotheses specifically to housing market activity, this area of research has the potential to provide some powerful explanations about why and how people will buy houses / move when their neighbours buy and move.

There are parallels between the explanations for herding in economics and sociology; both focus on informational versus social (or normative) influence. Herding may occur when individuals either believe that others around them are more knowledgeable (informational influence) and/or are responsive to group pressure not because they believe that others are of higher competence but more because they worry about others' opinions of them (normative influence). To herd for the former reason would be rational and sensible; to herd for the latter reason may not be. Modern economic analysis tends to focus on the first in analysing the impact of Bayesian updating on rational learning, as discussed above. Social psychology tends

to focus on normative influences. But to what extent are these explanations mutually exclusive?

The rational choice models of social economics allow heterogeneity in preferences and in subjective probabilities, but not in motivators of decision-making. The emphasis in sociology is on context and situational factors rather than individual predispositions. Paralleling the distinction between reason and emotion, in the sociology literature, distinctions are made between informational influence (which broadly parallels the social learning theories from economics) versus normative influences on sociality and conformity, i.e. doing what you think others think you should do. People who are members of a group and identify with it behave differently from people who perceive themselves as isolated individuals. Charness *et al.* (2007) show that group membership affects preferences over outcomes, and saliency of the group affects the perception of the environment. They manipulate the saliency of group membership by letting a player's own group watch as a passive audience as decisions are made, and/or by making part of the payoff common for members of the group; this significantly changes behaviour.

Similarly Asch's (1952, 1958) experiments showed many people follow misleading opinions from others in the context of simple tasks in which individual judgments are contradicted by group judgments - see Bond and Smith (1996) for a meta-analysis of Asch experiments. In interpreting this finding, there is more than one possible explanation. Perhaps intra-group pressure generates social effects inducing an unwillingness to disagree with others amongst conformist individuals. Alternative explanations focus on group 'learning' – e.g. Deutsch and Gerard (1955) argue that evidence from Asch experiments are not inconsistent with Bayesian hypotheses about rational learning because people will respond to intra-group pressure even without face-to-face interactions, e.g. when the "influence" is coming from machines. Developing Asch's findings Shiller (1995) argues that conformity as a response to social pressure is just an extreme version of rational social learning: agreeing with the group may be the outcome of a rational comparison of the probabilities of different possibilities; in the circumstances, it was rational to infer that it is very unlikely that a large group of other people are all wrong about a simple decision; experimental

subjects were rationally discounting their personal perceptions when favouring group information signals (Shiller, 1995, p.182).

Sherif (1935, 1936) observed the evolution of social norms in perceptual tasks using an experiment on autokinesis – when subjects were exposed to a small, stationary light, their perceptions of the location of that light converged to a group norm, and subsequent individual judgements were anchored on that group norm. This experiment suggested that social norms were generated by situational as well as traditional factors (Turner 1990). These findings are paralleled in the economics literature with Knez and Camerer (1995) who found that individual offers made in ultimatum games were affected by offers made by others. These findings suggest that, in groups, individual judgements are anchored on collective judgments, but separating the elements of social influence into normative influence versus informational influences is not straightforward in such tasks. Milgram, Bickman and Berkowitz 's (1969) analysis of using copying behaviours can be explained in terms of rational learning – for example if experimental subjects look at the sky because others looking at the sky, may be a genuine attempt to acquire potentially useful information. Willingness to conform is a positive function of the size of a crowd and social proof – a reflection of informational influence - must be distinguished from conformity moulded by normative influence (Milgram *et al.* 1969).

The problems with sociological accounts mirror some of the limitations of economic analyses: sociology focuses on the importance of context and this is used to explain heterogeneity of choices. In its emphasis on informational influence, sociological approaches to social influence mirror the social learning models of economics and informational influence is still consistent with procedural rationality. Nonetheless, these ideas have relevance for housing decisions if home buyers are affected by the interaction between social norms and social pressure. In a social context, economic herding may operate via conversational conventions and constraints imposed by politeness (Shiller 1995, Levine and Resnick 1993, Goodwin and Heritage 1990, Brown and Levinson 1987). Failures of human judgement falling under the category of herding may be due to limitations on thought and memory in a context of the rules of, and constraints upon, polite conversation and these constraints impact on collective memories and stories e.g. about the value of assets and the

performance of financial decision-makers (Akerlof and Shiller, Cao and Hirshleifer 2001). This parallels the analyses of herding in the economic literature and this seemingly non-rational behaviour is justified as being the outcome of and/or because of social conventions (Levine and Resnick 1993; Shiller 1995, 2000).

2.3   Cognitive constraints

If home owner-occupiers' decisions are heterogeneous and/or socially motivated, then at a microeconomic level, herding and social influence will generate path dependency and instability, and this instability will be greater when decision-making is limited by cognitive bias. Sources of cognitive constraints on economic decisions are outlined in Kahneman and Tversky (1979), Tversky and Kahneman (1974, 1982, 1991), Shiller (2000, p. 136) and Baddeley, Curtis and Wood (2004). These can be applied to the housing market by focusing on two important sources of cognitive bias relevant to housing: the anchoring effect and the loss aversion effect. Anchoring occurs when beliefs are anchored to prior experiences; a homeowner will anchor their judgments of a house's value to press reports and anecdotal evidence.[3] From analyses of financial markets by Odean 1998 and Shefrin and Statman 1995, it follows that house buyers and sellers may similarly anchor expectations to prior peaks, meaning that they will be reluctant to realize their losses and/or will ride losers too long. Experimental evidence from Northcraft and Neale (1987) shows that house buyers will anchor their willingness to pay to list prices and will adjust their willingness to pay in response to changes in these list prices. This can be linked into the patterns of habit persistence.

Apart from the impacts of anchoring, cognitive constraints may introduce other sources of instability into housing decisions. Genesove and Mayer (2001) apply these ideas to analyse loss aversion in housing markets. They point out the anomalous positive correlations between house prices and sales volumes across many OECD housing markets, with the effects being particularly pronounced in local markets. They also note the volatility in prices and the persistence of large housing inventories. They argue that the explanation lies in loss aversion; people assess gains and losses relative to a reference point (another example of anchoring) and they worry more

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[3] Described for example by Kahneman, Ritov & Schkade (1999).

about losses than gains. Following Tversky and Kahneman (1991) they argue that the housing value function is non-linear being steeper for losses than gains, with the marginal value of gains and losses diminishing with the size of gains and with the size of the loss. Using data on the downtown Boston housing market 1990-7, they estimate reservation house prices as a function of potential loss and find that loss aversion has a statically significant impact on seller behaviour. They separate out the responses of owner-occupiers versus 'pure' investors and find that behaviour differs across these groups – with a larger loss response amongst owner-occupiers. Genesove and Mayer (2001) also describe evidence that liquidity constraints affect house prices and the time properties remain on the market unsold. The also note that the impact of liquidity seems to affect the pure investors more – with low equity having a larger impact on their asking prices.

3.   A Behavioural Model of Herding in Housing Decisions

In this section, the ideas about herding as outlined above are encapsulated within a model of housing decisions, bringing together the ideas from rational choice theory and social economics.[4] As discussed above, herding and social influence can emerge for a number of reasons: as a form of social learning, as a form of reputation building and /or to derive positive payoff externalities from holding stocks in a rising market. We illustrate these influences. In constructing the model, it is *not* assumed that decision-makers will have the information and ability to *maximise* their returns. Decision-making will reflect an interaction of objective reasoning processes and subjective factors. In this section, a model is constructed which balances these aspects, starting with a baseline model of housing demand which incorporates the essential aspects of housing decisions as analysed in the existing literature, but moving on to include the impacts of social influence - including informational influence and normative influence.

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[4] This model is simplified to the context of financial assets but similar principles could be applied to consumption goods, e.g. in the context of Veblen goods, in terms of expected utility rather than expected returns.

3.1 A baseline model

Housing has sometimes been analysed as an investment good but an essential feature of housing is that a large proportion of housing market transactions (excepting new builds) involve the trade of an existing asset. In common with share trading, nothing new is produced and so housing demand cannot be fully understood in terms of concepts such as the user cost of housing, because the analogy with fixed asset investment would require that housing assets are generated via some sort of production function. Furthermore, whilst housing transactions have some features in common with stocks and shares, unlike share purchases, utility is generated directly from the ownership of the asset. Also, the impact of capital appreciation from house price rises is distinct from the impact of rising share prices on share portfolio valuations. House price rises will often generate only *notional* capital appreciation i.e. additional "psychic" may emerge because the value of a house has risen with generally rising house prices (and this may by amplified by an endowment effect). Whilst owner occupiers often gain much satisfaction from house price appreciation, this is a notional value because a house is not a standard asset. It is not liquid and if it's sold, often another will have to be bought at similar prices.

Housing assets do nonetheless have some investment asset aspect and they also share some features with durable consumption goods, but for owner-occupiers specifically, houses are lumpy and indivisible; they are not fungible. This means that an analysis focussing on marginal concepts will be less appropriate. For this reason, in this analysis, houses are treated as a durable, lumpy consumption goods generating a stream of future real and psychic utility - including tangible sources of utility arising from the fact that housing is a durable consumption good with an hedonic element i.e. it provides comfortable shelter. The utility of these aspects is captured in net imputed rents, adjusting for the fact that owner-occupied housing has additional value as a hedge against future rent rises. There are also intangible sources of utility e.g. perceptions of future utility will be affected by expectations of house price appreciation.

In standard intertemporal models of consumption, assuming exponential discounting and consumption smoothing, the present value of future streams of utility over a lifetime is given by:

$$U(u_0, u_1, ..., u_T) = \sum_{t=1}^{T} \delta^{t-1} u_t \quad (1)$$

where the discount factor is given by $\delta = \dfrac{1}{1+\rho}$, and ρ is the discount rate reflecting impatience for current consumption.[5] Consumers maximise utility given their intertemporal budget constraint. Housing purchases by owner occupiers are more complex however, because they are affected by liquidity constraints and must be financed via a combination of savings (accumulated into the house purchase deposit) and mortgage finance given by:

$$p_{i,t} = D + F \quad (2)$$

Where D is their deposit and F is mortgage finance. This can be expressed as a function of past and current income, rather than expected future income, because in a real world of endemic uncertainty, especially in mortgage financing, liquidity constraints will bind effective willingness to pay. If an owner occupier buys a house in period t, they will finance their purchase using income saved for the deposit and mortgage finance available (with mortgage finance determined as a multiple of income). This will generate a liquidity constraint because in the real world, effective willingness to pay will be limited by current and past incomes, regardless of expected future income, so the effective willingness to pay of an owner occupier can be expressed as:

$$p_{i,t} = d\overline{Y}_i + f\overline{Y}_i = (d + f)\overline{Y}_i \quad (3)$$

Where $\overline{Y}$ is average past income for person i.

An additional complication reflects the fact that future utility streams from home ownership are paid for upfront, reflecting the fact that owner-occupied housing is essentially a durable consumption good, yielding a utility stream that is delivered

[5] As housing exhibits properties of lumpiness and therefore is not fungible, it is appropriate to analyse it in discrete rather than continuous time.

over a long time horizon. So the standard Euler condition does not apply; the interest paid reflects not only the opportunity cost of current consumption but also the opportunity cost of future consumption.

Home owners will assess the value to themselves of the flow of utility over the two periods. This will include not only the tangible and intangible aspects of utility (tangible aspects being the utility from shelter, reflecting also hedonic value of the housing; with intangible aspects including social value), but also the additional psychic income that a home-owner gets from knowing that their property is increasing in value. So house price appreciation becomes an element in the utility flow to give:

$$U(u_{i,t}, u_{i,t+1}) = u_{i,t} + \delta u_{i,t+1} + E(\Delta p_{t+1}) \quad (4)$$

Which, if willingness to pay in the current period – p_t is pre-determined and exogenous gives:

$$U(u_{i,t}, u_{i,t+1}) = u_{i,t} + \delta u_{i,t+1} + E(p_{t+1}) - p_{i,t} \qquad (5)$$

The essence of the problem can be captured by focussing on a two-period model to capture the two-period flows of opportunity cost and utility gain. With cost flows, owner occupiers will forgo interest on the savings used to pay for their deposit as well as the interest accrued on the capital sum borrowed from their mortgage lender. Assuming that the spread between these two interest rates is 0 and also assuming that the amount borrowed is repaid at the end of the 2 periods, the net opportunity cost to the owner occupier will be rp_t where r is the interest rate.

This utility stream will be balanced against the opportunity cost of purchase – rp_t to give:

$$rp_{i,t} = u_{i,t} + \delta u_{i,t+1} + E(p_{t+1}) - p_{i,t} \quad (6)$$

So:

$$p_{i,t} = \frac{1}{1+r}[u_{i,t} + \delta u_{i,t+1} + E(p_{t+1})] = (d+f)\overline{Y}_i \quad (7)$$

This equation indicates that willingness to pay for housing will be greater if interest rates are lower, if people are more patient (and therefore place relatively more focus

on future utility from home ownership over a long time period) and future house prices are expected to be higher. The usual Euler relation has been adapted to reflect the fact that the owner occupier is paying upfront for future utility streams.

Using this as a baseline model, we can incorporate the impact of social influence in two ways: informational influence (owner occupiers learn about the market value of their homes by observing prices paid by others) versus normative influence (higher prices paid by other owner occupiers will increase the social rewards accruing to the home-owner e.g. because reputation and/or status are increasing i.e. house prices raise the intangible aspects of the utility stream from owning houses).

3.2   Informational Influence: Expectations of house price appreciation

As discussed above, the impact of informational influence on economic decision-making has been captured in Bayesian herding models (e.g. see Banerjee 1992, Bikhchandani et al 1992, 1998) and social network theory (Goyal 2007). In the context of housing demand, informational influence will affect expectations of house price appreciation if owner occupiers look to others in deciding whether or not their house purchase will generated capital appreciation. In sequential herding models, as shown by Bikhchandani *et al*. (1992), as the number of individuals in a herd increases, there is an increasing probability that private information will be ignored: as number of individuals making a particular decision increases, the probability of a cascade approaches 1, and a cascade will form in which case all private information will be ignored (Bikhchandani *et al* 1992, p. 1001). In the speculative bubble case, as more and more buyers buy houses during a housing boom, weights on non-social information will diminish. This sort of extreme may have implications for the tail-end of speculative bubbles when the last person to join a herd bases his/her decisions entirely upon the decisions of number of buyers. But in more usual times, there will be a balancing of social information about the decisions of others against private signals.

In judging the fundamental value of a house, expected utility will reflect the balancing of private information and social information about long-run fundamental value and subjective influences. The fundamental value of a house is assumed to

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equal the stream of imputed rents but returns to owner occupation will also be increasing as house prices appreciate. Expectations of house price appreciation will have two components. Firstly there will be long-run returns derived from capital appreciation.

Secondly, there will be ephemeral but *notional* returns from house price fluctuations. In this the assumption of rational, forward looking agents is abandoned by incorporating an assumption that owner occupiers' satisfaction from their homes is increasing in the short-run if the value of their home is increasing, even if they get no objective, physical utility from the increase in its value. Notwithstanding the fact that house price appreciation just generates intangible *perceptions* of value rather than tangible value - given that when an owner occupier sells a house they usually just have to buy another one under the same market conditions, nonetheless, owner occupiers derive satisfaction when they know that the value of their housing assets is rising. In assessing the extent of this notional house price appreciation, and assuming that the owner-occupier has imperfect information about the value of housing assets, social learning will occur as they infer the value of houses from the information available to them, where their information set includes the prices paid for similar houses by others:

$$E(\Delta p_{t+1}) = E(p_{t+1} \mid \Omega_i] - p_{i,t} \quad (8)$$

Following Topol's (1991) analysis of asset markets, in which traders make decisions using a weighted function of private versus social information, in deciding the value of their home, each owner occupier will use an information set – Ω where Ω is the collection of social and non-social signals, each of which are weighted idiosyncratically, i.e. different individuals may place different weights on each piece of financial information depending upon their private judgement of its relevance. So we are not assuming that the signals themselves are private information but we are assuming that information about the weights applied will be privately determined. So overall an individual's private information set can be represented as follows:

$$\Omega_i = \sum_{q=1}^{Q} \lambda_{q,i} x_q \quad (9)$$

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where $0 < \lambda_{q,i} < 1$ and $\sum_{q}^{Q} \lambda_{q,i} = 1$.

This implies that the information available to each individual *i* is represented by a vector of signals – *x* each weighted by each weighted by $\lambda_{q,i}$. The information set will have two distinct components. Most (i.e. *Q-1*) pieces of information will be all currently available objective information relating to non-social factors. Following Bikhchandani, Hirshleifer and Welch (1992), the *Q*th component of the information set will be the social information about the willingness to pay of *other* owner occupiers – $p_{-i,t}$. So the information set for individuals from (3) can be decomposed as follows:

$$\Omega_i = \sum_{q=1}^{Q-1} \lambda_{q,i} x_q + \lambda_{Q,i} p_{-i,t} \quad (10)$$

With weakly efficient markets, and also assuming that all people respond symmetrically to non-social signals, assume that λ_q is a constant across all individuals, it is assumed that the non-social information can be factored into prices to give an unbiased estimate of future prices. When social information is ignored (i.e. when for all individuals $\lambda_{Q,i} = 0$), all non-social information will be quickly captured within the price - *p*, anomalies in different individuals' weighting decisions will even out and individual expectations and the market price will coincide at $E(\bar{p}_{t+1})$.

However, when $\lambda_{Q,i} \neq 0$, social information may distort expectations of future house prices. This develops insights from Banerjee (1992) and Bikhchandani *et al* (1992) amongst others about the actions of others introducing herd externalities in which the herd's judgement will be biased by social information about the willingness to pay of others, it follows that:

$$E(\Delta p_{t+1}) = E(p_{t+1} \,|\, [\Omega_i = \sum_{q=1}^{Q-1} \lambda_{q,i} x_q + \lambda_{Q,i} p_{-i,t}] - p_{i,t} \quad (11)$$

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With weakly efficient markets, it is assumed that the non-social information is factored into market prices so that current prices are an unbiased estimator of future stock prices. So when social information is ignored (i.e. when for all individuals $\lambda_Q = 0$), all non-social information will be quickly captured within the current price, assuming that anomalies in different individuals' weighting decisions even out. As news arrives it will be incorporated immediately and the fundamental house price adjust quickly, future changes will be stochastic and $E(\Delta p_{t+1}) = 0$. The house price will follow a random walk and $\bar{p}_t$ will give an unbiased estimate of future prices and the expectation of asset price as follows:

$$E(p_{t+1} \mid \Omega = \sum_{q=1}^{Q-1} \bar{\lambda}_q x_q) = \bar{p}_t \quad (12)$$

However, with social information, i.e. when $\lambda_Q \neq 0$, social information will distort prices away from their fundamental value. This develops insights from Banerjee (1992) and Bikhchandani *et al* (1992) amongst others about the actions of others introducing herd externalities in which the herd's judgement will be biased by social information about the actions of others. So when $\lambda_Q > 0$:

$$E(p_{t+1} \mid \Omega = \sum_{q=1}^{Q} \bar{\lambda}_q x_q) = (1 - \lambda_Q)\bar{p}_t + \lambda_Q p_{-i,t} \quad (13)$$

This can be incorporated into the baseline model as shown in equation (7); putting together (13) and (7) gives:

$$p_{i,t} = \frac{1}{1+r}[u_{i,t} + \delta u_{i,t+1} + (1 - \lambda_Q)\bar{p}_t + \lambda_Q p_{-i,t}] \quad (14)$$

3.3 Normative influence: reputational effects and social value

The social world is affected by interactions between people and this generates a normative influence – each individual's actions will be affected by social norms and others' perceptions and also by the social capital and social value that the individual's own actions generates, e.g. as shown with Veblen goods (Veblen 1899) and

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demonstration effects (Friedman 1957). The impact of normative influence has been also been captured in modern economic analyses of reputation and conformity (e.g. see Keynes 1936, Scharfstein and Stein 1990, Bernheim 1994). More specifically, Clark and Oswald have developed a model incorporating additive and relative utility comparisons (Clark and Oswald 1998) and Becker and Murphy (2001) analyse social multipliers capturing complementarities between social capital and willingness to pay in the context of fads, fashions and information cascades. In the context of housing decisions, people's housing decisions will be affected by the desire for prestige and social status, and also the rewards from owning houses if others in their social networks do too.

Developing these insights in the context of the housing demand model, it is assumed that utility streams have two elements – the tangible benefits reflecting the fundamental value of house purchases – simplified here to reflect net imputed rents, abstracting from any hedonic or subjective aspects; and intangible benefits, specifically the social reward from owning a house that is valued by others.

$$u_{i,t} = G(h_{i,t}, s_{i,i}) \ (15)$$

Where h captures tangible rewards in terms of imputed rent and hedges against future rent rises and s is the intangible utility from social influences including social rewards. Assuming that social rewards are increasing as house prices paid by others are increasing, this will introduce another channel via which average house prices affect an individual's willingness to pay for housing. The utility term can be disaggregated to separate tangible and intangible rewards. Tangible utility – $\widetilde{u}$, includes objectively determined "non-social" utility (e.g. accruing from imputed rent, hedges against future rent rises and non-social hedonic factors) and will be constant across all individuals. Utility from intangible social reward is given by $u_{i,t}^{s}$.

Incorporating these different elements of utility into (14) gives:

$$p_{i,t} = \frac{1}{1+r}\left[(\widetilde{u}_t + u_{i,t}^s + \delta(\widetilde{u}_{t+1} + u_{i,t+1}^s) + (1-\lambda_Q)\overline{p}_t + \lambda_Q p_{-i,t} \right] \ (16)$$

The additional utility does not reflect information relevant to expectations of changes in the long-term fundamental value of housing but this does not mean that judgements of fundamentals are completely ignored; just that they are balanced against subjective considerations too. In this case, owner-occupiers may gain utility from notional beauty contests and iterative thinking as they attempt to second-guess how others value their home. Ephemeral returns capture the notional speculative gains from temporary fluctuations in house prices, and assuming strategic complementarity, these reflect positive but notional payoff externalities from house price appreciation when buyer demand is rising.

Ephemeral utility will also be affected by conformity and normative influence. This links to analyses in which there are indirect reputational benefits from doing what others are doing (or not – as discussed below). It also links into Becker and Murphy's (2000) analysis of increments to utility in the presence of strategic complementarities - the social multiplier generates social returns when an individual does what others are doing. Assuming that improvements in reputation add to social capital, expected reputational effects on an individual's status and credibility will generate increases in an individual's social capital (see also Clark and Oswald 1998).

The reassurance of agreement from others will have different effects on different people reflecting individual differences. Linking this into Simon's (1990) ideas about the relationship between personality and receptiveness to social influence, we assume here that the extent to which individuals are affected by the judgements of others is a function of their personality. The impact of reputation and increasing social status on expected increments to an individual's social capital will depend on personality traits associated with docility and sociability i.e. will depend on whether they are conformist / sociable / docile or contrarian / anti-social. Here and more generally we introduce the possibility that different types will be differentially affected by social influence and their susceptibility to herding externalities will depending on their personality type – we have the 'social' personalities (who would fit into Simon's categorisation of docile individuals) and the 'non-social' types', e.g. herd leaders and mavens.[6] For most people, as explained above, it is assumed that in a

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[6] For analyses of the role played by personality in the actions of mavens and herd leaders, see Goyal and Galeotti (2007).

risky world they would do better to be conventionally wrong rather than unconventionally right (Keynes 1936, Sharfstein and Stein 1990). The social personalities will boost reputation and accumulate social capital if they do what others are doing and the effects will be increasing in the extent of group agreement.

Herd leaders may not necessarily be unresponsive to social influence even if it is the mavens that initially decide the direction in which the herd will go. For example in the context of positive payoff externalities, the mavens will prefer to get in when price is very low, i.e. before others. So they will chase positive payoff externalities but by getting in first rather than by following the crowd. The non-social personalities will boost reputation and accumulate social capital if they get in ahead of the herd, i.e. act in contrarian ways and so their reputational returns will be decreasing with the extent of group agreement.

The non-informational, normative social impacts from seeing others' decisions will depend on personality. Assuming a simple functional form in which social utility is just a function of others' willingness to pay, this can be captured by incorporating heterogeneity in type and assuming that an individual's perception of the social reward from home ownership will be determined by:

$$u_i^s = \pi_i \phi p_{-i} \quad (17)$$

where p_{-i} is others' willingness to pay and personality type is captured by π_i. Three broad personality types can be defined and each type will be determined as an amalgam of various specific personality traits (following the approach developed in Baddeley *et al.* 2010, 2007). For a suggestible personality easily influenced by others $\pi_i = 1$ and $u_i^s = \phi p_{-i}$, Social reward and returns to reputation will be increasing as prices paid by others increase. Contrarians may build their reputation by leading the crowd rather than following it and so their social rewards will be decreasing in the prices paid by others. For a contrarian personality type e.g. mavens who want to lead rather than follow: $\pi_i = -1$ and $u_i^s = -\phi p_{-i}$. Within a model incorporating standard rationality assumptions, there will be no interaction between willingness to pay and

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social valuations and $\pi_i = 0$. When $\pi_i = 0$, changes in social rewards will be independent of group behaviour and group willingness to pay, i.e.. $u_i^s = 0$.

3.4   A behavioural model of housing demand

Collecting together the various objective, normative and informational influences on owner-occupiers' willingness to pay by amalgamating equations (16) and (17), an expression for person i's willingness to pay is given by:

$$p_{i,t} = \frac{1}{1+r}\left[(\widetilde{u}_t + \pi_i \phi p_{-i,t} + \delta(\widetilde{u}_{t+1} + \pi_i \phi p_{-i,t+1}) + (1-\lambda_Q)\overline{p}_t + \lambda_Q p_{-i,t}\right] (18)$$

Others' future willingness to pay is unknown to the individual and so must be expressed as an expectation to give:

$$p_{i,t} = \frac{1}{1+r}\left[(\widetilde{u}_t + \pi_i \phi p_{-i,t} + \delta[\widetilde{u}_{t+1} + \pi_i \phi E(p_{-i,t+1})] + (1-\lambda_Q)\overline{p}_t + \lambda_Q p_{-i,t}\right] (19)$$

Assuming a symmetric distribution of followers versus mavens, on average prices paid by others will exert no systematic influence but it is generally true that there will be a larger proportion of herders than mavens, so the average social reward will a positive function of prices paid by others.

4. An Experimental Analysis of Social Influence in Housing Decisions

In section 3 we outlined some of the reasons why housing herds might develop and why people might copy others when making their housing decisions. The main empirical hypothesis that emerges from these theoretical insights is that housing decisions will be affected by the decisions of others. Expressing these hypotheses in a general form that is testable using experimental techniques (by assuming that the interest rate and discount factor are constant over time and across individuals) gives the following empirical specification:

$$p_i = G(\widetilde{u}, \pi_i p_{-i}, p_{-i}, \overline{p}) (20)$$

To summarise: a person's willingness to pay for housing reflects not only the objective value of the house, as captured by $\widetilde{u}$, but also informational influence and normative influence. As explained above, informational influence is captured by p_{-i}

and $\bar{p}$ and any additional normative influence of others' willingness to pay - p_{-i} will be determined by an individual's personality type as determined by an amalgam of personality traits i.e. $\pi_i = F(Z_i^k)$ where Z_i^k is a vector of k personality traits.

Using this theoretical approach, the role of herding and social influence in housing decisions is analysed using a housing demand experiment which captures the various aspects of willingness to pay as outlined above *viz.* objective information about the fundamental value of a house purchase, the informational and normative influences of others' willingness to pay, all conditioned on individual differences. Personality traits assessed include impulsivity, venturesomeness, empathy and cognitive reflexivity. The latter variable is included on the assumption that people with higher cognitive reflexivity are less predisposed to cognitive bias and so are less susceptible to social influences.

The task involved asking them to report their willingness to pay for a range of real-world residential properties (see Appendix 1 for the instructions, which include the schedule of payments). The experiment involved the following stages:

1. Subjects were divided into groups of 6 and given 5 sets of property details for 5 real properties. These details were collected from real world property websites. Subjects were told that all 5 properties were valued in the region of £200,000–300,000. For the first two properties they were told the estate agents' valuations – to give them a sense of the likely valuations for the other properties.

2. For the remaining three properties, the agents' valuations were not revealed and subjects were asked to state their willingness to pay based on the valuations of predecessors in their group. (In the econometric analysis, the observations from the first decision makers were omitted as they had no predecessor's valuation.) The decision-making order varied across the 3 rounds of the experiment and for each round, the order of decision-making was determined using a random number generator.

3. The average valuation for each group was then calculated and announced. The subjects were then asked to state their final willingness to pay, without consulting the others from their group.

The experimental subjects were recruited using the Cambridge Experimental and Behavioural Economics Group (CEBEG) recruitment website and the experimental sample includes 55 subjects, mainly students. Before the experiment started, the experimental subjects were briefed about the structure of the experiment, completed personality and cognitive skills questionnaires[7]. They were then given one round of the task as a practice session.

Figures 1A and 1B show the distribution of the willingness to pay offers around predecessor's offer (from stage 2) and around the group average offer (from stage 3). These confirm that the experimental subjects' offers were closely distributed around the offers of others, confirming the existence of social influence.

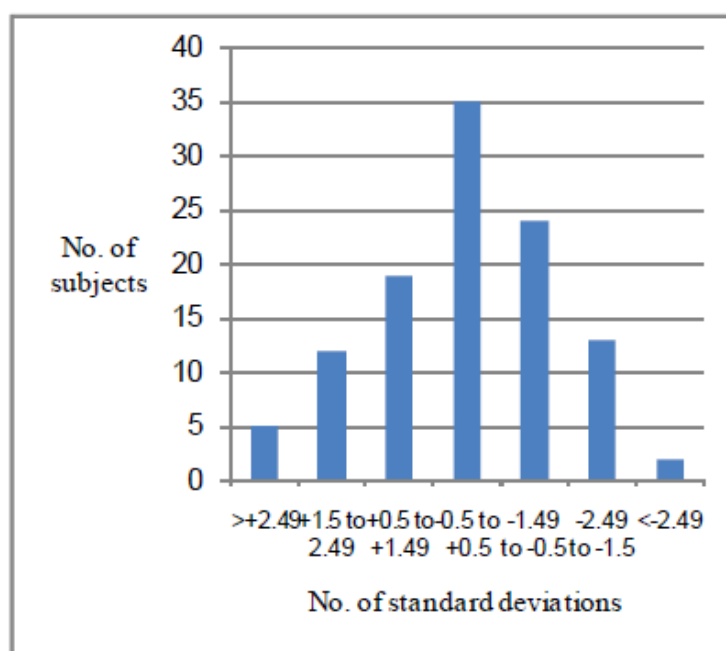**FIGURE 1A – Distribution of offers, as proportion of predecessor's offer**
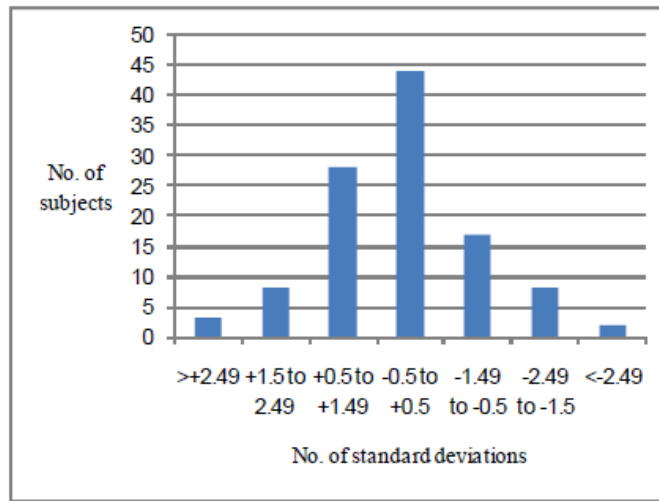

FIGURE 1B – Distribution of offers, as proportion of group offer

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[7] These questionnaires included the Eysenck IVE questionnaire (Eysenck and Eysenck 1975, 1978) and a cognitive reflection test (see Frederick 2005)

The experimental data were then analysed econometrically (using STATA) with unrestricted and restricted versions reported below. The restricted versions were reached using an encompassing approach, involving the deletion of variables with statistically insignificant slope parameter estimates ($H_0 : \beta = 0, H_1 : \beta \neq 0$, reject H_0 if $p>10\%$) unless the deletion of the variable led to signs of model misspecification error. (For the results in Table 1B, variables with p values greater than 10% were retained because the Ramsey's RESET test gave a rejection of the null of no model misspecification when these variables were deleted.)

The models were estimated using two sets of estimations. For the first set of estimations, subjects' valuations (logged) were estimated as a linear function of predecessors' valuation (logged) and average group valuation (logged) – see Figures 2A and 2B and Tables 1A and 1B) including the real-world estate agents' actual valuations (logged) as an additional explanatory variable to capture the objective value of each house. Individual characteristics were included as multiplicative dummies (logged characteristic multiplied by predecessor or group valuation) to capture the additional impact of social information by way of individual characteristics such as personality traits.

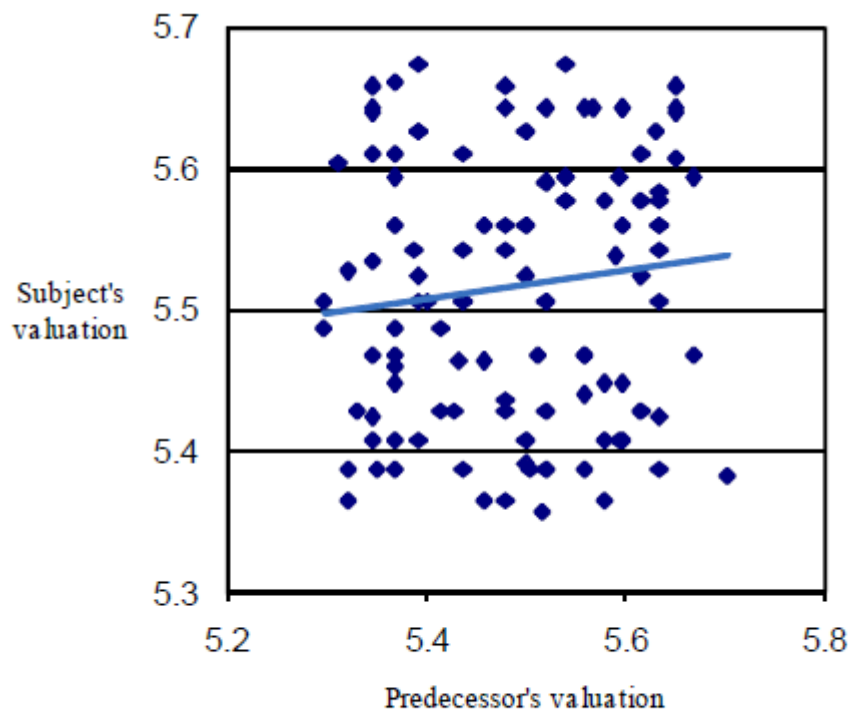**FIGURE 2A – Line of Best Fit: Subject's valuation vs predecessor's valuation (logs)**

FIGURE 2B – Line of Best Fit: Subject's valuation vs group valuation (logs)
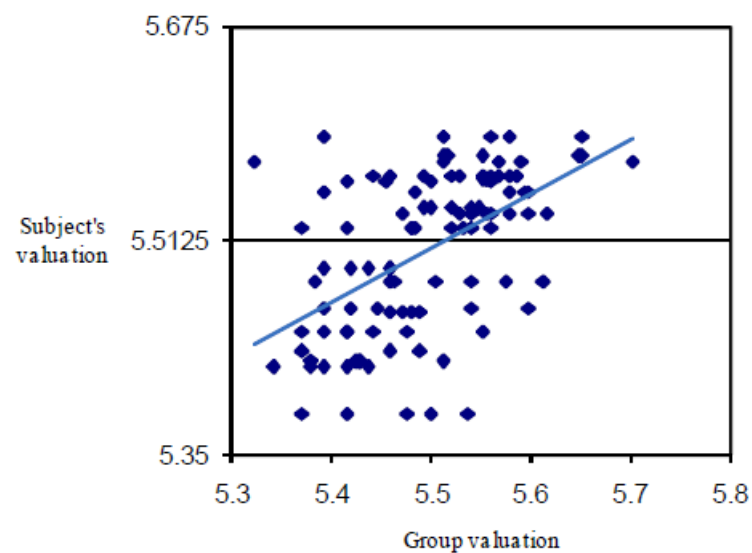
TABLE 1A ESTIMATIONS OF THE IMPACT OF PREDECESSOR'S VALUATIONS

Dependent variable: subject valuation

n=110

	UNRESTRICTED			RESTRICTED		
	Parameter estimate	t test	p value	Parameter estimate	t test	p value
Real valuation	-0.514	-2.100	0.038	-0.498	-4.670	0.000
Predecessor's valuation	0.336	1.280	0.203	0.311	2.350	0.021
Impulsivity	-0.008	-0.600	0.550	...	...	...
Empathy	-0.055	-1.560	0.121	-0.071	-2.250	0.027
Venturesomeness	-0.026	-1.570	0.119	-0.027	-1.660	0.100
Age	-0.018	-0.310	0.760	...	...	...
Gender (M=1, F=0)	0.027	1.430	0.156	...	...	...
Cognitive reflexivity	-0.008	-1.400	0.165	...	...	...
Constant	6.739	9.180	0.000	6.744	9.540	0.000
Breusch-Pagan	χ^2 (1) = 0.29 [p=0.588]			χ^2 (1) =0.02 [p=0.902]		
Ramsey RESET	F(3, 98)= 0.10 [p=0.960]			F(3, 102) = 0.35 [p=0.787]		
Akaike IC	-186.467			-189.914		
Bayesian IC	-162.163			-176.412		
R-squared	0.225			0.193		
Adj R-squared	0.164			0.162		

TABLE 1B ESTIMATIONS OF THE IMPACT OF AVERAGE GROUP VALUATION

Dependent variable: subject valuation

n=110

	UNRESTRICTED			RESTRICTED 1			RESTRICTED 2		
	Parameter estimate	t test	p value	Parameter estimate	t test	p value	Parameter estimate	t test	p value
Real valuation	-0.161	-0.930	0.352	-0.236	-3.290	0.001	-0.228	-3.030	0.003
Group valuation	0.516	2.650	0.009	0.576	4.620	0.000	0.554	4.180	0.000
Impulsivity	-0.009	-1.050	0.296	...	...	...	-0.010	-1.180	0.239
Empathy	-0.025	-1.120	0.265	-0.035	-1.830	0.069	-0.025	-1.180	0.240
Venturesomeness	0.006	0.530	0.600	...	...	...	...	...	...
Age	0.014	0.360	0.722	...	...	...	...	...	...
Gender (M=1, F=0)	0.008	0.630	0.529	...	...	...	0.008	0.650	0.516
Cognitive reflexivity	-0.001	-0.160	0.871	...	...	...	...	...	...
Constant	3.552	3.940	0.000	3.704	4.470	0.000	3.768	4.510	0.000
Breusch-Pagan test for heteroskedasticity									
	χ^2 (1)=0.34 [p= 0.559]			χ^2 (1)= 0.91 [p= 0.340]			χ^2 (1) = 0.66 [p=0.4157]		
Ramsey RESET test									
	F(3, 98)=1.97 [p= 0.124]			F(3, 103) = 4.01 [p=0.010]			F(3, 101) = 2.03 [p=0.1141]		
Akaike IC	-285.184			-292.924			-290.585		
Bayesian IC	-260.880			-282.122			-274.382		
R-squared	0.360			0.347			0.357		
Adj R-squared	0.310			0.329			0.326		

For the second set of estimations, the ratio of subjects' valuations to predecessors' valuations (logged) and group valuations (logged) was estimated, conditioned on individual characteristics. For these estimations, personality traits etc. could be included in simple additive (logged) form (not in multiplicative dummy form)

because the dependent variable is already constructed to capture herding. For estimation, a generalized linear model (GLM) was used incorporating a Gaussian distribution with cubic link function, weighted using dependent variable as weight and standard errors corrected using cluster estimation of the variance-covariance matrix.

TABLE 2A: ESTIMATIONS OF SOCIAL IMPACTS - Sequential herding (GLM estimation)

Dependent variable: Ratio of subject to predecessor's valuation

n=110

	UNRESTRICTED			RESTRICTED		
	Parameter estimate	t test	p value	Parameter estimate	t test	p value
Venturesomeness	-0.007	-0.600	0.551	...	...	...
Empathy	-0.075	-2.720	0.007	-0.081	-3.230	0.001
Impulsivity	-0.003	-0.230	0.821	...	...	...
Cognitive reflexivity	-0.044	-1.910	0.056	-0.034	-1.670	0.094
Gender (M=1, F=0)	0.013	0.840	0.399	...	...	...
Age	-0.038	-0.960	0.338	...	...	...
Constant	1.349	8.010	0.000	1.226	19.270	0.000
Akaike IC	-490.640			-497.069		
Bayesian IC	-471.736			-488.967		

TABLE 2B ESTIMATIONS OF SOCIAL IMPACTS - Group influence (GLM estimation)

Dependent variable: Ratio of subject to group average valuation

n=110

	UNRESTRICTED			RESTRICTED		
	Parameter estimate	t test	p value	Parameter Estimate	t test	p value
Venturesomeness	0.006	1.030	0.303	...	...	...
Empathy	-0.017	-1.250	0.212	-0.019	-1.490	0.137
Impulsivity	-0.006	-1.010	0.311	...	...	...
Cognitive reflexivity	-0.010	-0.770	0.441	...	...	...
Gender (M=1, F=0)	0.001	0.170	0.862	...	...	...
Age	0.007	0.320	0.747	...	...	...
Constant	1.019	11.950	0.000	1.043	33.390	0.000
Akaike IC	-648.486			-654.570		
Bayesian IC	-629.583			-649.169		

FIGURE 3A – Ratio of subject and predecessor's valuation – with cubic fit function
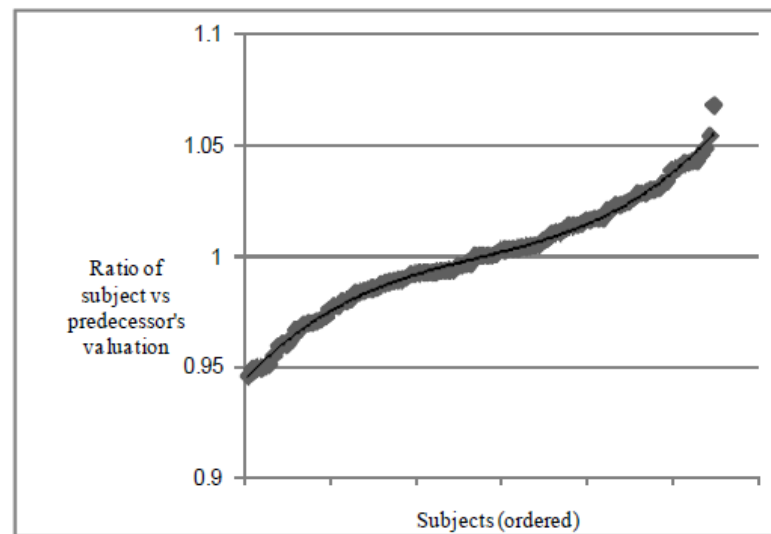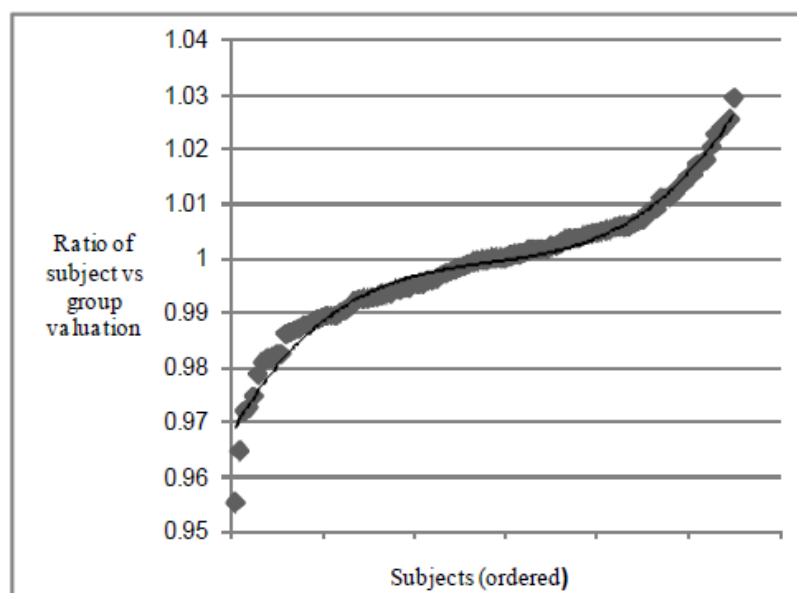

FIGURE 3B – Ratio of subject to group valuation – with cubic fit function

Discussion of results

For the first set of estimations (Tables 1A and 1B), the tests for heteroscedasticity (Breusch-Pagan) and model misspecification (Ramsey's RESET) suggest that the estimations are likely to be econometrically robust (no obvious violations of Gauss Markov assumptions) and the results indicate a reasonable goodness of fit of between about 16% to about 35% – with a better fit for the second set of models in which subjects' valuations are a function of the group average (versus predecessors' valuations). The negative and statistically significant parameter on the real valuation suggests that the subjects are diverging from the presumably objective valuations of estate agents but there is a strong degree of agreement not only with predecessor's valuations but also with average group valuations. This evidence is consistent with a negative herding externality in which social influence leads to persistent errors in valuations. The variables to capture individual characteristics are in multiplicative form i.e. are incorporated as a multiplicative function of the predecessor and group valuations. The parameters on empathy and cognitive reflexivity are statistically significant and negative which suggests that subject with more empathy and cognitive reflexivity are less likely to be affected by predecessors' valuations (for the estimations in Table 1A). The results in Table 1B, show that impulsivity and venturesomeness dampen the impact of group valuations and gender differences are associated with increased group influence on male subjects. But for all the individual characteristics, the parameters are relatively small with empathy having the largest impact by way of predecessors' valuations – lowering this impact by 7 percentage points.

For the second set of estimations (see Tables 2A and 2B), the constant parameter captures whether subjects' valuations differ from predecessors' or average group valuations. A social influence variable is constructed as the ratio between individuals' decisions and the decisions of predecessors or the group average. The extent to which social influence is significant or not can be ascertained by way of an hypothesis test on the intercept parameter ($H_0 : \alpha = 1, H_1 : \alpha < 1$) and the null is retained in both cases, suggesting a significant association between a subject's decisions and the social information about others' decisions (whether from the

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preceding decision-maker or the group average). The impact of individual characteristics is limited except, again, for empathy – with empathetic individuals less likely to be affected by others' valuations.

This set of estimations suggest that the tendency to converge to group valuation is stronger than tendency to converge to predecessor's valuation and the latter is significantly affected by personality traits suggesting different personality types will be more or less susceptible to social influence. The estimations also suggest that informational versus vs normative influences have different impacts, affected by personality traits. Empathy and cognitive reflexivity variables are both significant for regressions based on predecessors' decisions and empathy alone is significant in regressions based on group average valuations. This suggests that individual differences may have less impact in the context of group influence, perhaps because group consensus makes individuals less susceptible to subjective factors. For the theoretical model outlined in section 3, this finding would also be consistent with the dominance of informational influence over normative influence.

To summarise, in both sets of estimations there is a statistically significant correlation between subjects' decisions and the decisions again confirming that social influence has an important and significant impact on decisions. For the individual characteristics, whilst there is some evidence (again) that cognitive reflexivity lowers susceptibility to social influence, the key significant trait is empathy. This finding confirms previous findings from two different experiments (Baddeley *et al.* 2007, 2010). The robust finding that empathy and to a lesser extent cognitive reflexivity dampen susceptibility to social influence may be a reflection of sophisticated, confident personalities who not only are going to be less concerned about how others perceive them, but also have the capacity for what is presumably a more highly evolved empathetic instinct. This may be explained if responding to others' actions is a more primitive response, perhaps a proximate mechanism reflecting the fact that instincts to copy others have evolved as a way to overcome resource constraints (e.g. see Danchin *et al.* 2004)

5. Conclusion

In this paper, we have attempted theoretically to separate the objective and subjective determinants of willingness to pay for owner occupied housing and applied the insights to an experimental analysis of housing decisions. The experimental evidence shows that social information exerts both a normative and informational influence, with the impact of social information also affected by heterogeneity between individuals as measured by personality traits and gender.

The empirical evidence presented here is consistent with the presence of social influence and has also demonstrated an experimental approach designed to separate informational herding (e.g. as consistent with Bayesian models of social learning) from normative influence from factors such as social pressure. Further research is needed to separate the social, normative and psychological origins of housing herding behaviour to establish whether housing herding emerges because of cognitive constraints, social pressures and/or neurobiological responses. Further research could be done using neuroeconomic approaches, such as those outlined in Camerer *et al.* (2004, 2005), to ascertain whether these herding effects have neurological correlates. In addition, the theoretical and empirical approach could be extended to capture the impacts of financing constraints and gearing, and/or the role of attitudes towards the future because hypotheses about housing decisions will differ in models incorporating standard exponential discounting assumptions versus models capturing time inconsistency and preference reversals by allowing hyperbolic or quasihyperbolic discounting.

For policy implications, if housing herding emerges as a rational phenomenon in the face of uncertainty, then a policy implication might be that moderating housing market instability can be achieved through better dissemination of knowledge and information about local housing market conditions. This would ameliorate the negative herding externalities generated by rational herding in the face of uncertainty.

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APPENDIX 1 – EXPERIMENTAL INSTRUCTIONS

Assume that you have a budget of between £200,000 and £300,000 to buy a house in the Cambridge city area. To give you some indication of how much houses cost in Cambridge you have copies of sales brochures for two properties:

- House A: Kendal Way, Cambridge –valued at £205,000
- House B: Rosemary Lane, Cambridge – valued at £295,000

You have also been given sales brochures for a further **three** houses:
- House C: Green End Road, Cambridge
- House D: Dennis Road, Cambridge
- House E: St Matthews Gardens, Cambridge

You will be asked to record your judgements about the value of these 3 houses in three stages:
1. Stage 1: you will be asked for your initial judgement about the value of **three** houses to nearest £1000
2. Stage 2: in turn, each member of your team will estimate the value of each of the houses
3. Stage 3: after the average valuation for each team and each house has been revealed to everyone, you will be asked to record your final judgement of the value of each house

At each stage of the experiment you will be given a money reward according to how close your answers are to the real market value as judged by a professional surveyor. You can change your estimate from one stage of the trial to the next.

Schedule of Payments

Show-up fee	£10
Initial estimate (stage 1)	£3 per correct estimate
Group estimate (stage 2)	£18 per team per correct estimate, shared equally
Final estimate (stage 3)	£3 per correct estimate
Minimum payment	£10
Maximum payment	£37

You will now be given 15 minutes to read the sales brochures and form an initial judgement of the value of Houses C to D.