

How To Identify UK Housing Bubbles A Decision Support Model

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To my grandmother, Theodoula and my father Renos.

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List of Abbreviations

- (AUC) Area Under the Economic Curve
- (BCA) Bias Corrected and Accelerated Bootstrapping
- (BF) Behavioral Finance
- (D/B) Debt-Burden Ratio
- (DDM) Dividend Discount Model
- (EMH) Efficient Market Hypothesis
- (ERM) Exchange Rate Mechanism
- (EV) Event Validity

- (FLS) Funding for Lending Scheme
- (FV) fundamental value
- (GDP) Gross Domestic Product
- (HDV) Historical Data Validation
- (HP) House Price
- (HP/I) House Price to Income
- (HPE) House Price to Earning Ratio
- (LCI) Lower Confidence Interval

- (LPPL) Log-Periodic Power Law
- (MAP) Median Asking prices
- (NOI) Net Operating Income
- (OECD) Organization for Economic Co-operation and Development
- (OLS) Ordinary least squares
- (PP) Peak to peak
- (RICS) Royal Institution of Chartered Surveyors
- (RPI) Retail Price Index
- (SCP) Self-Correction Pattern
- (SE) Single Equation
- (SLS) Special Liquidity Scheme
- (TT) Trough to Trough
- (UCI) Upper Confidence Interval

- (VAR) Vector autoregressive

Abstract

Purpose - The purpose of this thesis is to provide a decision support model for the early diagnosis of housing bubbles in the UK during the phenomenon's maturity process.

Methodology - The development process of the model is divided into four stages. These stages are driven by the normal distribution theorem coupled with the case study approach. The application of normal distribution theory is allowed through the usage of several parametric tools. An empirical application of the model is conducted using UK housing market data for the period of 1983-2011; and by placing particular emphasis on the last two UK housing bubble case studies, 1986 to 1989 and 2001/2 to 2007. The central hypothesis of the model is that during housing bubbles, all speculative activities of market participants follow an approximate synchronisation.

Findings - The new algorithmic approach successfully identifies the well-known historical UK bubble episodes over the period of 1983-2011. The proposed algorithm acts like an index or a thermometer to gauge the "fever" of a housing bubble in the UK at any point in time. In this approach, the housing bubble is no longer invisible until the crash, and as such can be monitored over time. The study further determines that for uncovering housing bubbles in the UK, house price changes have the same weight as the debt-burden ratio when their velocity is positive. The application of this model-algorithm has led us to conclude that the model's outputs fluctuate approximately in line with phases of the UK real estate cycle. Finally, the research has provided a new and more technical definition of housing bubbles. The phenomenon is defined as a situation in which all speculative activities of market participants¹ achieve an approximate synchronisation. Consequently, under such regime, the model expects that (during housing bubbles) an irrational, synchronised and periodic increase in a wide range of relevant variables must occur to anticipate a bubble component. In this definition, the relevant variables are those that exhibit a periodic and irrational acceleration in the rate of change, which, in turn, is synchronised with other relevant variables. Therefore, the model views such variables as symptoms for identifying housing bubbles.

Originality/Value - This thesis proposes a new measure for studying the presence of irrational housing bubbles. This measure is not simply an ex post detection technique but employs dating algorithms that use data only up to the point of analysis for an on-going bubble assessment, giving an early warning diagnostic that can assist market participants and regulators in market monitoring.

¹ (i.e. individuals, investment firms, financial institutions, and builders)

Chapter 1

1.0 Introduction

There are many questions that vex researchers studying housing markets. Identifying a bubble is always a timely question in the academic world (Hunter, Kaufman, & Pomerleano, 2005). With crashes occurring more and more frequently in real estate markets, research attention on the topic of bubbles and on the question of how to identify housing bubbles has been gradually increasing. Particularly, following the recent financial crisis, the effect of housing bubbles on Western financial systems has become the centre of attention, since on the macroeconomic level, the burst of a housing bubble can send the overall economy into recession and depression. Underpinning such attention, several studies have underlined the macroeconomic and banking after-effects of the housing bubble-burst phenomenon (Panagopoulos & Vlamis, 2009; Reinhart & Rogoff, 2009; Kaminsky & Reinhart, 1999).

In addition, while housing bubble-busts are less frequent than stock market bubble busts, they last twice as long and their effects are twice as large in terms of GDP loss (Jowsey, 2011). Brocker and Hanes (2014) and Hlaváček and Komárek (2009) emphasise that the bursting of housing bubbles has a greater effect on the subsequent recovery of the economy than a stock market collapse, and that banks face greater exposure to residential markets than to equity markets. For Holcombe and Powel (2009), nothing better illustrates governmental failure than the housing bubble phenomenon.

However, most economists find the classical definition of a bubble (a rapid increase in the price of an asset) to be problematic and ambiguous. Such a definition is considered imprecise because it fails to address core questions such as how quickly prices should rise, and by how much, in order to qualify a situation as a bubble (Barlevy, 2007). Nevertheless, unlike a housing crash, a housing bubble is difficult to diagnose because positive housing changes, even at unprecedented rates, are not in and of themselves sufficient to define a situation as a bubble. Another big challenge that casts light on the identification of housing bubbles was made clear by Alan Greenspan in 2002 (cited in Geraskin & Fantazzini, 2011 pp. 2-3): “We, at the Federal Reserve... recognized that, despite our suspicions, it was very difficult to definitively identify a bubble until after the fact, that is, when its bursting confirmed its existence.” Similarly, the governor of the central bank of Japan, Hayami, (cited in Hunter et

al., 2005 p. 27) mentioned in 2001 that a housing bubble is “a name we assign to events that we cannot explain with standard hypotheses. After the event, we may rule out some explanations that appeared plausible earlier, but we are unlikely to exclude all alternatives except the bubble explanation.”

The first modern housing bubble, which took place between the mid to late 1980s in some Western economies like the US, Canada and the UK, have led institutions and property researchers to pursue the development of predictive tools. As a result, substantial progress in property research and forecasting has occurred with the development of several econometric models that predict the movements of prices, and/or identify housing bubbles or an impending crash (McDonald, 2002, Harris & Cundell, 1995). However, since then, the development of these models and the field of housing bubbles in particular have been dominated by the rational bubble theory. Discussion regarding investors’ irrationality has virtually disappeared. The vast amount of literature on rational bubbles has approached the “question” of how to identify/measure a housing bubble using some sort of fundamental value method. The most popular is the present value approach and the equilibrium models. (Mayer, 2011; Smith & Smith, 2006). Occasionally, fundamental analysts have also attempted to identify/measure housing bubbles using a regression-based method that compares actual housing prices with what house prices should be based on a model of fundamentals. However, such conventional bubble tests stand on two broad limitations, which in turn affect the reliability of their outcome. The overall critiques of the existing bubble measures are presented in detail in Chapter 4.0.

First limitation – Modelling and Interpreting Fundamental Value

When researchers apply or attempt to develop a fundamental value model, they are unwittingly bound to answer the question of what ultimately drives housing price changes; an equivalent question would be to ask the fundamental value of a housing asset. By relying on this approach, the ability to measure a bubble correctly depends on the ability to correctly measure the fundamental value of housing. The ambiguous nature of such a concept has been discussed by Hayek (cited in Budd 2011), who claims that no one will ever be able to fully explain what constitutes fundamental value. Concerning housing assets, Krainer and Wei (2004) state that fundamental value is fundamentally unobservable. In general, in recent

decades, the limitations of fundamental value methods have become increasingly obvious via several empirical studies (Orrel & McSharry, 2009).

Glaeser and Gyourko (2007), Krainer and Wei (2004) and Stiglitz (1990) have identified a number of potential concerns about the comparison of housing prices using the fundamental value approach of present discounted value of rent. Moreover, as Case and Shiller (1989) p.135 state, “We see no way of obtaining an accurate historical time series on implicit rents (i.e. cash flows) of owner-occupied homes.” Similarly, for regression-based models, Shiller (1992) raises the difficulty of applying a fundamental value model to the housing market, in which price determinants are far more complicated than they are for other assets. Smith and Smith (2006) also found empirically that fundamental value models, when used to gauge a housing bubble, are inherently flawed. They also found that fundamental values in housing markets are highly nonlinear functions of many variables, and thus regression-based models are likely to be specified incorrectly.

Another problem for regression-based fundamental value models regards the interpretation of their results. For such models, the amount by which actual market prices deviate from the prices predicted by a regression or a present-value-based model is interpreted as the extent to which house values are overpriced or underpriced. Therefore, to qualify a situation as a bubble, actual prices should be higher than the predicted fundamental values (what should be according to a model of fundamentals). This allows us to ask the question of why any positive deviation in actual house prices (i.e. index values) from predicted fundamental house prices (i.e. model values) should be considered as bubbles and not as forecast error. This question stems from the fact that regression-based models attempt to model real housing prices as a function of several fundamental indicators such as disposable income, long-term interest rates, population and others, while Robert Shiller (1992) has made clear that the price determinants of housing are far more complicated and unknown than they are for other assets. To this end, it is more rational to assume that the positive gap between actual housing prices (i.e. index values) and their predicted values (i.e. model values) is the forecast error rather than the bubble parameter. Finally, another interpretation problem for regression-based models in particular is that such models tend to reject the presence of a housing bubble if house prices are reconciled with variations of macroeconomic variables, or if the price change can be explained by both fundamentals and ‘reasonable’ shifts (Shen, Hui, & Liu, 2005). However, the notion of reasonableness in interpreting such results is absolutely subjective. Consequently, such results could be exposed to interpretation bias.

Second limitation – Rational Expectations

When applying fundamental value models to bubble problems, economists are also bound to assume that the market is dominated by a large number of rational people who base their investment decisions on rational expectations. A rational expectation assumes that participants in the housing market make optimal use of the information and make decisions using rational rules (Diappi, 2013). The idea that participants in housing markets are so calculating and willing to take into account any new investment information has been consistently challenged and disproved by the influential work of Case and Shiller (2003, 1989, 1988). They found that the housing market paints a very different picture and concluded that real estate markets are far from rational, as they are populated by amateurs who make infrequent transactions on the basis of limited information and with no serious experience in gauging the fundamental value of the houses they are trading. Keynes (1936, p.156) also explained that asset markets operate in an environment in which market participants may not be governed by an objective view of fundamentals but by “what average opinion expects the average opinion to be.” In addition, Krugman (2009), in one of his most notable articles, asserts that the widespread belief that markets are efficient and rationally constructed blinded many if not most economists to the emergence of the biggest financial bubble in history. Meltzer (2002, pp.2-3) also mentions that “at this stage in the development of economic theory, we must regard the rational bubble hypothesis as devoid of empirical content, or empty. The main reasons are that we do not observe expectations, and we cannot exclude other, entirely rational, non-bubble, alternative explanations of prices. I believe it is for these reasons that attempts to test the rational bubble hypothesis have not produced compelling evidence.”

The two abovementioned limitations, together with the current perception that fundamental value models (i.e. asset pricing models and regression models) persistently fail to explain asset price bubbles and property market movements (Scherbina, 2013; Tonelli, Cowley, & Boyd, 2004; Orrell & McSharry, 2009; Case & Shiller, 2003; Meltzer, 2002), introduce doubt about whether the concepts of fundamental value and ‘market rationality’ should be the tools used to determine the presence of housing bubbles. Additionally, in all previous work (except Case & Shiller, 2003), the epicentre for identifying housing bubbles was the variable

representing housing prices, which raises my second concern of whether housing prices should be the central variable in identifying housing bubbles².

Nevertheless, despite the success of Case and Shiller's (2003) survey method in terms of detecting bubbles and explaining reality, surveys have only been found to be useful when comparable surveys from previous bubble case studies are available. Moreover, surveys are subject to serious inherent limitations that are often relevant to qualitative research (Popper, 1959). This is the third concern that the present study takes into account. The demand for more empirical, quantitative evidence of bubbles calls for the development of new techniques for identifying the magnitude of bubbles. Perhaps, there is a need to change the kinds of questions we ask. Instead of trying to predict changes in prices and the future of housing markets to explain bubbles, we should focus on developing models that better understand the bubble system as a whole. In support of this viewpoint and to the best of my knowledge, the studies of Mayer (2011), Agnello and Schuknecht (2011), and Orrel and McSharry (2009) have been the only three to point out the need for and significance of developing models that help in the diagnosis of housing bubbles rather than their prediction. If the bubble component of the housing market can be identified and measured appropriately, it will significantly aid market participants and households in reducing their exposure to unnecessary risks, thus reducing stress in residential property markets.

My idea (for the development of the model) came from searching for a collection of several anomalies generated in the housing market. This search was based on the irrational view of bubbles and on the main hypothesis of the study (presented in the research methodology chapter). It is hoped that the success of this fresh idea will provide a new approach for researching housing bubbles, in that it will not only bridge the existing survey-based techniques and quantitative measurements of bubbles, but will also provide both a new definition of the phenomenon and a new practical approach that can further the research in the field of housing bubble detection.

² The second concern does not lead us to underestimate the importance of the house price variable in diagnosing housing bubbles.

1.1 Bubble views

Asset bubbles are one of the topics most debated between economists. The controversy is central in certain schools of economic thought. Principally, there are three official views on bubbles: the view of Chicago school, the view of Keynesians and proponents of behavioural economics, and the view of Austrian economic school.

The Chicago school and the proponents of the efficient market hypothesis (EMH) deny the existence of bubbles. They claim that all asset prices (i.e. stocks, houses) are equal to the discounted value of their rationally expected dividend payment streams. This incorporates many factors such as volatility and all risks. Under this proposition, adherents of the Chicago School and the EMH consider that asset prices are always correctly priced (i.e. they reflect all available information). As a result, bubbles are impossible events. Supporters of this view also tend to deny a connection between excessive speculation and subsequent crises within markets (Kettel, 2002; Orrel & McSharry, 2009; Dreman, 2011; Kaul, 2014; French, 2013 and Fama, 1970, 1976). However, during the early 1980s, a growing disapproval of the EMH seems to have been started with the pioneering study of Shiller (1981, 1989) on the excess volatility of financial markets, which challenged the orthodoxy that economic models must always assume rational expectations by all economic agents. Concerning housing markets, Case and Shiller (2003, 1989, 1988) found that housing markets paint a very different picture from what EMH holds and that bubbles may exist. They concluded that real estate markets are driven largely by expectations based on past price movements rather than on any knowledge of fundamentals and that market participants are far from rational. After nearly three decades of research, the study of investor behaviour within asset markets eventually resulted in the creation of behavioural finance (BF); an opposing theory to the EMH. Since then, researchers have paid much attention to bubble issues and have appreciated the presence of bubbles in asset markets. This shift could be described as the birth of the modern bubble literature.

Almost a half a century before behavioural economists reached the conclusion that bubbles might exist, Chapter 12 of Keynes' (1936) influential work, *General Theory of Employment Interest and Money*, was among the first to introduce the idea that asset markets operate in an environment in which market participants may not be governed by an objective view of fundamentals but by "what average opinion expects the average opinion to be" (p.156). The Keynesian view (1936) accepts the presence of bubbles, with the belief that investment is

driven by expectations about what other investors think everyone else think, rather than expectations about the fundamental profitability of an investment. Keynes (1936, pp.161-162) further accepted that “there is the instability due to the characteristics of human nature that a large proportion of our positive activities depend on spontaneous optimism rather than on mathematical expectation, whether moral or hedonistic or economic. Most, probably, of our decisions to do something positive ... can only be taken as a result of animal spirit.” Here, animal spirit refers to the tendency of asset prices to rise and fall (or economic decisions to be formed) based on human emotions and herd behaviour (irrationally) rather than on intrinsic value. Generally, Keynesians and proponents of behavioural economics argue that bubbles exist because of psychological factors.

The third view is that of the Austrian school, which also sees bubbles as real phenomena. The Austrian school argues that a bubble is the product of a government’s failure to manage the money supply and interest rates in an optimal and rational manner. Proponents further claim that as long as central banks retain their authority to set controls on interest rates, such bubbles will periodically appear in the economy. The Austrian school sees bubbles as a combination of both real and psychological changes caused by manipulations of monetary policy. While behavioural economists emphasise the irrational nature of market participants to explain bubbles, followers of Austrian economics claim that loose and failed monetary policy is the prime reason that can explain bubbles (Holcombe & Powel, 2009; Rapp, 2015; Kennard & Hanne, 2015; Lemieux, 2011; French, 2009).

1.2 Types of bubbles

There are three main concepts present in the literature with regard to the types of asset bubbles: explosive, intrinsic and momentum (Black, Fraser, & Hoesli, 2006). The explosive and intrinsic types of asset bubbles constitute the rational bubble theory. The rational bubble theory holds that market participants (i.e. investors) know that the market is overvalued but have no incentive to leave the market because they expect that the bubble component will grow and compensate them appropriately (through a bubble premium) (Hardouvelis, 1998; Harrison & Kreps, 1978), Flood & Hodrick, 1990). Rational bubble theory is grounded in the efficient market hypothesis (EMH), which usually implies some form of the expected present-value model (Shiller, 1992). It is worth clarifying here that despite the fact that the

official position of the EMH on bubbles is that bubbles generally do not exist (Dreman, 2011; Kaul, 2014; Kettel, 2002; Fama cited in French, 2013), there can exist a rational deviation from the fundamental value known as a “rational bubble” (Blanchard & Watson, 1982). The main difference between the two aforementioned rational concepts is that in an explosive rational bubble, prices continuously deviate from fundamentals due to factors extraneous to asset value, whereas in an intrinsic rational bubble, prices periodically diverge from fundamental value due to exogenous fundamentals (Black et al., 2006).

In contrast, the third concept (“momentum”) denotes the general or irrational bubble theory. Irrational bubble theory supports the idea that investors who stay in the marketplace do not focus sufficiently on fundamentals and do not know that the market is overvalued (Hardouvelis, 1998). Under such a basis, market participants follow adaptive expectations³ (rather than rational expectations) when they estimate future price outcomes. In opposition to rational theory, the irrational bubble theory does not emphasise the appropriateness of using present-value models to detect bubbles. Irrational speculative bubbles are caused by precipitating factors that have an immediate effect on demand as well as through amplification mechanisms that take the form of optimistic price-to-price feedback (Shiller, 2000, Case & Shiller, 2003). Following this logic, irrational bubble theory is akin to herd behaviour, in which in the absence of complete information makes housing investors more inclined to look to the behaviour of others when deciding what to do (Baddeley, 2005).

1.3 What type of bubble the study aims to examine/identify?

My work conforms to the irrational bubble theory. The main available approach to justify housing bubbles on such a basis is to measure the qualitative characteristics and opinions of housing buyers. Qualitative evidence of speculative activities, coupled with the risk unawareness of housing buyers, forms the conclusion that a housing bubble exists (Case & Shiller, 2003). This thesis proposes an alternative approach of quantitative measurement to detect such speculative bubbles. Generally, under the irrational bubble theory, a housing bubble is a “peculiar kind of fad or social epidemic that is regularly seen in speculative markets; not a wild orgy of delusions but a natural consequence of the principles of social psychology coupled with imperfect news media and information channels” (Shiller 2013,

³ Individuals look to past experiences to estimate future price outcomes.

p.2). The theory also accepts that, during housing bubbles, some degree of herd behaviour is found in the marketplace. This study also accepts that during housing bubbles, market participants do not know that prices are overvalued or bubbly. These theoretical “truths” (i.e. elements) of irrational bubble theory provide the initial basic conceptual elements upon which this research is grounded. Further details regarding the conceptual elements of the study and its main hypothesis can be found in the research methodology chapter.

1.4 Historical bubble events: The real world

By reflecting back on what has been written here, it is apparent that speculative bubbles do exist and do occur. And if Keynes’s animal spirits were referring to the cause of speculative bubbles, then these bubbles would have occurred ad infinitum throughout history. Moreover, as Shiller (2005) makes clear in his book, *Irrational Exuberance* that a bubble is a kind of social epidemic, and there is always a story behind each bubble that in turn changes with each new bubble. Hence, it is instructive to provide a snapshot of some of the most famous bubbles in history, with an emphasis on the UK region, and also to indicate the main story behind each of the bubble episodes.

Table 1. Historical Bubble Events

Bubble	Location	Period	Social Epidemic – Story
Tulip Bubble	The Netherlands	1636-1637 (1630s)	Tulip mosaic virus affected the colour of petals and it made them more attractive.
South Sea Bubble (Stock bubble)	Britain	1711/19-1720 (1710s)	Company was granted a monopoly in trade with Spain’s colonies in South America and the West Indies. Public opinion assumed that an inestimable value of future profits would occur.
British Railway Bubble	Britain	1843-1845 (1840s)	Extensive enthusiasm for investing in railways shares. Railways were seen as the optimal future business.
Stock Bubble	USA	1927-1929 (1920s)	Roaring Twenties – God intended the American middle class to be rich. Economic and industrial transformation. Promising economic climate.
Florida Real Estate Bubble	USA	1921-1926 1920s	The Riviera of America. Living in Florida became the fashion. Belief that Florida’s land offered the best opportunity to get rich quick.
Dot.Com Bubble	USA	1997-2000 (1990s)	People believed the Internet would instantly change the entire way business was done and that all firms related to the dot.com business would see enormous profits.
Housing Bubble	UK	1971-1973 (1970s)	Enthusiasm for investing in the housing market. Buying a house was considered a smart investment to get rich quick. Increasing competition between banks and the presence of highly attractive lending products.
Housing Bubble	UK	1986-1989 (1980s)	
Housing Bubble	UK	2001/2-2007 (2000s)	

1.5 Significance and intended contribution of the study

With bubbles and busts occurring more and more frequently in housing markets, research interest on the theme has been gradually increasing. Yet, what we have learnt from the housing bubble studies done since Florida's real estate bubble of 1920s? The answer is ambiguous. First, existing bubble detection methods are subject to serious limitations at both the theoretical and empirical levels. Moreover, existing approaches have consistently failed to identify the presence of bubbles in housing markets with adequate confidence. Also, the efficient market hypothesis, rational bubble theory and conventional 'fundamental' approaches have been placed in doubt and are increasingly being seen as antiquated and non-useful when it comes to bubble problems. At the same time, Case and Shiller (2003, 1989, 1988) have challenged the conventional belief that economic models must always include the assumption of rational expectations by all economic agents and that the housing market is an efficient market. The authors asserted that real estate markets are largely driven by expectations based on past price movements rather than on any knowledge of fundamentals and that market participants are far from rational. Thus, their conclusion was that housing markets are irrational. After nearly three decades of research, the study of investor behaviours in asset markets eventually resulted in the creation of behavioural finance (BF), an opposing theory to the EMH. At the present, the irrational view of housing bubbles, seen through the view of BF, is the most popular theory among academics. Turning to the identification of housing market bubbles, behavioural finance has provided significant evidence that the survey-based method is the best available approach for identifying housing bubbles. However, despite the widespread success of this method, the survey-based approach is subject to inherent problems as well as to problems related to its applicability. Another inefficiency in the literature on housing bubbles is that most economists find the classical definitions of housing bubbles quite problematic and imprecise.

In order to fill the above gaps in the bubble research, the idea was to study the measurement of housing bubbles. This research is dedicated to the development of a new technique for estimating bubbles caused by the irrational interactions in the housing market. The technique is focused on the overall aim of developing an identification metric for bubbles rather than a prediction mechanism. With this in mind, I have attempted to construct an empirical model that allows us to mimic the path of irrational bubbles with a view to detecting them early enough during the phenomenon. This study is both theoretically and empirically significant in many respects. Given the need to develop better methods for measuring housing bubbles,

the research attempts to link the existing irrational view of housing bubbles with a new quantitative measurement method. Also, in attempting to produce a more reliable metric for housing bubbles, it is hoped that this research will reveal a new concept and hypothesis that will provide a more sophisticated definition of housing bubbles. Overall, it is hoped that the study will contribute towards a 'big picture' understanding of the development of housing bubbles in the UK context. Finally, it is hoped that this research will provide inspiration for future research in other geographical locations, like the US.

1.6 Research aim and objectives

1.6.1 Aim of the research

The specific purpose of this research is to develop an algorithm-based model for the identification of UK housing bubbles. It is hoped that the model will provide a new measure for studying the presence of (irrational) housing bubbles by using data up to the point of analysis for on-going bubble assessment, with a view to providing early bubble diagnostics. With this in mind, I have attempted to construct an empirical model that allows us to mimic the path of irrational bubbles, with the aim of detecting them during the phenomenon's maturity process. Therefore, the question this study intends to answer is: How can property bubbles be better detected in order to provide advance warning to market participants? The broad target of this study is to understand how the housing market operates within the context of cyclicity, what a housing bubble as a phenomenon is, and what causes the formation of housing bubbles.

1.6.2 What kind of model does the study aim to develop?

A model is an abstract representation of real world events and not an absolute representation of the real world. Models are developed and used for a range of different purposes, such as improving one's understanding of a phenomenon, simplifying and simulating a complex process, forecasting an outcome, identifying a phenomenon or providing a basis for decision making (Helms, 1998; Byrne, McAllister, & Wyatt, 2010; Giere, 1999; Caminiti, 2004; Jordaan & Lategan, 2010).

This research is concerned primarily with developing a model for the purpose of identifying the phenomenon of housing bubbles. The rationale for developing identification models in economics has been emphasised in recent studies by Mayer (2011), Agnello and Schuknecht (2011), and Orrel and McSharry (2009). These authors propose that economic models should emphasise the identification of economic phenomena (e.g. bubbles) rather than predicting the exact probability or the timing of the next crash or bubble, or even forecasting an outcome. Following this view, it is suggested that despite the productivity and dynamism of the economy and asset markets, they become unhealthy and unbalanced, with unstable price movements, and in such situations they appear to be near a state of disease⁴. Interestingly, the authors mention that the approach applied in medicine could guide the development process of economic models to the extent to which doctors use models to assess a person's health without predicting the exact probability or timing of catastrophic events like a heart attack. In the same way, the authors suggest that there is a need to develop and apply models to measure the health of the economy or specific markets (e.g. the housing market) without seeking to predict the next crash or the future movements of a variable/output. Following the above description, the model should be able to assess the 'health' of the UK housing market by providing early bubble warning diagnostics (during the bubble phenomenon's maturity process). In particular, the potential model should not only act as a diagnostic tool for housing bubbles but should also serve as a simplifying and simulating process. It is expected that this will be achieved by developing an empirical model that allows us to mimic the path of irrational bubbles. Finally, the potential model's results should be comparable with actual bubble behaviours/episodes in order to reach reliable conclusions. The key principles used in the development process of the model, as well as the characteristics of the model, are detailed in Chapter 5.0 on research methodology.

1.6.3 Objectives

The specific objectives of this study are the following:

- a) To build contextual knowledge regarding historical housing bubble episodes and the cyclical development of the UK housing market
- b) To explore the theoretical framework of housing bubbles and housing cycles

⁴ Regarding bubbles, Shiller (2000, 2015) and Case and Shiller (2003) also mentioned that a housing bubble is a kind of social epidemic (disease), whose contagion is mediated by price movements

- c) To review the literature on bubble detection methods/approaches and to critically analyse their gaps and limitations
- d) To describe historically and empirically the last two UK housing bubble case studies
- e) To develop a new methodology/model for estimating irrational housing bubbles and apply it to the UK housing market
- f) Draw conclusions

1.7 Research Outline

The thesis consists of nine chapters, including the current one, which has attempted to introduce the essential elements of the research. The remainder of the thesis is organized as follows. Chapter 2 attempts to demonstrate the cyclical nature of the UK housing market through three parts. The first part presents the general theoretical framework of housing cycles. The second part includes a historical evaluation of UK housing cycles since World War II. In the third, empirical section, the triangular methodology is applied to historical UK house price data in order to assess the magnitude, persistence, and severity of each phase within each UK cycle. Subsequently, Chapter 3 is devoted to presenting some notable historical examples of bubbles and examining the housing bubble theory. The theoretical framework provides details regarding key aspects of housing bubbles, such as definitions, concepts, academic views, causes and challenges. It also deals with the question of why housing bubbles are a recurrent phenomenon. Chapter 4 examines the literature on housing bubble detection/forecasting methods. It describes the several existing methods, including the fundamental value models, user cost (i.e. equilibrium) models, behavioural and survey method and descriptive analytical approaches. Chapter 4 also presents a composite critique on the effectiveness of these approaches, their weaknesses, knowledge, gaps and considerations that have influenced the particular focus of this research. A review of the optimal variables that a model should incorporate is also given. Finally, Chapter 4 details the on-going debate between the rational and irrational bubble theories, situating the current debate within the broader framework of the interactions of market participants. Chapter 5 presents the theoretical and technical level of the research methodology of the study. It also presents and describes the selected data in this study, the rationality behind these choices and justifications for excluding some other variables in this analysis. Chapter 6 provide a descriptive historical and empirical analysis of the last two UK housing bubble case studies.

Chapter 6 also links descriptively the recorded UK housing bubble episodes with the cyclical behaviour of historic UK house prices. The methodology's section in Chapter 5 provides the framework for the development of the model in Chapter 7. Here (in Chapter 7), an attempt is made to present, in a comprehensible manner, the actual development of the bubble detection model derived from the composite methodology proposed in Chapter 5. Chapter 7 also presents and explains the model's equation and its main properties based on the variables used. Chapter 8 apply the tests to validate the model. The testing process is undertaken by comparing the model's outputs with the actual historic bubble episodes in the UK (via utilising validation techniques). Finally, a discussion of the relationship between this thesis results with results of existing UK bubble studies is presented in Chapter 8. Chapter 9 draws conclusions and presents a brief review in terms of the research objectives achieved, the main research findings, contribution to knowledge, advantages and limitations of the proposed model as well as proposals for future research.

Chapter 2

2.0 Real Estate Cycle and Housing Market

This chapter is divided in three parts. First, a review of the theoretical foundations of cyclical markets in real estate is given in Part A. This review is extended to explain several issues such as the significance of cycles, the relevance of cycles in real estate market performance, existing definitions, the phases and inner workings of the cyclical behaviour of property markets.

The second part (Part B) i) presents a historical review of the evolution of the UK housing market, ii) highlights its cyclical and historic turning points, and iii) explains the main factors causing the UK market to experience cyclical behaviours.

The third part (Part C) includes a simple empirical analysis using the triangular methodology to empirically detect the turning points in UK housing cycles, as well as to understand them in terms of persistence, magnitude and severity.

2.1 Theoretical foundations of property cycles (Part A)

2.1.1 The significance of real estate cycles

Roulac (1996) has argued that the domain of real estate cycles has been used in professional practice more so than in the academic literature and that it has therefore received very limited attention in real estate education. Furthermore, few real estate courses have paid meaningful attention to real estate market cycles. However, since Roulac's criticism was published in 1996, many authors have published relevant academic articles on real estate cycles.

Pyhrr, Roulac, and Born (1999) state that if 'location, location, location' is used as a vehicle to validate an investment opportunity, then property cycles are increasingly becoming the mode for justifying the timing of several real estate strategies with respect to portfolio allocations (i.e. type and geographical market selection). The authors cite in p. 24 the

following from Dobrian (1997): “Like a wheel of fortune, the real estate cycle presents varied changes and opportunities. Can you bet with confidence on your response?” Pyhrr et al. (1999) further state that throughout history, real estate cycles have been a key factor in the financial success or failure of real estate investments.

2.1.2 The relevance of real estate cycles

Pyhrr et al. (1999) state that there are two schools of thought regarding whether real estate cycles are relevant. The first school claims that real estate cycles are not relevant and can thus be ignored, whereas the second argues that they are very relevant and should be carefully studied by analysts and investors.

Pyhrr et al. (1999) further outline 16 factors that the first school uses to argue that real estate cycles are not relevant and can therefore be ignored. They state that valuation theorists and appraisers have historically ignored cycles in their valuation frameworks and models. However, the second school of thought, using the “preponderance of evidence” approach, distinguishes the relevance of real estate cycles within three categories: macroeconomic, microeconomic and practitioner (expert).

The overwhelming academic and practitioner interest in real estate cycles, as evidenced by the growing body of knowledge on the subject, leads to the clear conclusion that real estate cycles are relevant and will become a more important decision variable for investors and portfolio managers in the future. While in the past, the concept of market cycles has been oversimplified and used more to support self-serving assertions about probable market recovery than as a guide to investment decisions, the situation appears to be changing rapidly. Increasing numbers of investors and portfolio managers appear to understand the dynamics and complexity of real estate cycles and their implications for investment and portfolio strategies and decisions (Pyhrr et al., 1999) p. 27.

2.1.3 Describing and defining real estate cycles

The theory of cycles is one of the basic human observations of the natural world. Events, economics and political systems move through cycles similar to the natural lifecycles of living beings (Bothamley, 2002). An early definition of a cycle as an economic phenomenon was suggested by Burns and Mitchell (1941) p.3: “Cycles consist of expansions occurring at about the same time in many activities, followed by similarly general recessions, contractions and

revivals.” One of the few concise definitions of the property cycle is offered by the Royal Institution of Chartered Surveyors (RICS, 1994): “Property cycles are recurrent but irregular fluctuations in the rate of all-property total return, which are also apparent in many other indicators of property activity, but with varying leads and lags against the all-property cycle.” RICS further clarifies that the property cycle is not necessarily regular in length, speed or severity. Baum (2000, p.6) attempts to simplify this by describing property cycles as a tendency for property demand, supply, prices and returns to fluctuate around their long-term trends or averages. As he further suggests, “prices in all markets go up and down. Inefficiency in real estate markets makes these up and down movements look like a repeatable, cyclical, pattern.” Another observer, Wheaton (1999), suggests that a property cycle involves repeated oscillations of a market as it continually overshoots and then undershoots its own steady state.

Among popular explanations of the property cycle referencing the UK market, is one developed by Barras (1983, 1994, 2005, 2009). He proposes that property markets behave cyclically in the long run, primarily because of building lags in relation to changes in demand for space that are mainly determined by fluctuations in business activity. An alternative explanation of boom-bust cycles is provided by Stoken (1993) and Shiller (2005). They suggest that boom and bust cycle theories are not theories in their own right because major events serve to trigger major cycles in property markets, which themselves are often explained by irrational human or crowd behaviour.

2.1.4 The phases of cycles

Several studies have described the property cycle as composed of various phases. An early study by Hoyt (1933) recognised four distinct phases of market behaviour in the property cycle: a boom in demand, rising prices, a boom in construction, and finally, a bust. Campbell and Trass (2011) simplified these phases into boom, slump and recovery. An alternative approach to the conceptualisation of property cycle phases was proposed by Pyhrr, Webb, and Born (1990, cited in Pyhrr et al., 1999). The authors suggest that a cycle consists of peak, declining, trough and rising phases. Baen (1994) developed a generalised risk analysis model and decision matrix for global property investments. His study advanced the theory that there is one generalised, theoretical property cycle and that each property market within each country is located separately on this ‘conceptual’ cycle consisting of five market phases:

recovering, improving, maturing, overbuilding and falling. Mueller and Laposa (1994) suggest that there are four phases in property cycles: recession, recovery, expansion and contraction (oversupply).

2.1.5 Theories of property cycles

Pugh and Dehesh (2001) distinguish two types of property cycle: endogenous and exogenous. The endogenous type results from long lead times between commissioning a project and contracting the work (Pugh & Dehesh, 2001; Reed & Wu, 2010). Kummerow and Lun (2005) add that endogenous real estate cycles are mainly caused by information problems: asymmetric information, forecasting difficulties and strategic uncertainty. In contrast, exogenous cycles have an external transmission mechanism and are caused mainly by macroeconomic and property trends. This type is sensitive to incomes, flows of funds, interest rates and exchange rates (Pugh & Dehesh, 2001).

Hoyt (1933), a pioneer in the subject of property cyclicity, conducted a major study on Chicago property cycles using analytical methods and other techniques. His findings were briefly as follows. The upswing in excess demand will cause a rise in gross rents, which will in turn drive increases in net rents. This will lead to escalating selling prices, consequently stimulating increased rates of renovation and new construction. Subsequently, an increased supply will be established, until it exceeds demand. In most cases, the full rate of construction constitutes a mania for building, which continues at the peaks of booms and is later followed by foreclosures, crashes and a long period of subsequent recession and abrupt reversals in lending policies among financial institutions.

According to Reed and Wu (2010), the fact that construction and development are lengthy processes in space development creates a mismatch in relation to changing market demand. Barras (1983, 1994, 2005, 2009) concurs with Pugh and Dehesh (2001) and with Reed and Wu (2010) that the property market behaves cyclically in the long run, principally due to building lags (construction delays) in relation to changes in demand for space, which themselves are primarily driven by fluctuations in economic and business activity. Mueller (cited in Rosenthal, 2006) explains that the lag between demand and supply exists because real estate supply cannot be produced instantaneously and that this lag creates the cycle. If new supply could be produced instantaneously in relation to proposed demand, then the market would always be in equilibrium and there would therefore be no cycles at all.

Questioning the construction lag explanation, however, Dokko, Edelstein, Lacayo, and Le (1999) argue that although many markets do have considerable production lags for large office construction projects, the building lag argument does not seem to explain the cyclical movement of other types of property, such as “tilt-up industrial space” (precast concrete), where the production time required is less than a year. Dokko et al. (1999) also shed light on two other aspects of real estate cycles: the greed of developers and bad decisions by lenders. They explain that as long as developers can secure financing for construction, they will build. On the other hand, the existence of lenders who fail to learn from past lending mistakes, along with the absence of regulatory or profitability limitations on lenders, contribute materially to the availability of credit, leading to the inevitable creation of bubbles and busts in real estate. Using a historical analysis based on some key studies, Barras (2009) argues that upward building trends are directly connected with the growth of urban populations and that there is an inverse relationship between building activity trends and the yields on government bonds: low interest rates and the resulting cheap credit fuel speculative building booms, while shocks such as wars or bank crises lead to massive increases in interest rates that cause building slumps.

Regarding the pattern of property cycles, Baum and Hartzell (2012) take a generic approach, noting that the following pattern in real estate cycles has repeated itself three times since 1970 in the US:

- The market value of existing property exceeds the cost of construction. Developers increase supply and sell properties at completion (earn profits).
- There are large amounts of debt and capital flow in the real estate industry.
- Building development activity increases (supply increases), creating jobs in real estate and related sectors (lending, construction, etc.).
- Supply exceeds tenants’ demand for space and oversupply (overstock) of properties causes rents to fall as tenants’ options expand.
- Property values decrease, ultimately dropping below replacement value. However, given the relatively long lead time to develop real estate, supply continues to be introduced to the market as projects that have been started are completed.

- New development stops, eliminating jobs in real estate and the associated industries, leading to further economic decline.
- Over time, the economy recovers, occasionally very slowly.
- As the economy recovers, jobs are created and income rises, increasing the demand for office, retail, residential and other space.
- Market rent levels increase, together with the wider expansion of the economy and absorption of space by tenants.
- Since replacement value (cost of building) exceeds the market value of existing properties, developers cannot profit by adding new supply to the market and a supply shortage develops.
- Nevertheless, rents increase at the same time, so market values for existing properties rise above the replacement value (cost). Developers are attracted and development slowly starts again.
- As investors seek abnormal returns based on the expectation of continuing value appreciation, capital flows into the real estate industry. Values and returns continue to increase, attracting more investors and funds, which in turn means more jobs, etc.
- As market values of existing properties increase above replacement values, developers boost the supply, sell buildings at completion and earn profits.
- Large amounts of debt (mortgages) and equity capital flow into the real estate industry.
- The cycle repeats itself.

Describing in more detail the direction of the phases, Mueller and Laposo (1994) and Mueller and Pevnev (1997) explain that the recovery and expansion phases are marked by falling vacancy rates, while construction and recession are characterized by rising vacancy rates. The up-cycle part of the real estate cycle denotes the recovery and expansion phases, while the term 'down-cycle' mainly refers to the contraction and recession phases.

Particularly, the pattern is as follows. In the recovery phase, the market is in a state of oversupply due to the previous oversupply or negative demand growth. At this stage, vacancy rates hit their peak. A market bottom is considered to have been reached when the construction from the previous cycle stops. When the cycle bottom has passed and growth takes place, the existing oversupply is absorbed and existing vacancy rates begin to fall significantly. In the wake of this, rental rates stabilise or even begin to rise, albeit at a slow pace, normally below the inflation rate. Eventually, the market reaches equilibrium. In the second phase (expansion), demand continues to grow with confidence, leading to a need for extra space. Vacancy rates fall below the equilibrium level, signalling that supply is limited in the market. During this phase, rents begin to increase rapidly (normally above the inflation rate) until they drive prices to reach the 'cost feasible' level that will allow new construction to start. Then, at some point, the property cycle reaches its peak, which can be described as the 'inflection point,' where the space market is tight and rents are high. This attracts new supply. The inflection point is followed by the third phase (hyper-supply). However, most participants do not recognize that this transition has occurred, since the market still looks good. During this phase, supply growth is higher than demand growth, while vacancy rates rise back towards a new market equilibrium. Eventually, market participants realise that the market has turned and commitments to new construction slow down or stop. If construction continues beyond the equilibrium point, the market will move into the fourth phase (recession), marked by high supply growth and low or negative demand. The extent of this downside phase is determined by the excess supply (i.e. the difference between supply growth and demand growth). The cycle eventually reaches the bottom (Mueller & Laposa, 1994; Mueller & Pevnev, 1997).

2.1.6 Cycles and bubbles - their relationship

Barras (2009) argues that after the 1960s, property cycles entered a new era called "modern real estate cycles," which differ from the old cycles in four ways. The most profound difference is that real estate cycles have become an international phenomenon due to globalization, since local and national real estate markets are linked via the cross-border movements of occupiers and investment capital. Pugh and Dehesh (2001) state that after the cyclicity of the post-1980 period, the interdependence of the property sector, the finance sector and the macro-economy in general has become even more obvious than in earlier times. The creation of this interrelationship basically marked the beginning of hyperinflation

in property prices, extended recessions, debt overhang (excessive debt), nonperforming loans in the banking and finance sectors, and more frequent bubble phenomena in the real estate market. Stoken (1993) asserts that most real estate cycles are not accounted for by theories in their own right. They happen when human irrationality or crowd behaviour causes major events that directly trigger cycles in property markets. Similarly, Dokko et al. (1999) shed light on two other aspects of real estate cycles: the greed of developers and bad decisions by lenders (i.e. disaster myopia). The authors explain that as long as developers can secure financing for construction, they will build. On the other hand, the failure of lenders to learn from past lending mistakes and the absence of serious regulations on lenders contributes materially to the availability of credit, resulting in the inevitable creation of bubbles and busts in real estate prices.

Generally, it is not yet clear whether a bubble is a part of a cycle or is an isolated phenomenon within real estate markets. It is, however, clear that bubbles are phenomena that are derived from or affected by the cyclical patterns of the market. Therefore, it is imperative for this study to first look at the cyclical nature of real estate and particularly at the evolution of the UK housing market within the context of cycles in order to better understand the meaning of bubbles. As such, this chapter will look at the historical cyclical movements of the UK property market, while the subsequent chapter will explore the UK housing bubbles episodes that have occurred throughout history.

2.2 Historical analysis of UK housing cycles and the evolution of the UK property market (Part B)

2.2.1 The UK property market prior to the Second World War

Prior to the Second World War, a large portion of urban and rural property was owned by aristocratic families, together with the Crown, and by large institutions such as Cambridge and Oxford Colleges. In addition, the Church of England was one of the prime landowners in the UK. Over half of the Church's investment portfolio comprised property assets (Fraser, 1993; Cadman, 1984). Compared to today, public authorities held only a small proportion of urban property before the Second World War era (Fraser, 1993). In addition,

insurance companies were relatively restricted to the ownership of property occupied in whole or part by the company itself. Most attention was paid to mortgages and ground rents. Thus, direct investments in property were almost non-existent. Nevertheless, a small number of insurance companies (legal and general) during the 1930s became aware of the long-term advantage of property and slowly began to increase their investments in property shares and equity involvement through the direct purchase of freeholds (Fraser, 1993).

Scott (1996) describes the entrance of insurance companies into property investment that occurred during the mid 1930s, reaching a peak of 11.2% of the total funds in 1935. Prior that period, during the 1920s, one of the few insurance companies to undertake a considerable volume of property investment was Clerical Medical. According to Fraser (1993), the lessons learned by the American insurance companies regarding the management of risk in the property sector during the crash of 1929 deterred UK insurance companies from becoming more actively involved in direct property investment at that time.

According to Scott (1996), between 1933 and 1938 there was a huge increase in the number of new public property companies that were established compared to the previous years, as banks and insurance companies began to offer funds for the property sector during the 1930s. Most importantly, the insurance sector offered long-term financing, while banks were a key source of short-term financing for the property development industry.

2.2.2 The UK property market during wartime and the immediate post-WWII period

After the announcement of war in 1939, confidence in the property market collapsed (Cadman, 1984; Scott, 1996). According to Scott (1996), during the wartime years only a small number of insurance companies became active in the property market. While property assets appeared to have performed relatively well compared to other assets during wartime, some well-known property developers (e.g. Jackie Phillips) fell into bankruptcy due to the sudden decline in the property market following the declaration of war in 1939. Some other speculators and developers faced a similar fate, and in a few cases insurance companies did foreclose on properties (mortgages) due to payment arrears or a moratorium on loans.

Speculators are always active, even in the most difficult times, such as war. A quite detailed example of that argument is underlined by Scott (1996): Despite the uncertainty in both economic and political issues due to wartime conditions and the emerging threat of a Hitler

invasion of Britain, some insightful individual speculators began to invest in properties during wartime. Their reasoning was simple: If the “Allies” (UK and other anti-Hitler coalition members) win the war, property values will be expected to escalate substantially during the post-war recovery period. On the other hand, if Hitler and the Axis alliance were victorious and conquered Britain’s land, it would be of little importance where they had invested their money.

Such investors/speculators purchased real estate for bargain prices during wartime and took advantage of future capital appreciation. That strategy created a number of post-war fortunes. The insurance companies, however, were unable to purchase properties during the Second World War, as they were obliged to place all their new funds in government bonds. This was a “gentlemen’s agreement” between the insurance companies and the central bank of England. This was despite the fact that general managers of insurance companies held an opposite view. For example, Sir Andrew Rowell, the general manager of Clerical Medical, a British life insurance company, stated in 1942 that his company should invest in property during the war since there would be prospects after the war. However, Clerical’s board did not accept this idea. A freeze on property investment was imposed until the end of the war in February 1945 (Scott, 1996). During the war, a huge destruction of property took place in the UK, especially in the city of London. An area of about 9.5 million square ft. of office space in central London was destroyed. About one third of London City was heavily bombed (Fraser, 1993). According to Scott (1996), more than 3 million properties were destroyed and most of them were houses. Moreover, this figure includes a total of 75,000 shops, 42,000 commercial properties and 25,000 factories. Bristol, Hull, Coventry, Portsmouth and central London suffered the greatest damage. According to Balchin, Bull, and Kieve (1995), 200,000 houses were destroyed during the Second World War era. At the end of the war in 1945, the shortage of housing was at least 1,350,000, without taking into account the obsolete houses that needed replacing. Under such conditions, the War Damage Act of 1943 was passed in order to cover the full costs of rebuilding properties that had been destroyed.

Following the end of Second World War, there was a tremendous increase in the birth rates of many countries, including the United States, United Kingdom, France and Japan. This is known as the “Baby boom” of the post-WWII era. The baby boom period lasted between 1946-1966 (Shiller, 2000). Despite the demographic growth, the beginning of the post-war era in 1945 led to a rise in real incomes and demand for services, goods and office space

(Fraser, 1993). In September 1944, a year prior to the end of the war, Lord Woolton and Winston Churchill stated that housing was “the very first urgency after the immediate needs of the war.” The previous housing shortage balance in 1939, together with population growth and the demand for replacement of unfit or obsolete houses caused massive housing shortages. In general, it was estimated that 3-4 million houses were needed in England and Wales in the first post-war decade (Malpass, 2003). According to Balchin et al. (1995) and Malpass (2005), between 1945 and 1951 more than a million houses were constructed in the UK, with local authorities contributing most. In total, UK local authorities produced almost 3 million housing units in the two decades following World War II. The massive scale of housing production was in response to the huge housing shortage together with the welfare state housing program (Stone, 2003).

By 1945, it was clear that Great Britain would win the war, and thus there was a sense that the redevelopment of the bombed cities would follow (Cadman, 1984). Soon, individual speculators and buyers began to appear more often. Scott (1996) argues that the demand for commercial space between 1945 and 1951 had increased. About 6% of total employment before the war was made up of office jobs. In 1951, this figure was increased by 16%. Compared to 1938, Britain’s GDP had increased by more than one-third in real terms by 1954. Eventually, under such promising and prosperous conditions, rental and capital values escalated. Even the prime locations that were bombed were eagerly acquired by speculators and developers immediately after the war, as there was a huge demand for tenancies. Despite favourable trends in the real estate market, many factors prevented wholesale redevelopment during the early post-war years (Fraser, 1993). As a result, by 1949, only 1% of London’s war-damaged area had been restored (Scott, 1996). Most importantly, the construction industry could not cope with demand, as there were insufficient industrial plants, a lack of skilled labour and building materials, and many businesses that had gone out of the real estate business during the war. Secondly, a building licensing system was imposed that consequently gave priority to repair work, work in aid of the exporting industry and work providing space for public authorities. Thus, long delays occurred in gaining ministerial approval for reconstruction plans (Scott, 1996; Fraser, 1993). Furthermore, the Town and County Planning Act of 1947 imposed a 100% tax on the development value of land, further demotivating developers (Fraser, 1993). The succeeding Conservative government took control in 1951 under W. Churchill. The Town and Country Planning Acts of 1953, 1954

and 1959 removed development charges and the Central Land Board⁵ terminated the building license system (Connellan, 2004). According to Fraser (1993) and Cadman (1984), these measures resulted in an increase in development potential and profitability in the real estate market. Consequently, a huge increase in site values occurred, laying the foundation for 10 years of intense redevelopment activity that led to the UK's first building boom.

2.2.3 The UK's first modern development boom of the 1950s and 1960s

According to Solomou (1998), the 1950s and 1960s constituted a period of economic stability. RICS (1999) argues that the property market was less volatile during that period. In support of this, Wellings (2006) reports that throughout the 1960s the growth in house prices was stable, with an average increase between 5% and 10%. The average performance of property assets during the development boom of 1955-1964 was less profitable than ordinary shares, but better than government bonds. Returns were 7% for property, 0.7% for bonds and 10.2% for ordinary shares (Scott, 1996). As for the property development industry, the development process in the first two decades after the Second World War was comparatively simple, secure, and profitable, especially from the developers' perspective. Firstly, the bombsites that were available for development (e.g. office use) and the high amount of unsatisfied occupation demand (due to previous shortages) meant a low risk of rent voids at completion. Developers found that in the post-war boom, a large amount of funds were accessible at low interest rates. The fact that rental growth tended to outstrip the rising rate of inflation over this period (1954-1964) resulted in huge returns for highly geared investors (Fraser, 1993). In 1951, there were 23,000 housing completions in the UK. After the removal of development controls in 1954 following the abolition of the Town and County Planning Act of 1947 and the switch to the "1953 policy," housing completions soared to 91,000, a 295% increase. By the early 1960s, the top ten house-builders in the UK constructed about 15,000 houses per year. Five years later, in the mid 1960s, the top ten builders were producing 17,000-18,000 houses per year, reaching the industry's peak of 222,000 houses constructed in 1968. By 1960, only 35% of new buildings were being produced by local authorities compared to their previous share of 89% between 1945-1951. Private property development was the new trend. Another notable trend at the time was the massive demand and production of flat-type housing. In central London, floor space had risen by 50% compared to pre-war levels (Wellings, 2006; Scott, 1996). According to Scott

⁵ The CLB was "set up with powers to facilitate the supply of land at existing use price" (Connellan, 2004).

(1996), inflation was reaching about 5% per annum in the mid 1950s. Under such conditions, an important innovation was introduced that is known today as “rent reviews clauses” with upwards rent reviews. However, the proper introduction of rent reviews happened in 1955. By the end of 1955, rent reviews became increasingly popular. For instance, Church commissioners began to seek rent review clauses for their new property purchases. Gradual progress was made regarding rent reviews clauses, starting with rent reviews in the 33rd and 66th years of leases. Later, the intervals became shorter and shorter as rent reviews became more widespread and inflation’s effects on property were more broadly appreciated.

Investors that had commercial properties (land) during the immediate post-war period between 1945-1954 found their fortunes increased considerably during the development boom of 1954-1964 (Scott, 1996; Fraser, 1993). According to Balchin et al. (1995), from 1953 until the mid-1960s there were tremendous changes in land values, which increased as much as ten times. Today’s property companies in the UK are fundamentally a post-war phenomenon. According to Fraser (1993), in the two decades following the war, from 1945-1965, at least 110 property millionaires were created. Moreover, the structural changes of real estate companies during this period were rapid. In 1939, the number of public property companies in the UK was just 35. Twenty-five years later, in 1964, the number of public property companies amounted to 185 (Fraser, 1993).

On November 4th, 1964, George Brown, the new Minister of Economic Affairs under Prime Minister Harold Wilson, announced the so-called “Brown Ban”⁶ requiring the issue of Office Development Permits (ODP) for new office developments in and around London. The introduction of the Brown Ban in 1964 announced the end of the development boom period that had lasted for 10 years. From 1965-1966, office development controls were extended to Birmingham and then to the whole region of the South East, East and West Midlands (Scott, 1996; Fraser, 1993). According to Scott (1996), the main aim of the “Brown Ban” implemented by the Labour Government was not to prevent a slump in the real estate market, but rather to prevent the rapid growth of London’s working population and the problems associated with it, such as transportation. However, the Brown Ban did set the foundations for an aggressive investment boom between 1965-1973 (Scott, 1996). Similarly, Fraser (1993) mentions that the outcome of the Brown ban policy restricted the supply of investments, especially in London and South East England. However, new investments in the form of re-sale and lease-backs were being created. According to Porter (2000), the only

⁶ Brown Ban: An almost complete ban on office development in and around London. The ban marked the end of the property development boom.

thing the “Brown Ban” succeeded in doing was driving up rents and increasing developers’ profits. Similarly, Scott (1996) states that the results of the Brown Ban and thus the ODP⁷ system had a number of faults. Firstly, it resulted in the rapid growth in office rents and market rents in the City area. For instance, City office rents increased from typical levels of £2 per sq. ft. in 1963 (prior to the introduction of the ban) to £5 in 1969, and more than £15 per square ft. in the early 1970s. Finally, the Brown Ban pushed developers to re-direct their investments to the retail property market where such restrictions were absent and which had prospects of high returns.

2.2.4 The 1970s Cycle

The 1970s were an important period for the UK housing market, as it was full of changes, ups and downs in prices, political shifts and major events in the spectrum of economics and banking. The following sub-sections are devoted to explaining in detail the aspects and events of the 1970s cycle.

2.2.4.1 The boom period of 1971-1973

The 1970s had started with a small decline in property values as the Labour Government introduced strict credit conditions in 1968. However, in June 1970, the conservatives took control under Edward Heath⁸. The main target of the new government was to curb inflation and regenerate the industrial sector and productivity. The government adopted a strict monetary and fiscal policy. Soon it was realized that tight monetary and fiscal policy was not the solution, so the government switched their policy to an “all-out expansion” using all available resources in order to beat inflation by increasing production. Under these conditions, industries were encouraged to reinvest and expand their businesses, in the belief that economic growth would be sustained without deflationary measures. In such circumstances, cheap and easy borrowing was the method by which this would be achieved (Fraser, 1993). When the Conservative government took control, many policies enacted to revise the market conditions, such as Office Development Permit controls, were relaxed and

⁷ Office Development Permit

⁸ Prime Minister (1970-1974)

the betterment levy⁹ was abolished (Connellan, 2004; Plimmer & McGill, 2003; Cadman, 1984).

This was the beginning of the property boom. In mid-1971, property yields started to fall and prices were rising. The fall in the bank rate on the 1st of April 1971, together with the relaxation of bank requirements for lending, was the inflection point of the boom. In September 1971, the Competition and Credit Control (CCC) agreement was formed. According to Matthews et al. (2007), the Competition and Credit Control agreement (CCC) enacted by the Bank of England in 1971 marked the beginning of the deregulation process and increased competition between banking institutions. Furthermore, restrictions on bank lending were abolished. Although the Government's strategy was to encourage investment in the manufacturing industry and thus improve the export balance, much of the available funds found their way into real estate and speculation (Cadman, 1984). Quite notable is the fact that secondary banks became highly exposed to risk starting in the early 1970s, as they provided loans to property companies for as much as 100% of the value of the project (Balchin et al., 1995). Scott (1996) also highlights that in some cases, real estate companies allowed interest payments to exceed their overall current income.

By 1971 and until 1973, a rapid inflow of funds fuelled the boom in property share prices (Perez & Westrup, 2008; Brett, 1997; Scott, 1996). In May 1972, property companies' share values almost doubled. The increased money supply gave rise to a strong but brief increase in economic activity during 1971-1973 in the UK, the so so-called 'Barber Boom' of 1971-73. During the early 1970s, bank advances to property companies rose dramatically, from £362 million in February 1971 to over £2.5 billion in February 1974, an increase of 614%. (Scott, 1996).

Alongside the increased lending to the property sector, a further boost in the UK economy occurred during early 1970s due to inflows of capital from foreign investors to London. Fraser (1993, p.346) states that in the early 1970s, property prices "far exceeded any year within living memory." Scott (1996) mentions that during the period of 1965-1973, property returns performed quite well. The average rate of return was 15.1%, compared to 9% for ordinary shares and 3.2% for bonds. As for the returns in real terms, the rate of return on UK investment property between 1965-1967 just exceeded the inflation rate, with 1.55%

⁹ Land Commission Act 1967: formed by the Labour Government, introduced a betterment levy as a 40% proportion of development value on all land sold, either in the market or to the Commission. However, the outcome of that policy was disappointing since the authorities failed to collect the forecast yield from the levy (Connellan, 2004).

return per annum in real terms. However, from 1968-1970, property returns exceeded the inflation rate by 10.65% and in 1971-1973, the return rose by 14.20% in real terms. As for the rent reviews, Brett (1997) mentions that between 1967-1973 landlords realized that the influence of inflation on rental values was very significant. This led the rent review period to be decreased to 14 years and then to 7 years and finally to today's 5-year period. This trend caused effective yields to increase and investment in property became even more attractive (Scott, 1996).

2.2.4.2 The inflection point of the crisis and recession of the 1970s (1973-1974)

The economic strategy of the Conservative Government under Edward Heath was to promote a regeneration of the industrial base of the economy. That strategy, however, soon began to go wrong. The supply of money expanded and despite the respectable performance of industry exports, imports from foreign manufactures increased dramatically. Hence, an imbalance of payments occurred from 1971 onwards (Fraser, 1993). Despite controls imposed on income and prices by the government, inflation started to rise again at a frightening pace. In late 1973, the oil crisis¹⁰ began and the effects were immediate. The crude oil price increased by four times. This event finally forced the government to begin a deflationary policy in November 1973. The funds that were available for investment in British industry for its fundamental reconstruction were inappropriately distributed in an inefficient way, consequently ending up in the pockets of a few property speculators and invoking the wrath of the press, politicians and public. Eventually, property companies and developers had become the subject of adverse publicity, which led public opinion to demand strict policies on developers. This led politician Denis Healey to say that they would "squeeze the property developers until the pips squeak" (Fraser, 1993, p.352). In November 1973, the successor of Peter Walker, Geoffrey Rippon, felt somehow obliged to act, as the public outcry had become more vigorous. He stated on television that "no one section of the community should make excessive profits at the expense of the rest," and that this was a matter of taxation. In the following month, December, the government announced proposals for Capital Gains Tax rates on the first letting of commercial property and a tax on new commercial property sales. The new taxes, together with the sudden increase in interest rates, acted as a threat to property companies' liquidity (Fraser, 1993). Additionally, during

¹⁰ On 6th October, a war between Egypt, Syria and Israel called "Yom-Kippur" started. On 17th of October 1973, several Arab countries decided to enact an oil export embargo.

the same month, new legislation was announced regarding empty commercial property premises (Scott, 1996). Fraser (1993) holds that despite increasing inflation during the early 1970s, little deflationary policy action was taken until the oil crisis. Cuts in Arab oil production, industrial action by electricity power workers and an overtime ban for coal miners led the Government to declare a state of emergency on the 13th of November 1973. The minimum lending rate was raised to 13%, with the aim of controlling the money supply. This action was followed by restrictions on personal loans, public expenditure cuts, and a 10% surtax charge on the 17th of December 1973 (Scott, 1996; Wellings, 2006).

According to Scott (1996), the major cause of the real estate crash in 1973-1974 was the fact that interest rates rose rapidly. Together with falling rental values and the falling demand for property, projects that seemed profitable and feasible when the interest rate was at 5% became quite risky when the market conditions changed unfavourably (i.e. when interest rates jumped to 13%) (Cadman, 1984). Balchin et al. (1995) highlight that uncertainty over the duration of the rent “freeze,” high interest rates and the prospect of strict fiscal measures restricting development profits, together with the wider international political crisis, affected the property market significantly. As secondary bank fortunes were directly linked to the property sector, falling property values led the secondary banks into financial deadlock. Cadman (1984) states that this then was the context in which the crisis of secondary banking erupted. The government responded to the property market slump with the introduction of legislation to “freeze” funds for property lending. Between 1973-1974, the involvement of secondary banks in the property sector had doubled. In 1974, the secondary bank “London and Country Securities” collapsed, leading to the collapse of two other secondary banks. It is quite notable that the property boom became a slump in a relatively short period (Cadman, 1984; Scott, 1996).

Due to the secondary banks’ collapse, there was a widespread fear of a generalized crisis in the UK financial system (Panagopoulos & Vlamis, 2009). Due to that fear, the Bank of England, with the contribution of the major clearing banks, formed a rescue plan in the 1970s called “Lifeboat.’ In total, 26 small banks (secondary banks) were supported with a grant of up to £1.3 billion in loans. The lifeboat plan was arranged by the Bank of England, the big four clearing banks, and the Scottish clearing banks. This led to the prevention of a widespread financial collapse, however, at a cost to both the Bank of England and the clearing banks that took part in the rescue plan (Balchin et al., 1995).

2.2.4.3 The crisis of the property market in the 1970s (1973-1974)

In 1974, the first property bubble collapsed (Balchin et al., 1995; Scott, 1996). This property boom had lasted almost without break since 1945, but the bust reminded market participants that real estate prices could go down as well as up (Scott, 1996). Following the government announcement of the 17th of December 1973 measures¹¹, the demand for investment within the UK property sector materially disappeared “overnight” (Fraser, 1993). However, financial institutions maintained a high degree of confidence and trust in the property sector, even after the crash in the early months of 1974. The first signs of the real estate crash were taken mainly as a momentary phenomenon of rising yields, rather than a crash and impending long-term recession (Scott, 1996).

The initial problems of the secondary banks were partly responsible for the problems of the property market in general. However, the problems of the property market then returned to the banking system. The inability of property companies to liquidate their assets made them unable to repay their interest payments and debt payments. Also, the declining value of properties made bank loans and thus the banks uncovered, since in some cases loans were as high as 100% of the property value. The banks were “locked into property” for two reasons. Firstly, the loans could not be served without forcing the property company into liquidation. Secondly, banks were committed to providing finance for continuing development projects (Fraser, 1993). According to Panagopoulos and Vlamis (2009) and Fraser (1993), the crash of the UK property market in December 1973 was caused by monetary and fiscal tightening, together with the general economic decline and the oil crisis of 1973. Additionally, high interest rates (13%) and the decline in rental and capital values made property firms quite vulnerable and unable to repay their enormous debts. These tight conditions made firms without instant cash flow highly vulnerable in the wake of falling property values. Property businesses were obliged to liquidate their tangible assets in order to remain solvent and avoid default. Thus, property companies began to place more and more properties on the market and the supply was increasing day by day. At the same time, the traditional purchasers, the institutions, appeared unwilling to buy as they did during 1968-1969. Thus, these events marked the deathblow to expectations of further capital gains (Fraser, 1993).

Wellings (2006) states that the financial crisis of 1974 hit the private housing market and caused financial damage to many house-building firms in Britain. In 1972, during the boom

¹¹ 13th of November declaration of state of emergency (MLR to 13%), 17th of December announcement of hire-purchase controls, restrictions on personal loans, public expenditure cuts, a 10% surtax charge and Development Gains Tax

period, housing completions were at 191,000. During the recession of 1974, private housing completions totalled 140,000. However, there was a 50% decline in the amount of housing projects begun during 1974. According to Fraser (1993), nearly no new commercial development projects were started after 17th December 1973, due to the fall in the value of property, rising building costs that were up to 25-30%, extremely high interest rates, and the liquidity problems faced by many property companies. Fraser (1993) argues that even at a nil land cost, most development projects were unattractive. During late 1973, a sharp rise in the completion of new office projects coincided with the recession. This caused supply to increase even more and occupation demand to fall, especially for offices in the City of London (Fraser, 1993). Balchin et al. (1995) state that in 1974, the rents in prime locations such as central London fell by 20% from the peaks reached in 1973. Meanwhile, the rental values of retail and industrial units seemed to withstand the pressure of the economy. The expansion of local authorities due to re-organization of space needs across the UK maintained the rents of regional offices at a relatively good level (Fraser, 1993). Quite remarkable is the fact starting that from the property market crash in 1974, and onwards until 1980, and for the first time since the end of the Second World War, both shares and bonds outperformed property returns for the first time (Scott, 1996).

2.2.4.4 The recovery of the UK property market after the 1970s crash (1975-1977)

In February 1974, the Labour Party won the election. Investment and recovery started in the UK property market at the end of 1974 due to the government's assurance that the "rent freeze" would be terminated in February 1975. On the 19th of December 1974, the government announced that the rent freeze would end on 1st February 1975, and rents would be allowed to rise starting from the 19th of March 1975. After the introduction of the Development Land Tax and the Community Land Act, no further property taxation measures were proposed (Fraser, 1993). This seemed to mark a turning point in the Labour Government's attitude towards the property sector. In this regard, financial institutions and pension funds were attracted to investing in the property market, mainly due to the abolishment of the "rent freeze." Furthermore, with liquid cash available, they found themselves in a good position to take advantage of the low market prices to build up their property portfolios (Fraser, 1993; Scott, 1996). However, Scott (1996) criticizes both of the acts (the Development Land Tax and the Community Land Act), as they caused further uncertainty in the development market during the mid-1970s.

The number of overseas real estate purchasers increased considerably due to the attractive property prices of the mid-1970s. This acted as a contributing factor in the recovery of the property sector in the UK (Fraser, 1993; Scott, 1996). According to Balchin et al. (1995), between 1973-1977 institutional organizations acquired property assets valued at approximately £4 billion, with half of them purchased under the lifeboat plan. According to Scott (1996), the property transfer from the troubled property companies to financial institutions that was organized by the Bank of England via the lifeboat scheme acted as a barrier to a further decline in property values. Although the properties were acquired at relatively low prices, without the Bank of England's intervention they would have been even lower. The recovery in the property market was interrupted in October 1976 due to another sterling crisis. However, in 1977, inflation began to decline again and interest rates fell abruptly. The balance of payments were at a healthier level, and together with the announcement of the North Sea Oil¹² project about to flow, the economy of the UK became more stable. Interest rates were not employed to protect sterling, and oil discoveries enabled the government to focus its attention on the problems of unemployment and production. In such a promising economic environment, property investment seemed waterproof, particularly due to rental growth in the recovering economy and the absence of new development (Fraser, 1993).

Fraser (1993) underlines that in 1977, property values regained or even surpassed the levels of 1973. Scott (1996) mentions that prime properties recovered more quickly, as these were more attractive during recession. According to Rowe and Pitman, cited in Scott (1996), expenditures by property firms reached £700 million in 1974. In 1977, this amount fell to £158 million and finally recovered in 1979 to more than £250 million. The real estate market continued its recovery through 1977. A statement showing the year's exact condition was made by *The Estates Gazette*, cited in Scott (1996, p. 207), describing 1977 as "the year when property as an investment medium came back from the dead." Scott (1996) states that although property yields were lower at the end of the 1970s than at their peak in 1970-1973, there was no threat of another property crash, since the re-structuring of the property and financial sectors enhanced the stability of the market.

¹² According to Bedarida (1979), in 1975 North Sea Oil landed on mainland Britain. UK became a net oil exporter and a self-dependent oil producer in 1980 (Bjornland, 1998).

2.2.5 The 1980s Cycle

2.2.5.1 The early to mid 1980s

The early 1980s can be characterised as one of the worst periods of industrial disinvestment, unemployment and uncertainty in the property sector. By 1983, unemployment in the UK had risen to approximately 3 million (Rydin, 1998; Brett, 1997; Clara, 1993). During this period, the government introduced two major policies, Enterprise Zones and Urban Development Corporations, with a view to reorganising development control and planning in accordance with a more market-oriented and entrepreneurial approach (Reitan, 2003).

These policies reflected economic rather than land use planning objectives. Thirty-two enterprise zones were designated. In some cases there was an important increase in development activity. The Urban Development Grant (UDG) was capital offered by the government with the purpose of involving both local authorities and the private sector in development projects. The Urban Regeneration Grant (URG) provided additional assistance to the private sector. It enhanced the role of the private sector and diminished that of the local authorities (Beswick & Tsenkova, 2010.) Based on a government review by consultants, it was found that between 1981-1982 to 1985-1986, the Enterprise Zone (EZ) scheme cost the government almost £300 million. 51% represented capital allowances, 28% was for relief and 21% for infrastructures and land acquisitions. However, by 1986, the outcome was the introduction of 2,800 businesses. The majority of those businesses were small, and about a quarter of them were new start-ups. In total, they employed around 63,300 people (Hall & Jones, 2011). In 1982, the fall in inflation to about 5%, from its peak of 22% in 1980, signalled a breakthrough in the early 1980s recession. Furthermore, as Roy and Clarke (2005) note, unemployment fell rapidly to 6% in the second half of the 1980s. Also during the 1980s, the UK's domestic financial markets saw strong deregulation initiatives. Banking deregulation, together with the abolishment of lending constraints, encouraged competition among UK banks. Traditionally, mortgages were predominately in the form of first advances for the purchase of a house. In the mid-1980s, second mortgages and further advances were given relatively freely to owner-occupiers via the introduction of the innovative product of house equity withdrawal (Buckle & Thompson, 2004; Dolphin & Griffith, 2011). Equity withdrawal supported a consumption boom in the latter half of the decade (Buckle & Thompson, 2004). In parallel with this during the early 1980s, the government introduced the right to buy scheme to help council and housing association tenants buy their homes at a discount. This measure contributed positively to home ownership and investment in the UK

housing sector (Kay, 2006). Generally, between 1982 and 1986, bank lending to property firms grew at over 25% per annum (Fraser, 1993). During this time frame, a property recovery began in London's real estate market and thereafter literally spread out like a "ripple." Vacancy rates in the City of London fell from 8% in 1984 to 2.25% in 1987. Market rents increased by over 50% in real terms between 1985 and 1989 (Scott, 1996). Between 1986 and 1989, UK house prices almost doubled, whereas between 1983 and 1987, house prices grew 12% per annum on average (Balchin et al., 1995; Wellings, 2006).

2.2.5.2 The boom period of the 1980s

As happened in the Barber Boom of the early 1970s, many of the funds that were primarily aimed at stimulating production were used on the financial sectors. However, the 1980s boom did not see a rapid inflow of funds from domestic institutions to the property market, as happened in the Barber Boom. It was principally a classical case of a speculative boom in property prices (Scott, 1996). The leverage of the UK's banking system changed dramatically during the 1980s. For instance, in 1979, banks accounted for about 5% of the outstanding mortgage debt, while by the end of 1987, they held 19.5% of the total mortgage debt. Also, during 1978-1981, between 5% and 20% of first time buyers borrowed 94% or more of their house value. During 1983-1987, almost half of the total mortgagors borrowed on a 95% to 100% loan-to-value ratio (LTV).

In general terms, between 1982 and 1986, bank lending to property firms grew at over 25% per annum (Fraser, 1993). Brett (1997) note that between 1988 and 1990, bank lending to property firms doubled to £34 billion. As to the loans for property development purposes, the conditions were relaxed. For instance, developers were usually required to put down at least 35% of the project's total cost. In the boom period, however, this threshold was reduced to 25% (Scott, 1996). This led to a massive expansion of real estate output. In 1981, private completions totalled 115,000. In 1988, the market peaked, with 200,000 completions (Wellings, 2006). As for office development, by the mid 1990s the volume of office space under construction was 110% greater than the levels reached during the early 1970s boom (Balchin et al., 1995). Also, demand for commercial space increased dramatically as vacancy rates in the City of London declined from 8% in 1984 to 2.25% in 1987. At the same time, market rents increased by over 50% in real terms between 1985 and 1989 (Scott 1996).

According to Brett (1997), between November 1985 and November 1990, office rental values rose by 135%, while between 1983 and 1987, housing prices grew at an average rate of 12% per annum. During the “hot years” between 1988 and the first half of 1989, house prices inflated nearly 30% (Wellings, 2006). Moreover, Japanese, Scandinavian, American and Middle Eastern investors and banks, among others, showed great interest in the UK property market at that time. According to Fraser (1993), the main reasons for the massive expansion of credit by foreign banks and investors were the removal of exchange controls and deregulation in the UK, European and other banking systems. This event contributed to the globalization of the financial markets. In addition, major overseas banks sought to establish a well-diversified portfolio of loans worldwide. European banks sought a European Union (Community) diversification and Britain was one place for this. Also, London became the European financial centre. Between Black Monday and December 4th, 1987 (almost 1 and a half months), property shares fell by almost 30% in absolute terms. Due to the crash, some tenants and businesses cut back their expansion plans and property companies adopted a ‘wait and see’ approach (Scott, 1996; Reitan, 2003). Surprisingly, the stock market collapse in October 1987 had little immediate influence on property values in the UK (Balchin et al., 1995). Values continued to increase and reached a peak in the first quarter of 1990.

2.2.6 The 1990s cycle

2.2.6.1 The property crash and the recovery that followed (late 1980s to early 1990s cycle)

In the early 1990s, the UK economy went into recession and interest rates began moving up to squeeze inflation out of the system (Fraser, 1993). Fraser (1993), Scott (1996) and Brett (1997) agree that the peak of housing completions coincided with a downturn in tenant demand, and as the economy moved into recession, a fall in property values inevitably occurred. Following these conditions, the mortgage rate in the UK in March 1990 climbed to 15.4% (Wellings, 2006). The first shock to the UK property industry was the announcement of bankruptcy by house builder firm Kentish Properties in August 1989. The main reason that triggered the default of Kentish Property Company was its inability to sell its completed houses due to high mortgage rates and the market downturn that was on the way (Fraser, 1993). The hope that the British economy would avoid a deep recession was lost when Saddam Hussein invaded Kuwait in July 1990, an event that brought about the same result as the Yom Kippur War. The oil price increased dramatically and there was a loss of business

confidence (Fraser, 1993). According to Vlamis (2007) and Roy and Clarke (2005), the entrance of the United Kingdom's currency into the European Rate Mechanism on 8 October 1990 triggered an overall failure of the UK economy. Meanwhile, lending institutions were becoming highly concerned about their non-performing loans; before 1991, few property companies had gone into receivership, while in 1992, Olympia and York and many others were placed into administration (Scott, 1996; Pugh & Dehesh 2011). Scott (1996) argues that ever since the international markets became interrelated, the collapse of one market could lead to the collapse of other markets. In support of this viewpoint, the property crash in the UK coincided with other property crashes in North America, Australia and Japan (Balchin et al., 1995).

According to Hillier Parker agents, cited in Brett (1997), between 1990 and 1993 property prices in all types fell by about 38% on average (Scott, 1996). Hillier, Parker and the London Business School, cited in Scott (1996), estimated that the total value of commercial property in Britain peaked at £250 billion in 1989, and then fell to £90 billion by 1992 (Scott, 1996). Similarly, the output of housing completions fell to 141,000 in 1992 from 200,000 in 1988, an almost 30% decrease (Wellings, 2006). The bust in the 1990s was the result of the reversal of several important factors. First, demographic trends reversed. Debt levels and real house prices reached very high levels, while income showed rather stable performance. Finally, mortgage lenders tightened up their lending criteria (Muellbauer & Murphy, 1997).

The exit of UK sterling from the Exchange Rate Mechanism (ERM) in 1992 caused interest rates to fall. In light of this, the property market began to stabilise. According to Brett (1997), during late 1993 and early 1994, ordinary share and bond returns fell to very low levels. This led investors to turn their attention towards real estate. By 1993, foreign investors had begun to invest in the UK property market, especially German, Middle Eastern, and Far Eastern investors. Moreover, the Hungarian-born financier George Soros announced a move into the UK real estate market. That move was a partnership with British Land and Quantum Group in an investment of about £500 million into the British commercial property sector. Such news was immediately reflected in the share price of British property companies, which showed a 6.4% increase. Also, outstanding bank loans to real estate companies, which had peaked at over £41 billion in May 1991, eventually fell to £33.5 billion in March 1994 (Scott, 1996; Brett, 1997). The year 1996 signalled the end of the recession and the beginning of recovery for the national housing market.

2.2.6.2 From the recovery of the mid-1990s to the bust of the 2000s bubble

Following the recovery year of 1996, the UK housing market went into a price expansion phase that became profound in the mid- to late 2000s. Low interest rates, strong levels of employment and the availability of credit caused residential values in the UK to escalate further. Between 2001 and 2003, the Bank of England base rate fell from 6% to 4%. Between 2005 and 2007, it was observed that global borrowing access had increased due to global credit availability. Lending criteria became less strict for borrowers and new mortgage techniques emerged to satisfy market demand. In such economic conditions, the average UK house price grew by £107,000 between 1999 and 2007. In the wake of the global financial crisis, 2008 signalled the end of the expansion phase and the beginning of the recession phase for the UK housing market (Adair, Berry, Haran, Lloyd, & McGreal, 2009). In July 2012, the Bank of England, along with HM Treasury, launched the Funding for Lending Scheme (FLS) to provide incentives to banks and building societies to boost their lending to UK's real economy and property sector. After this action, house prices saw a decline of about 1.5% in 2012, and since 2013, house prices have exhibited a significant increase.

2.3 Empirical analysis of UK housing cycles (Part C)

2.3.1 Overview of UK property cycles (literature)

So far, most of the research into UK property cycles has been limited to the commercial property market sector (McGough & Tsolacos, 1995; RICS, 1994; Barras, 2005; 2009; Ball & Grilli, 1997; IPD, 1999)

Among the few studies to concentrate on UK housing cycles, Bracke (2013) analysed data for nineteen countries, including the UK. The data ranged from 1970 to 2010. Bracke's (2013) findings reveal that upturns in international cycles are longer, on average, than downturns. Other related studies include the work of Agnello and Schuknecht (2011), who utilised data from 18 industrialised countries, including the UK, over the period of 1980-2007. Their analysis is based on annual data of real housing prices, as provided by the Bank of International Settlement (BIS). Similarly, Jaeger and Schuknecht (2007) examined the duration of boom and bust phases in the context of fiscal policy for 20 industrialised countries. They also utilised data from the BIS. It is noteworthy that the findings of the

studies are not conclusive at a country-specific level. The conclusions are based on the characteristics of the housing price cycle from several countries. Generally, the length of a property cycle has been examined on the basis of two phases: the upswing and the downswing (Case & Shiller, 1994; Bry & Boschan, 1971; Agnello & Schuknecht, 2011; Harding & Pagan, 2002; Bracke, 2013; RICS, 1994).

Murph (1997) and Reed and Wu (2010) highlight the importance of housing affordability in the context of cyclical markets. The existing theory of cycles implies that housing affordability decreases during house price upturns, while in periods of price downturns, affordability increases (Case & Shiller, 2003; Himmelberg, Mayer, & Sinai, 2005; Campbell & Trass, 2011; McCarthy & Peach, 2004). Nevertheless, the existing literature does not offer a consensus estimate of the size or even the existence of a housing affordability cycle. However, Tsai (2013) provides a way to gain an initial understanding on this topic. His study addresses how affordability is a driving force for self-occupancy demand and how this influences the direction of prices.

The identification of the co-movements of cycles requires detection of cyclical components and turning points. According to the past literature, the triangular methodology proposed by Harding and Pagan (2002) is among the most widely used approaches (Bracke, 2013; Jaeger & Schuknecht, 2007; Agnello & Schuknecht, 2011). Over the past several years, there have been a number of studies and publications on the characteristics of housing price cycles. Such studies have investigated house price cycles in different countries, including the UK (Bracke, 2013; Agnello & Schuknecht, 2011; Jaeger & Schuknecht, 2007); however, the conclusions drawn do not concern a specific country. In addition, the consideration of the cyclical behaviour of UK housing affordability has been overlooked.

2.3.2 Methodology and Data

This sub-section adopts the “triangular methodology,” as proposed by Harding and Pagan (2002), which extends the BB algorithm developed by Bry and Boschan (1971). The triangular methodology describes the cyclical turning points as follows. Locations corresponding to turning points in the original series are determined by identifying shifts in the level of rate of change. The sequence $[\Delta x_t > 0, \Delta x_{t+1} < 0]$ signals a local *Peak* in the

series occurring at time t , while the sequence $[\Delta x_t < 0, \Delta x_{t+1} > 0]$ identifies a local *Trough* occurring at time t . The cycle length is computed by both Peak-to-Peak and Trough-to-Trough. The cyclical Peaks and Troughs are placed at the highest and lowest points of the cyclical fluctuation (Bry & Boschan, 1971) using the above sequence. Based on the “triangular methodology,” I apply the approach of Agnello and Schuknecht (2011) to define the characteristics of the cyclical phases of upswings and downswings in terms of magnitude, persistence and severity. The persistence (i.e. duration) of each phase is calculated as the temporal distance between the beginning and the end of each phase. The magnitude is defined as the size of price change between the beginning and the end of each turning point. Finally, the severity is computed by combining persistence and magnitude for each phase i *via* a triangle, where the base represents persistence (D_i) and the height represents the magnitude (A_i). Hence, the severity is computed as $C_i = (D_i \times A_i) \times 0.5$.

This sub-section utilises data on real average house prices provided by Nationwide statistics over the period 1980-2014 for the United Kingdom. In this data set, real house prices refer to the inflation-adjusted prices. This data set uses the Office for National Statistics Retail Price Index (RPI) to convert nominal average house prices to current prices. Nationwide average house price represents the average price of all property types (i.e. new houses, modern houses, older houses). This data set spans from Q1 of 1980 to Q4 of 2014. In this sub-section, real average house price series have been converted to annual figures to reduce noise from short-term “interruptions” of long-term trends.

This sub-section also uses data on the house price to earnings (HPE) ratio to reflect the cyclical pattern of housing affordability over the period of 1984-2014 for the United Kingdom. The Halifax house price earnings ratio is calculated by dividing the Halifax seasonally adjusted standardised average house price by average earnings. Data on Halifax earnings is a calculation based on the average earnings for male full-time employees from the annual survey of hours and earnings (ASHE) done in April each year. Subsequent quarters are estimated using the national average weekly earnings (KAI7) published by the Office for National Statistics. Data for the HPE ratio is provided by the Halifax statistics on a quarterly basis. The data range between Q2 1983 and Q4 of 2014. The HPE ratios have been converted to annual percentage figures on the basis of the average ratio per annum to reduce noise from short-term “interruptions” of long-term trends. Data on the house price to earnings ratio is also analysed using the triangular methodology.

2.3.3 UK house price empirical cycle

The empirical analysis is applied using the methodology discussed above. The results reveal episodes of upswings and downswings for the UK housing market over the period of 1980-2014. The identified upswing and downswing episodes and their characteristics in terms of persistence, magnitude and severity are reported in Table 2 and Table 3. The upswings and downswing phases over the selected time period are indicated in Fig. 1. Upswings are denoted by a solid line and downswings are denoted by a broken line. Table 4 indicates the length of the house price cycle.

Empirical analysis of house price data over the period of 1980-2014 reveals two upswing and two downswing phases for the UK housing market. The upswings include 1983-1989 and 1996-2007. The downswings were found to be the periods of 1990-1995, 2008-2009 and 2011-2012. The latter downswing period was interrupted in 2010. On average, upturns tended to be longer than downswings, lasting 9.5 years, whereas downswings lasted for five years. The latest upturn¹³ in UK house prices was characterised by an extraordinarily long duration, large magnitude and high severity. The persistence, magnitude and severity of the latest upturn was increased almost two-fold compared to the 1980s upturn. Regarding the downturn phases, the analogy is not the same. The persistence of the downturn of 1990-1995 lasted for two years longer than that of the later case (2008-2009, 2011-2012), while the price magnitude and the severity of the 1990-1995 downturn declined almost twice as much as the first slump of the new millennium. By comparing the magnitude difference between each upswing period and its following downswing, I yielded some further interesting results. The total price decline for the downswing period of 1990-1995 was around 70% as a proportion of its prior price appreciation during the 1980s upswing¹⁴. While one would have plausibly expected that the level of price decline for the downswing period following the later upturn¹⁵ would have followed a similar pattern, the results are vastly different. The downturn phase following the 1980s upswing (i.e. 1995-2007) was about 25% as a proportion of the previous upturn.

Table 4 reports the full length of the recent completed house price cycle. Regarding the peak-to-peak turning points, the length is 19 years, spanning from the peak years of 1989 to 2007. For a complete cycle on a pure trough-to-trough level, the length is 15 years (i.e. 1995

¹³ 1996-2007

¹⁴ 1980s upswing, 1983-1989

¹⁵ Upswing period of 1996-2007

to 2009). Excluding the interrupted year of 2010, the length of the trough-to-trough cycle is 18 years.

Figure 1. UK real house price changes between 1980 and 2014

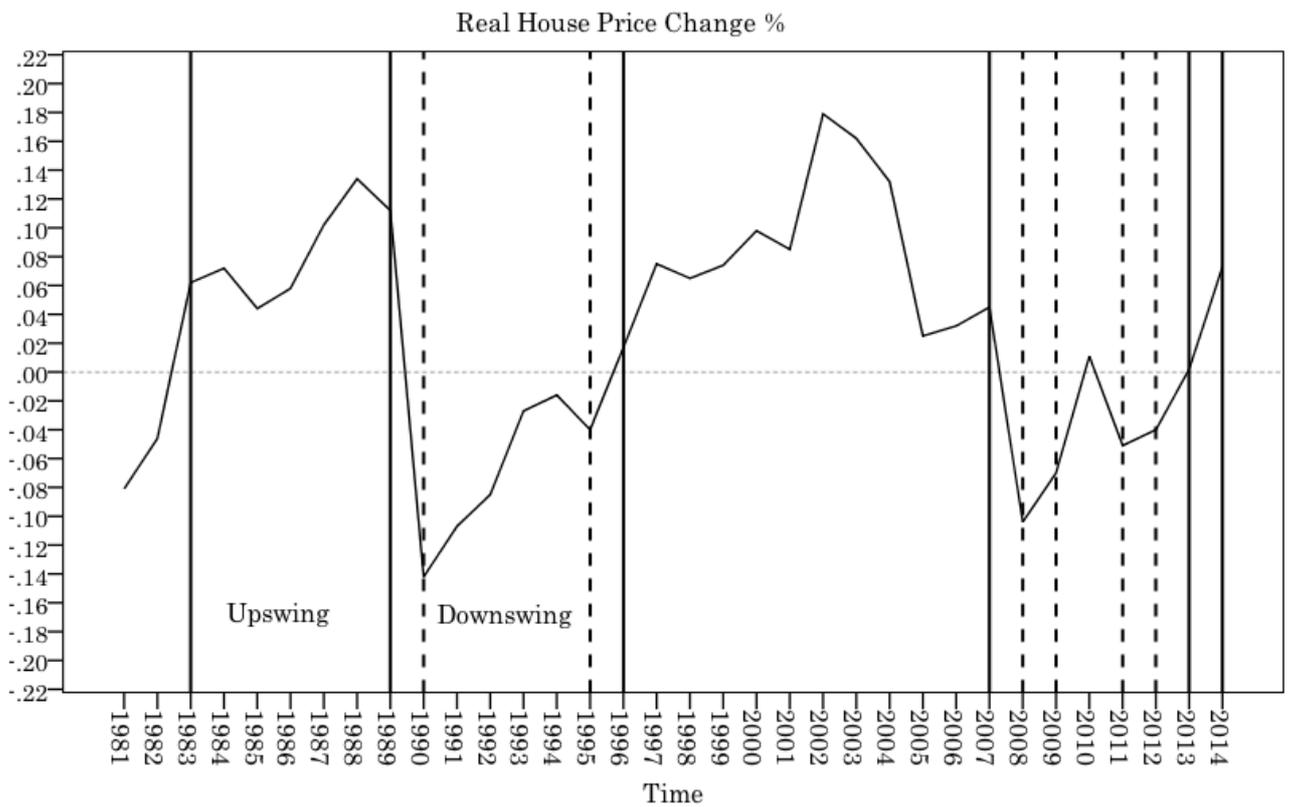


Table 2. Upswings in UK real house prices

Years	Persistence ¹⁶	Magnitude	Severity
1983-1989	7	58.4	204.4
1996-2007	12	98.9	593.4

Table 3. Downswings in UK real house prices

Years	Persistence	Magnitude	Severity
1990-1995	6	-41.7	-125.1
2008-2009 and 2011-2012 ¹⁷	4	-26.5	-53.0

¹⁶ Years

¹⁷ The downswing period was interrupted in the year 2010, when UK real house prices rose slightly, by 1.1%.

Table 4. Duration of UK housing cycles in years

Turning Points ¹⁸	Years	Length
Peak-to-Peak	1989-2007	19
Trough-to-Trough ¹⁹	1995-2012	18
Trough-to-Trough	1995-2009	15

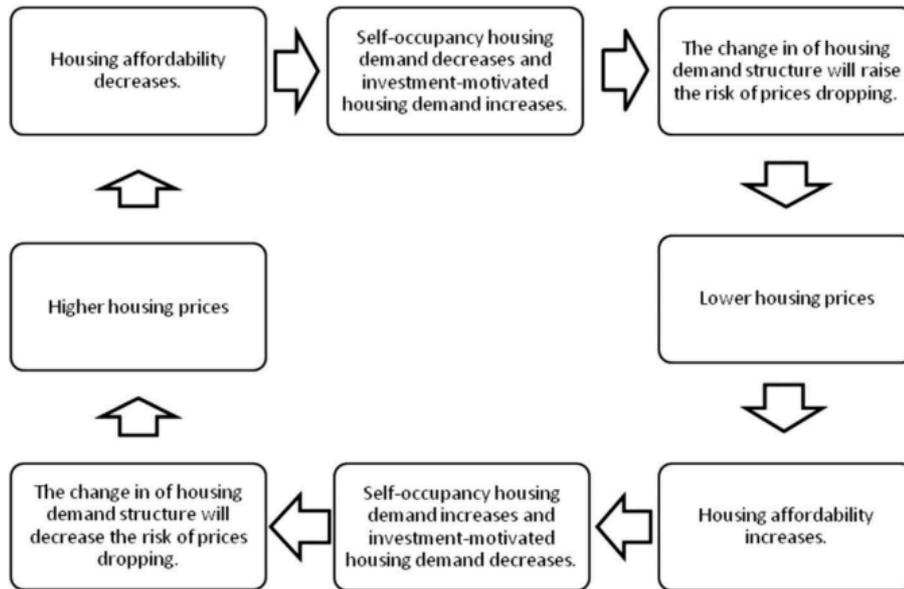
2.3.4 UK housing affordability empirical cycle

Does housing affordability have a cyclical pattern? Is such a cycle comparable to the housing cycle? An examination of the existing literature relating to property cycles does not offer a consensus estimate of the size or even the existence of the housing affordability cycle as a phenomenon. Not surprisingly, a comparative analysis between the house price cycle and the housing affordability cycle has not been previously reported. In an attempt to observe whether housing demand explains house price dynamics, Tsai (2013) hypothesised an interesting self-correction pattern for housing demand in the consent of affordability. His proposed pattern provides a good starting point for describing the cyclical stages of what can be defined as a housing affordability cycle. Figure 2 shows the house price self-correction pattern (SCP) of Tsai (2013), which illustrates the cyclical pattern that house prices follow during the self-correction process. It also describes how affordability is a driving force (in the SCP of house prices) and shows its effects on both self-occupancy and investment-motivated demand. The remaining part of this sub-section hypothesises the cyclical pattern of housing affordability, which parallels the house price cycle but is also subject to its own autonomous influences.

¹⁸ Peaks and Troughs are identified by the triangular methodology (sequence) provided by Harding and Pagan (2002)

¹⁹ Excluding the interrupted year of 2010, the trough point is the year 2012.

Figure 2. Tsai's (2013) self-correction pattern in house prices



Initially, it is worth clarifying that the hypothesis proposed below focuses on the one side of Tsai's (2013) demand structure, the self-occupancy demand. The rationale behind this choice relies on the fact that most housing affordability indices are made to illustrate the ability of first-time buyers or typical households to purchase a house. Therefore, this implies that most affordability indices estimate the demand from the perspective of self-occupancy.

In light of this, I modify the house price self-correction pattern of Tsai (2013) to shape the pattern of a housing affordability cycle. The modification is done by excluding investment-motivated demand, hence isolating self-occupancy demand. Self-occupancy demand is used to explain the pattern of a housing affordability cycle:

1. The starting point is a drop in house prices, which increases housing affordability²⁰ and self-occupancy demand.
2. As affordability and self-occupancy demand increase, the risk of price drops decreases, implying that a new upturn in house prices is underway.
3. Strengthening of demand increases house prices. An increase in house prices reduces²¹ housing affordability and self-occupancy demand.

²⁰ Higher or increased affordability refers to a decrease in the housing affordability benchmark (i.e., house price to income ratio).

4. The deterioration in housing affordability and the reduction in self-occupancy demand increases the risk of price drops. By that time, the price cycle is moving into its downswing phase.

The above-mentioned sequence describes the pattern of the affordability cycle, which parallels the house price cycle but which is also subject to its own autonomous influences.

The analysis concentrates on issues of persistence, magnitude and severity in the upswings and downswings of the UK housing affordability cycle. It also concerns the total cycle length. Figure 3 provides a visual representation of the cyclical performance of housing affordability in the UK. Tables 5 and 6 report the upswings and downswings of HPE in terms of persistence, magnitude and severity. In Table 7, I report the length of the complete UK housing affordability cycle, using both Peak-to-Peak and Through-to-Trough.

Before reporting the results, it is necessary to clarify that upswings in the HPE ratio show worsening housing affordability, while downswings reveal improving housing affordability levels. Over the study term, I found two upswing and two downswing phases for the UK housing affordability. The upswings include 1985-1989 and 1999-2007, and the downswings comprise 1990-1996, 2008-2009 and 2011-2012. As with the UK house price cycle, the downswing period of affordability in the latter case was interrupted in 2010, before ending in 2012. The interval period of 1997-1998 has not been attached to a phase, as it involves an unchanged situation (0). On average, upturns in HPE were longer than downswings. Upswings tended to last for seven years, whereas downswings lasted for 5.5 years on average.

The mid- to late 1980s upturn in HPE lasted for five years, whereas the latter upturn lasted for nine years. By comparing these two upswings in terms of the cycle's magnitude and severity characteristics, I found that the 1999-2007 upturn was almost twice as large as the 1985-1989 upturn. When comparing the two downturn phases, the results are the opposite. In particular, this study found that the earlier downswing (1990-1996) lasted three years longer than the most recent affordability downturn (2008-2009, 2011-2012). Furthermore, the magnitude of the earlier phase was 1.5 times larger, whereas the severity was almost 2.5 times higher.

²⁰ Decrease in affordability implies an increase in the housing affordability index (i.e. house price to income ratio)

By associating the differences in magnitude between each upswing period and its following downswing, I yield interesting descriptive conclusions. The total decline in HPE in the downswing period of 1990-1996 was approximately 120% as a proportion of the prior upswing. However, the downswing phase (2008-2009, 2011-2012) following the later upswing (1999-2007) had only an approximately 40% decline in HPE. Regarding the length of a complete housing affordability cycle, I found that the length is 19 years on a Peak-To-Peak basis and 17 years when measured on a Trough-To-Trough basis.

Figure 3. UK HP to earnings ratio, changes in %, between 1980 and 2014



Table 5. Upswings in HPE

Years	Persistence	Magnitude	Severity
1985-1989	5	34.0	85.0
1999-2007	9	65.0	292.5

Table 6. Downswings in HPE

Years	Persistence	Magnitude	Severity
1990-1996	7	-42.0	-147.0
2008-2009 and 2011-2012	4	-28.0	-56.0

Table 7. Duration of the UK housing affordability cycle

Turning Points ²²	Years	Length
Peak-to-Peak	1989-2007	19
Trough-to-Trough ²³	1996-2012	17
Trough-to-Trough	1996-2009	14

2.3.5 A comparison of UK housing cycles

The purpose of this sub-section is to provide a descriptive comparative analysis of the cycles of house prices and housing affordability. Initially, the analysis concentrates on the graphical trajectory of these two cycles. It then seeks to investigate their characteristics at both the cycle and phase levels. To this end, Table 8 presents the results for the house price and housing affordability cycles.

Figure 4 provides a comparison of the changes in the house price and housing affordability indicators. The change in housing prices fluctuates around the shift in housing affordability. Evidently, the shift in house prices is in near perfect cyclical synchronisation with that of the housing affordability indicator. In terms of magnitude, it seems that this harmonisation is slightly violated in the period of 1996-2001; however, the directions are approximately consistent.

²² Peaks and Troughs are identified by the triangular methodology (sequence) as provided by Harding and Pagan (2002)

²³ Excluding the interrupted year of 2010, the trough point is the year 2012.

Figure 4. House price and housing affordability: cycle comparison

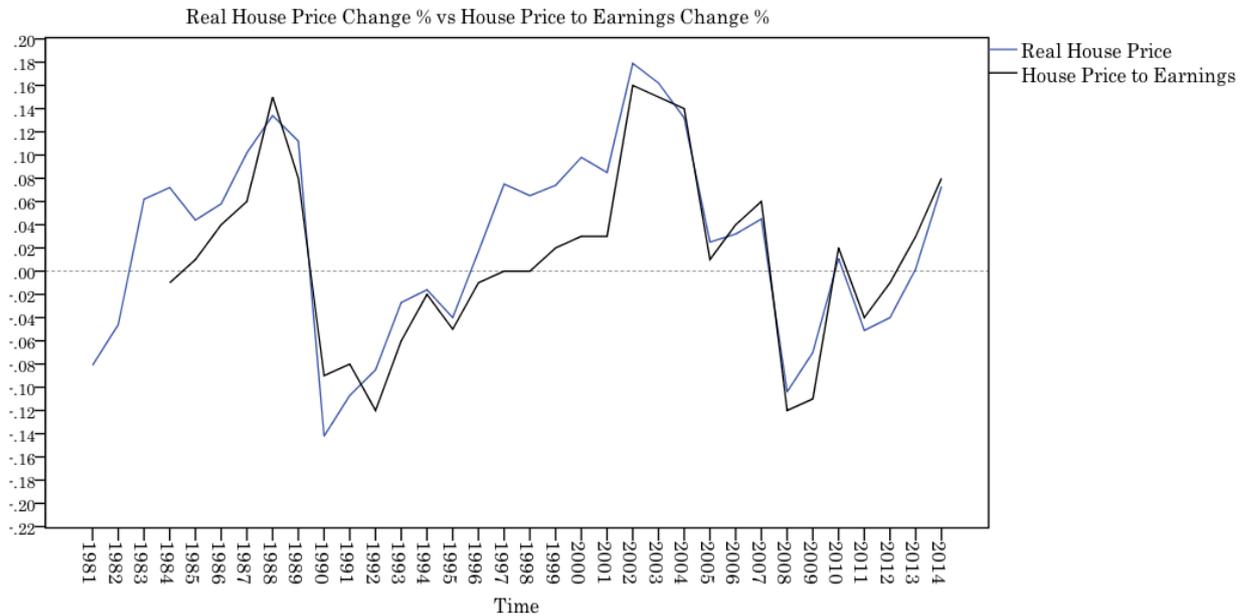


Table 8 reports the total lengths for both types of cycles by measuring them on a peak-to-peak (PP) and trough-to-trough (TT) basis. Their identified upswings and downswings and features in terms of persistence, magnitude and severity are also reported in Table 8.

When looking on the length of each cycle, it is worth noting that their total length is the same on a peak-to-peak basis. This is explained by the simultaneous occurrence of both cycles' peak points. On a trough-to-trough basis, their lengths are different by one year. Examining the results in Table 8 in greater detail, we find that the latter upswings for both cycles were more prolonged in terms of persistence. The study also reveals that the latter upswings for both cycles were characterised by extraordinary magnitude and severity. For both cases (price and affordability), the later downswing had lower persistence, magnitude and severity when compared with the earlier downswing. It is also worth noting that the downswings of both cycles were similar in terms of persistence, magnitude and severity.

Table 8. House price cycle vs. housing affordability cycle – A large-scale comparison

Cycle	Upswings			Downswings			Length of Cycle in years	
	Persistence	Magnitude	Severity	Persistence	Magnitude	Severity	Peak-to-Peak	Trough-to-Trough
House price							19	18
1983-1989	7	58.4	204.4	-	-	-	-	-
1996-2007	12	98.9	593.4	-	-	-	-	-
1990-1995	-	-	-	6	-41.7	-125.1	-	-
2008-09, 11-12	-	-	-	4	-26.5	-53.0	-	-
Housing affordability							19	17
1985-1989	5	34.0	85.0	-	-	-	-	-
1999-2007	9	65.0	292.5	-	-	-	-	-
1990-1996	-	-	-	7	-42.0	-147.0	-	-
2008-09,11- 12	-	-	-	4	-28.0	-56.0	-	-

2.3.6 Synopsis of the empirical analysis of the UK housing cycles

This sub-section examines the cycles in UK real house prices and housing affordability in the 1980s-2000s. The analysis focuses on the duration of the cycle and its phases, amplitude and severity. It also aims to examine the asymmetrical behaviour of the phases and the co-movements between the two types of cycles. From a historical perspective, analysis of these episodes leads to some interesting conclusions.

For the UK house price cycle, upturns tended to be longer than downswings on average. Upswings lasted for 9.5 years on average, whereas downswings lasted for five years. The latest upturn in UK house prices was almost twice as strong as the 1980s upturn in terms of persistence, magnitude and severity. Regarding the downturn phases, the opposite pattern is seen. The persistence of the price downturn of 1990-1995 lasted for two years longer than that of the most recent case (2008-2009, 2011-2012). The price magnitude and severity declined almost twice as much as in the first downswing of the new millennium. By comparing the difference in magnitude between each upswing period and its subsequent downswing, I yield some further interesting results. The total price decline for the downswing period of 1990-1995 was approximately 70% as a proportion of the prior price appreciation of the 1980s upswing. While one would have plausibly expected that the level of the price decline for the following downswing period would have followed a similar pattern, the results are vastly different. The downturn phase (2008-2009, 2011-2012) following the later upswing (1995-2007) had a price decline of about 25% as a proportion of the previous upturn.

Regarding the UK housing affordability cycle, the study's findings reveal similar results as with the house price cycle. On average, upturns were longer than downswings. Upswings tended to last for seven years, whereas downswings lasted for 5.5 years on average. By comparing the latest two upturns of HPE on the basis of magnitude and severity, I found that the 1999-2007 upturn was almost twice as large as the 1985-1989 upturn. When comparing the two downturn phases, the results are the opposite. In particular, my study found that the earlier downswing (1990-1996) lasted three years longer than the later affordability downturn (2008-2009, 2011, 2012). Furthermore, the magnitude of the earlier downswing was 1.5 times larger, whereas the severity was almost 2.5 times higher. The total decline in HPE in the downswing period of 1990-1996 was approximately 120% as a proportion of the prior upswing. However, the downswing phase (2008/09, 2011-2012) following the later upswing (1999-2007) had only an approximately 40% decline in HPE.

By comparing the two cycles, this study found four interesting results. First, the graphical trajectory of cycles in house price and housing affordability is highly synchronised. Second, upturns in both cycles tend to be longer, on average, than the downturns. Third, the recent upturns in house prices and housing affordability are characterised by a larger duration, magnitude and severity than the earlier cases. Fourth, the latest downturns in both cycles are highly synchronised with each other in terms of time occurrence, persistence, magnitude and severity and were lower than in the previous downturns. Additional results indicate that, on average, the length of a complete house price and housing affordability cycle is 19 years on a peak-to-peak basis. This evidence suggests that high regularity exists between the two types of cycles.

The above analysis is essentially exploratory and raises a number of questions for further investigation. There is an opportunity to extend the research questions for different geographical definitions, and there is also room to extend the research to examine causal factors underlying the differences in the phases of persistence, magnitude and severity. This analysis is among the few that has analysed cycles in house prices in the UK and the first study that draws attention to the housing affordability cycle. This analysis is also helpful in that it provides an initial understanding of the relationship between the house price and housing affordability cycles. This provides an initial basis for understanding the cyclical behaviour of the UK housing market. Since the 1970s and 1980s, real estate cycles have become an international phenomenon due to globalization. Evidently, the last two UK housing cycles have ended with a housing bubble bust, while for both cases there was a degree of over-optimism in the UK housing market from all market participants. Perhaps, the internationalisation of housing markets as well as the sophistication and openness of financial markets after the 1980s have created an era in which the UK housing market is prone to producing bubbles over an investment horizon. The following chapters seek to analyse and explain the mechanism of housing bubbles, with emphasis given to the UK context.

Chapter 3

3.0 Housing Bubbles and the Historical Review

This chapter focuses upon the theory of bubbles and particularly on the housing bubble as a phenomenon. It starts with a review on the definitions and descriptions of housing bubbles. A number of historic examples of bubbles are then selected for more detailed explanation, placing particular emphasis on their “bubbly atmosphere”. This review is followed by a summary of the current bubble views as hold by the current schools of economic thought. Then, this chapter outlines the concepts-types of bubbles. This review leads to a discussion of the expectation and speculation parameters and their relationship towards the phenomenon. Finally, this chapter examines the questions; what creates a real estate bubble, why housing bubbles recur and why does real estate crashes last so long.

3.1 Bubble definitions

Geraskin and Fantazzini (2011) note that the economic literature has reached no consensus about what a bubble is. Nevertheless, the authors offer the common example of “an asset whose price rises rapidly, encouraging investors to buy it, even though it is over-valued, because they can turn around and sell it at a higher price than they bought it at.” Barlevy (2007) notes that most economists would find the classical definition of a bubble (an irrational increase in the price of an asset in a short time) to be problematic and ambiguous. This definition is seen as imprecise because it fails to address core questions, such as how much the price must rise or how quickly in order to qualify the situation as a bubble. Stiglitz (1990) offers the following basic definition: “If the reason the price is high today is only because investors believe that the selling price will be high tomorrow—when ‘fundamental’ factors do not seem to justify such a price—then a bubble exists.” McCarthy and Peach (2005, p.4) divide Stiglitz’s (1990) definition into two parts. The first part is that “the level of prices has been bid up beyond what is consistent with underlying fundamentals,” and the second is that “buyers of the asset do so with the expectation of future price increases.”

Kindleberger and Aliher (2005, p.30) define a bubble as “any significant increase in the price of an asset or a security or a commodity that cannot be explained by the fundamentals,” while Reed and Wu (2010) summarise the contributions of Black et al. (2006), Glaeser, Gyourko, & Saiz, (2008) and Case and Shiller (1994) by defining a housing bubble as an unsustainable price surge that does not fit with societal fundamentals. Similarly, Barlevy (2007) p.46 affirms that most economists would define a bubble “as a situation where an asset’s price exceeds the fundamental value of the asset.” Thus, a simple mathematical expression of an asset price bubble is as follows:

$P > F$, where P denotes the price of the asset and F denotes the fundamental value of the asset. Housing bubble implies that the price of a house exceeds its fundamental value (Barlevy, 2007).

In a variant of this simple formula, Smith and Smith (2006) p.2 define a bubble as “a situation in which the market prices of an asset (such as stocks or real estate) rise far above the present value of the anticipated cash flow from the asset. Austrian economists Holcombe and Powel (2009, p.243) quote Frank Shostak’s definition of a bubble as “any activity that springs up from loose monetary policies, in other words in the absence of monetary pumping these activities would not emerge.” Agnello and Schuknecht (2011) mention that, in its simplest form, a bubble is defined as price rises of major duration and amplitude that deviate significantly from long-term trends.

For behavioural economists, a bubble is a kind of social epidemic that involves extravagant expectations of the future. Mainly, behavioural economists differentiate themselves from others by defining bubbles as a social epidemic rather than as a difference between existing prices and fundamental values. The above definitions of ‘asset bubble’ shed light upon the complexity of this phenomenon. Reflecting this complexity, Hayami (cited Hunter, et al. 2005) p.27 asserts that a ‘housing bubble’ is “a name we assign to events that we cannot explain with standard hypotheses. After the event, we may rule out some explanations that appeared plausible earlier, but we are unlikely to exclude all alternatives except the bubble explanation.” Expanding on the argument of Hayami, Meltzer (2002) explains that the reason why a bubble hypothesis is difficult, if not impossible, to test using fundamental value methods is that expectations are measured relative to hypotheses associated with rational expectations (i.e. they exploit all of the information) and thus the bubble phenomenon is what remains unexplained by the hypotheses. In this framework, a bubble is a name assigned to a phenomenon that may be explained by an alternative hypothesis.

3.2 Describing housing bubbles

In December 1996, Alan Greenspan, as chairman of the US Federal Reserve Board, coined the term 'irrational exuberance' to describe the behaviour of stock market investors during the 1990s. His use of these two words was immediately followed by stock market slumps: in Japan the Nikkei index dropped by 3.2%, in Hong Kong the Hang Seng lost 2.9%, in Germany the DAX index fell by 4% and in London the FT-SE 100 was down by 4%. The next morning in the United States, the Dow Jones Industrial Average decreased by 2.3% in early trading. A decade later, Shiller (2005) reported that people were still referring to 'irrational exuberance,' since this phenomenon had occurred again and again in different forms. During the late 1990s and 2000s, it became a catchphrase associated with bubbles, including housing bubbles. Case and Shiller (2003) p.299 state that in general and everyday use, the terms 'bubble' or 'housing bubble' refer to situations "in which excessive public expectations of future price increases cause prices to be temporarily elevated," indicating that the concept is defined in terms of people's thinking, their expectations and assumptions about future price performance, their theories regarding the risk of falling prices, and their worries about being priced out of the housing market in the future if they do not buy now. McCarthy and Peach (2004) present a simpler analysis: the rapid increase in national house price series counts as *prima facie* evidence of a bubble. However, such increases alone are necessary but not sufficient evidence; a deeper analysis is required.

Barlevy (2007) points out that the mass media often uses the term 'bubble' to describe a market condition in which the price of an asset has increased considerably in such a short period of time so as to suggest that the price is vulnerable to an equally sudden collapse. Shiller (2005, cited in Wanfeng, 2011, p.5) refers to the contribution of the mass media with respect to bubbles, citing a "price increase driven by irrational euphoria among individual investors, fed by an emphatic media, which maximized TV ratings and catered to investor demand for pseudo-news." Farlow (2004) claims that during a bubbly housing market, any evaluation of what is going on tends to become out of date and muted. During bubbles, the media have developed the habit of referring to those who continue to promote optimistic views as 'housing market experts,' while those holding more cautious views are called 'housing market doomsayers.' It seems that such behaviour on the part of the media is in the nature of a housing bubble. Another notable trend during housing bubbles is that homebuyers believe that a home that they would normally consider too expensive becomes an acceptable purchase due to the prospect of significant future price increases. As a result,

homebuyers feel they do not need to save as much as they otherwise might, because they expect that the rising value of their home will do the savings for them. First-time homebuyers may also worry during a housing bubble that if they do not buy now, they will not be able to afford a home later (Case & Shiller, 2003)

Case and Shiller (2003) observe a tendency during a housing bubble for market participants to view housing as an investment. Expectations of future capital appreciation are a motive for buying a home, while considerations of how much one must pay for housing services are ignored. The authors argue that this “is what a bubble is all about, buying for the future price increases rather than simply for the pleasure of occupying the home” and that “there is a tendency to crash when the investment motive weakens” p.321. Shiller (2000, 2002) further describes a bubble as “a social epidemic period of feedback, where price increases present stock prices could contain bubbles...enthusiasm among investors, who then bid up prices more, and then it feeds back again and again until prices get too high. During that period, people are motivated by envy of others who made money doing it, regret in not having participated and the gambler’s excitement. Stories develop that justify the bubble, they become current and then people think they’re right because everyone’s confirming the stories. So, when that happens eventually prices get too high and the bubble bursts.”

Shiller (2000, cited in Farlow, 2004, p.4) notes that the “absurd prices sometimes last a long time,” indicating that even when prices converge, the process might not be smooth or short. Tirole (1982, cited in Barlevy, 2007) likens investment in a bubble market to a game of ‘hot potato,’ in which each investor tries to pass an overvalued asset to the next investor to make a profit at the expense of the next buyer. If there were infinitely many investors, each trader would never run out of prospective hands into which to pass the hot potato. However, since the market has a finite number of buyers, it is not possible for everyone to find a buyer and avoid getting stuck with the hot potato. Similarly, Moinas and Pouget (2010) note that the main element in the existence of a rational bubble is that market participants can never be sure whether they will be last in the sequence.

Case and Shiller (2003) cast light on the description of the phenomenon by mentioning that the term ‘boom’ is much more neutral than ‘bubble’ and suggests that the rise in prices may provide an opportunity for investors. In other words, from the point of view of investors, a booming market offers the opportunity to make future profits. Conversely, the use of the term ‘bubble’ implies a negative judgment on the phenomenon of rising prices, or the view that the current price levels cannot be sustained, at least not for very long. Also, in a

graphical illustration, Case and Shiller (2003) show that a boom is the peak point of house prices, while a bubble is the process underlying the boom.

3.3 Historical Examples

3.3.1 Tulip Bubble – 1630s

One of the very first recorded bubbles was a rapid rise and sudden collapse of tulip prices in Holland in the 17th century (1636-1637) (Rapp, 2015; Maurits van der Veen, 2012). This event has been called ‘tulipmania’ and has become almost synonymous with the term ‘bubble.’ The story goes back to 1593, when a botany professor (Carolus Clusius) from Vienna brought to Leyden (a Dutch city) a collection of uncommon flowers that had originated in Turkey. Over the next decades, tulips became popular, but expensive. The year 1634 is widely held to be the first or second year in which tulip prices increased to levels considerably above those of the previous year. Then, in the autumn of 1636, the price of Dutch tulips increased by several hundred percent, with even larger rises in the price of some “infected” varieties. Some plants succumbed to a nonfatal virus known as the mosaic virus. The tulip mosaic virus affected the colour of petals and made them more attractive. In this aspect, the mosaic virus helped to trigger aggressive speculation in tulip bulbs (Malkiel, 2011; Kindleberger & Aliber, 2005). As Malkiel (2011) reports, by January 1637, bulb prices had reached astronomical levels. Indeed, a notable feature of tulipmania was the high participation of ordinary members of the public, including seamen, farmers and mechanics, while the sellers were mostly professional tulip planters and growers. Almost all participants imagined that the passion for tulips would last forever. However, in February 1637, the price of tulips entered a dramatic decline (Malkiel, 2011). When the bubble went bust, the tulips’ nominal value was negligible and people who had been trading in them were left with nothing more than a beautiful flower. The effects of the tulip price collapse were similar to those of today’s bubble-busts.

3.3.2 South Sea Bubble – 1720s (1719-1720)

The South Sea Bubble is considered the first major example of a speculative bubble that occurred on the London Stock exchange. The term South Sea Bubble originated from the name of the ‘South Sea Company.’ The company was founded in 1711 as a public-private

partnership with the purpose of converting £9.41 million of the British government's debt²⁴ into £10 million in company stocks. In return, the company was granted a trade monopoly with Spain's colonies in South America and the West Indies. The government would also benefit from this action since it would result in lower debt interest payments. Overall, the company would receive future profits resulting from the monopoly granted, and on 6 percent interest in perpetuity on the loan. Thus, the value of these new stocks were supported by at least the annuity held by the company and the anticipated further gains that the company would earn from its trade monopoly. Under these prospects of increased wealth flowing from South Seas ventures, massive amounts of money were freely invested in company stocks in anticipation of the over-optimistic stories of the massive profitability of those times (Glasner, 1997). However, during the 1710s, the King of Spain partly restricted the trading of South Sea Company in South America. Furthermore, the company never realised any significant profit due to the trading monopoly (Hargreaves, 2003). As a result, the directors of the South Sea Company turned their full attention to the further conversion of government debt in order to sustain their profitability. In 1720, a new proposal made by the company to the Parliament to take over the entire national debt sparked further speculation as market participants gambled on the conversion plan (Glasner, 1997). The price of the company's shares soon rose rapidly, and in about a decade their stock's price had increased ten times. A common trend at that time was the formation of numerous other companies to feed this wild speculation craze. Some promised profits from gold mining, while others promised massive trading in tobacco (Glasner, 1997; Kaul, 2014). By 1720, many market participants realized that the South Sea Company would produce very little compared to what it had promised (Hargreaves, 2003). In autumn of 1720, the South Sea Bubble burst. The company's share price fell from a high of £950 per share in mid-July 1720 to £200 by the end of September the same year (Walsh, 2014). The critical date in the collapse was the 24th of September 1720. On that date, the Sword-Blade Company, which had been acting as the banking agent for the South Sea Company, failed due to liquidity pressure from the Bank of England (Glasner, 1997). By December 1720, the South Sea Company's stock price had returned to its original value. Thousands of people suffered financial ruin (Hargreaves, 2003). Among them was the famous scientist Sir Isaac Newton, who believed in the dream and lost £20,000 as a result, amounting to almost all of his life savings (about £3 million in today's money) (Schoon, 2009). This event led him to famously

²⁴ British national debt incurred during the on-going War of Spanish Succession (1701-1714)

quote: “I can calculate the motions-movements of stars but not the madness of men” (Kaul, 2014).

3.3.3 British Railway Bubble – 1840s

The Railway Bubble was another instance of speculative activity that occurred in Britain almost one hundred years after the South Sea Bubble. The British Railway mania of the 1840s was characterised by an extensive enthusiasm for investing in railways shares. Initially, the industry was begun in 1825 with the development of the world’s first recognisably modern inter-city railway (the Liverpool and Manchester railway). At that time (in the late 1830s and early 1840s), the British economy was slowing down, interest rates were rising and government bonds had become a very attractive investment option. However, in the mid-1840s, since the economy was now improving rapidly, the Bank of England cut interest rates and the newly developed manufacturing industries began to expand. In that environment, government bonds became an unattractive investment and existing railway company shares began to increase in value, as more and more of people became willing to invest in railways. It is worth mentioning that many middle class families invested their entire savings in the prospect of the ‘railway revolution’ (Kennard & Hanne, 2015). In the wake of this, railway share prices showed a nearly exponential growth in price. Between January 1843 and August 1845, prices almost doubled as several railway companies were formed (Dimsdal & Hoston, 2014). As with other bubbles, the railway frenzy had uncovered another self-promoting cycle of over-enthusiastic speculation. In late 1845, investors began to realise that shares of railways companies were not as profitable as was believed, and most importantly, that railways were not as easy to build as they had been led to believe. In addition to this, the Bank of England raised its interest rates and alternative investments became more attractive. All of these factors caused a slowdown in the share prices of railway companies (Kennard & Hanne, 2015). By November 1845, railway stock prices had declined by 18% compared to their peak in August 1845. After a small recovery, prices continued the correction process until April 1850 marked a decline of about 58% in total on a peak to bottom basis, causing many families and individual investors to lose almost everything (Dimsdal & Hoston, 2014). However, unlike with some other asset bubbles, there was actually a tangible net benefit of the railway bubble: the vast expansion of the British railway system (Kennard & Hanne, 2015).

3.3.4 Stock bubble – 1920s

During the 1920s, there was another massive bubble. This time it was the stock market that experienced the bubble. In the early 1920s, economic developments in the US encouraged the rise of the stock market in the following decade. While Europe was still in the process of recovering from the damages of the First World War (1914-1918), the economic development of the US was occurring rapidly. The economy was also undergoing a transformation in the sense of an industrial organisation revolution, new management techniques, and the application of innovative and scientific approaches to industrial problems (Western, 2004). In this climate, the “roaring twenties” were characterised by a fabulous stock market bubble. Most investors in this wild market were on margin; a down payment of 10% was common (Western, 2004). This meant that an investor in \$5,000 worth of stocks would put down only a small part of that price in cash, borrowing the difference by guaranteeing the newly bought shares as collateral for the margin loan. In such a promising economic climate and with such lax financial regulations (governing the use of margins), it mattered little to investors whether they had to pay a broker 5, 12, or 14% per year on a such loan when motor or steel companies’ stocks might jump 10% in price overnight (Samuelson & Nordhaus, 2010). Between the beginning of the US recovery in 1922 and the height of its economic growth in 1927, the Dow Jones Industrial Average rose from about 80 to 150. The high revenues and productivity of the economy that prevailed at the time can explain this performance. However, between 1927 and 1929, the Dow Jones Industrial Average rose from about 150 to more than 380 points at a time when economic growth and corporate revenues were slowing down. Much of the explanation for this substantial increase was the excessive financial leverage and irrational enthusiasm for further economic growth fuelled by low interest rates and lax credit policies on borrowing for the purpose of investing in stocks (Odekon, 2010; Western, 2004). The speculation of the 1920s was soon followed by the 1929 panic and crash. October 24th, 1929, a date known as “Black Thursday,” marked the beginning of the “Great Crash.” The 1929 stock market crash was one of the most devastating stock market crashes in the recorded economic history of the United States. In the next four years, from 1929 to 1933, the US gross domestic product fell from \$103 billion to \$56 billion (Ruether, 2009). In particular, gross national product declined 30% between the period of 1929-1933 (Gailbraith, 1973). Coupled with this, five thousands banks were closed, 9 million Americans lost their savings and high unemployment resulted (Ruether, 2009). The crash affected all Western industrialized countries and did not end in the United States until the onset of American mobilization for World War II at the end of 1941 (Yan,

2011). Overall, the depression lasted for about 10 years, with the economy only recovering to the 1929 level in 1939 (Galbraith, 1973).

3.3.5 Florida Real Estate Bubble – 1920s – “The Riviera of America”

Alongside the stock market bubble of the 1920s, a real estate bubble was formed. According to Galbraith (1973), the Florida land boom was a classic speculative bubble. The Florida boom was a first indication of the mood of the twenties and the prevailing conviction at the time that “God intended the American middle class to be rich.” The land bubble in Florida was based on the illusion that the Florida swamps would make a wonderful residential area. The Florida real estate boom contained all the characteristics of a classical speculative bubble. The reality during the 1920s period was that real estate assets were gaining in value each day and could be sold at an attractive profit in a fortnight. The desire to get rich quick without much effort brought individuals to Florida in increasing numbers. Each week, more and more land was subdivided in order to satisfy peoples’ “needs.” Even the property prices of the close suburbs in Florida, within 40 miles, saw a significant increase (Galbraith, 1973). Allen (1931, cited in Rapp, 2009) provides many examples of huge increases in the prices of plots. The standard joke at the time was “a native saying to the visitor” “want to buy a plot?” and the visitor replying “sold” (Allen, 1931, cited in Rapp, 2009). The impact of the Florida land boom was also reflected in the formation and development of many new towns and cities such as Hollywood, Miami Beach, Coral Gables and more (Cumming, 2006). As in any bubble there is a pre-bubble environment that prepares for the upcoming development of a bubble, the case of Florida’s pre-bubble environment can be described as follows: easy credit, advertising and promotion of a lifestyle of sunshine and leisure, high accessibility to the popular cities of the Northeast, developments in transportation technology – especially automobiles, the aura of economic confidence of the 1920s, and the widespread belief that Florida land offered the best option to get rich quick (Allen, 1931, cited in Rapp, 2009).

These factors caused Florida’s population to expand relatively quickly and since housing supply could not match increasing demand, prices increased instantly as a result. As prices continued to increase rapidly, more and more speculators were attracted to investing in real estate, not with the purpose of living in the housing, but with the aim of re-selling it to another speculator. In that speculative stage, the original reason for investing in Florida’s real

estate market was already forgotten and investments were being made only for resale purposes. As this uncontrolled state continued and as the massive borrowing to invest in housing was something common, the real estate bubble inevitably popped (Rapp, 2009; Allen, 1931). In the spring of 1926, the supply of new buyers began to fall. At that time, the land boom of Florida had started to collapse and payments were beginning to default. Developers found themselves with overpriced land and no prospective buyers. The market did not recover until 1939²⁵ (Allen, 1931, cited in Rapp, 2009).

3.3.6 Dot.Com Bubble – 1997-2000

The dot-com bubble, also referred to as the “Internet bubble” was a classical speculative bubble covering the period of 1997-2000. From 1995 onwards, people began to have enormous expectations for Internet technology. They believed that it would instantly change the entire way business was done and that firms related to this business would reap enormous profits. As a result, an increasing number of American start-up Internet companies were formed and listed on the American stock exchange NASDAQ (Wollscheid, 2012). At the time, companies could trigger an increase in their share price by just simply adding the letter ‘e’ or ‘.com’ to the end of their names. In this situation, investors were willing to overlook traditional metrics such as P/E ratio when making their investment decisions. One of the companies that was significant to the bubble component was Books-a-million, which saw its stock price increase by over 1,000% in one week, simply by announcing and up-dated website on November 25, 1998. The company’s share price rose from around \$3 to \$47 on November 30. Two weeks later, its stock price was quickly corrected to around \$10. In 2000, the share price returned to \$3. Another example is the famous web hosting service company GeoCities. Yahoo purchased it for \$3.57 billion in January 1999. At that time, it was the third most visited web site on the World Wide Web. In October 2009, Yahoo announced the shut down of GeoCities services.

As the new millennium began, the dot.com companies began to look less like a commercial revolution and more like a bubble that was due for a bust. The collapse of the dot.com bubble occurred during 1999 to 2001. Some companies, such as Pets.com, failed completely, while other lost a large share of their market capitalization but remained profitable overall. A few others not only recovered but also surpassed their dot.com bubble peaks, including Amazon.com and eBay.com, whose stock went from \$107 to \$7 per share, but a decade later

²⁵ Extreme climate events (temperatures and hurricane) in 1925 contributed to the downfall of the land boom.

exceeded \$400. Generally, the end of dot.com bubble in the early 2000s caused a loss of \$5 trillion in the market value of companies in just slightly over two years (from March 2000 to October 2002) (Kennard & Hanne, 2015).

3.3.7 1970s (1971-1973)

Briefly speaking, in the early 1970s, property lending jumped from £362 million in February 1971 to over £2.5 billion in February 1974 (Scott, 1996; Panagopoulos & Vlamis, 2009). Inflows of capital rose and policies in favour of income allowances became more frequent during this period (Scott, 1996). The result of these actions was a property market boom in which increases in values “far exceeded any year within living memory” (Fraser, 1993, p.346). Additionally, due to the flawless record of stable growth and security during the post-war period, property was considered to be the “ultimate” inflation hedge asset. Relying on this view and on the increasing competition between banks, a huge expansion in lending for property investment purposes occurred. In some cases, the loan-to-value ratio was up to 100%. As long as the property capital values were expected to increase at a rate greater than the interest rates (i.e. the borrowing rate), increasing interest rates and thus debt had little influence on further borrowing (Fraser, 1993). From 1968 to 1970, property returns exceeded the inflation rate by 10.65% and in the bubble period of 1971-1973, the real return rose by 14.20% (Scott, 1996). In terms of the scale of this increase, Wellings (2006) and Fraser (1993) describe the changes as unprecedentedly high. Beginning in 1971, imports from foreign manufactures increased dramatically and an imbalance of payments occurred (Fraser, 1993). In October 1973, the oil crisis²⁶ started, and the effects were immediate. As such, in November 1973, the Bank of England raised the minimum lending rate to 13% (Wellings, 2006). In December, the government announced proposals for Capital Gains Tax rates. The new taxes, together with a sudden increase in interest rates, acted as a threat to the liquidity of property companies (Fraser, 1993). The government measures of 17 December 1973, which imposed a restriction on personal loans, public expenditure cuts and a 10% surtax (Scott, 1996), caused demand for investment in the property sector to disappear “overnight” (Fraser, 1993). In this property market slump, a crisis in secondary banking erupted (Cadman, 1984). By 1974, private housing orders had declined by 50% (Wellings, 2006) while from 1974 to 1980, both shares and bonds outperformed property returns for the first time since the end of the Second World War (Scott, 1996). By 1977, the UK

²⁶ On 6th October 1973, the “Yom-Kippur war” started.

property market showed signs of recovery following a brief price expansion (Scott, 1996). During late 1973, a sharp rise in the completion of new office project coincided with the recession. This caused supply to increase while occupation demand for offices in the City of London fell (Fraser, 1993). In 1974, the rents in prime locations such as central London fell by 20% from the peaks reached in 1973 (Balchin et al., 1995). The property expansion, which had lasted literally almost without break since the end of World War Two, reminded speculators that real estate prices could go down as well (Scott, 1996).

3.4 Bubble Views

Asset bubbles are one of the most debated topics between economists. Different schools of economic thought hold different views as to whether asset bubbles exist and what causes the phenomenon. Principally, there are three main views on bubbles. These are the view of the Chicago school, the view of Keynesians and the proponents of behavioural economics, and the view of the Austrian economic school.

3.4.1 Chicago school of economic thought: Bubbles do not exist

The efficient market hypothesis (EMH) is central to efficient market theory. It is generally known as a foundation of modern financial economics and an inherent part of the Chicago school of economic thought.

Roberts (1967) first coined the term ‘efficient markets hypothesis’ (EMH). He was the first to make a distinction between weak and strong form tests, which became the classic taxonomy used by Fama (1970). The notion of market efficiency was evolved and operationalized in two influential papers by Fama, in 1970 and 1976. In these works, Fama (1970, 1976) claimed that under the EMH, asset prices (i.e. stock prices) incorporate and reflect all available information. This main hypothesis implies that no investment strategy or investor can beat the market, since market efficiency causes existing share prices to always incorporate and reflect all relevant information. Following Fama (1970, 1976), three assumptions must hold for the efficient market hypothesis to be accepted²⁷. First, there must be a large number of profit maximizing participants who analyse and value securities, and

²⁷ Except for the main hypothesis of efficient markets that prices reflect all available information.

they must operate independently of each other. Second, new information regarding securities comes to the market in a random and independent fashion over time. Third, investors adjust security prices rapidly to reflect the effect of new information (Lee, Lee, & Lee, 2009). Under the EMH, all asset prices (i.e. stocks) are equal to the discounted value of their rationally expected dividend payment streams. This incorporates many factors such as volatility and all risks. Also, markets are assumed to consist of rational, independent investors who drive the economy to a state of optimal equilibrium. This is the simplest version of the EMH and often the one most referred to for calculating prices. Adherents of the EMH consider that asset prices are always correctly priced (i.e. they reflect all available information). As a result, EMH proponents tend to deny a connection between excessive speculation and subsequent crises within markets (Kettel, 2002; Orrel & McSharry, 2009).

The Chicago school and the proponents of the efficient market hypothesis deny the existence of bubbles. They claim that under the EMH, bubbles are impossible events (Dreman, 2011; Kaul, 2014; Kettel, 2002). Continuing with this theme, Fama emphatically asserts that there are no bubbles or panics because rational investors always keep prices where they should be (Dreman, 2011). Particularly, when Fama was asked by *The New Yorker's* John Cassidy how he thought the EMH had held up during the recent financial crisis, the Nobel laureate responded:

"I don't even know what that means. People who get credit have to get it from somewhere. Does a credit bubble mean that people save too much during that period? I don't know what a credit bubble means. I don't even know what a bubble means. These words have become popular. I don't think they have any meaning" (cited in French, 2013).

In support of Fama's viewpoint, Friedman (1953) advises us that rational traders will quickly undo any dislocations caused by irrational traders. He divided his argument into two steps. First, as soon there is a deviation from 'fundamental value,' a mispricing is created. A mispricing is translated as an investment opportunity from "markets." Second, rational traders will immediately catch such an opportunity, thereby correcting the mispricing (Barberis, 2003). Hence, no bubble can emerge. Malkiel (2011) also emphasized that markets will eventually correct any mispricing and recognize the true value. However, some adherents to the EMH and rational expectations consider that there could be a rational deviation from the fundamental value, which they term "rational bubbles" (Blanchard & Watson, 1982).

3.4.2 Critiques of the Chicago school and the EMH: Bubbles may exist

According to the mainstream financial theory of the EMH, the market and its participants are, for the most part, rational, wealth maximizers. As such, bubbles are impossible events. However, with the development of the real-world markets, the perception that investors might not be rational and that bubbles may exist has become progressively stronger. Speculative bubbles are an obvious anomaly. In the real world, bubbles and busts are too numerous to count, including in stocks, real estate, commodities, and art, all over the world and throughout modern economic history. Historical bubble events empirically justify the existence of irrationality and the fact that bubbles do happen is the one clear and unequivocal proof that the efficient market hypothesis is unrealistic. Warren Buffet is an ideal example of an investor doing what the EMH deems implausible if markets were efficient: he invests smart, buys cheap, sells high and consistently makes a good profit, thus “beating” the market.

The growing disapproval of the EMH seems to have begun in the early 1980s with the pioneering studies of Robert Shiller (1981, 1989) on the excess volatility of financial markets. Shiller’s work challenged the orthodoxy that economic models must always assume rational expectations by all economic agents (Campbell, 2014). Shiller applied formulated statistical tests of the EMH based on the volatility of stock market prices relative to the volatility of dividends. He proved that asset prices in the stock market diverge systematically from what are considered fundamental values. Shiller proposed and verified that asset prices in the stock market are too volatile to be justified by changes in dividends. His findings were interpreted as a violation of the efficient market hypothesis. From then on, researchers have paid widespread attention to bubble issues and Shiller’s work is seen as having signalled the birth of the modern bubble literature.

After nearly three decades of research, the knowledge of investors’ behaviour and asset markets constitutes a new area of research, eventually resulting in the creation of behavioral finance (BF), an opposing theory to the EMH. More broadly, the EMH under Fama’s opinion claims that asset price movements can be understood using economic models under the assumption of rational investors, whereas behavioural finance under Shiller’s opinion does not (Campbell, 2014). Behavioural finance argues that models containing irrationality (or non-fully rational agents) can better explain some financial phenomena, like bubbles

(Thaler, 2005). This distinction is important for evaluating the on-going debate on market efficiency.

Opponents of the EMH claim that the central hypothesis and the required assumptions of the EMH are over-idealistic in the real world. Yang (2006) p.19 also claims that “rational bubble tests are weakened by excessive assumptions as well as statistical biases.” Concerning housing markets, Case and Shiller (2003, 1989, 1988) found that the housing market paints a very different picture from what the EMH holds. Their survey results suggest that house prices do not follow a rational pattern. Instead, the authors found that real estate markets are driven largely by expectations based on past price movements rather than on any knowledge of fundamentals. Of course, this finding stands opposed to the EMH assumption that investors value assets rationally by utilizing all available information. Kuhnlenz (2014) also mentions that the assumption that all investors make use of all available information when forming their decisions (i.e. rational calculations) is unrealistic for all real investors and for all markets. Following this, Kuhnlenz (2014) criticizes the EMH by arguing that if all investors had the same information and if prices were always correctly priced then obviously there would be no incentive to trade. In line with this, Hasset (2002) supports the existence of irrationality and bubbles in asset markets and declares that if investors believe they can sell stocks at higher prices, present stock prices could contain bubbles. Meltzer (2002, pp.2-3) also mentions that the rational bubble hypothesis is empirically empty and that expectations of prices cannot be observed at all. He further states that “it is for these reasons that attempts to test the rational bubble hypothesis have not produced compelling evidence.” As for the argument of rational traders and mispriced assets, which was elaborated by Friedman (1953), followers of behavioural finance have responded that Friedman’s argument is not true. They argue that even when an asset is ‘noisily mispriced,’ the strategies that are designed to correct mispricing can be costly and/or risky and may be rendered unattractive (Barberis, 2003; Thaler, 2005; Sulphrey, 2014).

3.4.3 Keynesianism and behavioural economics: Bubbles do exist

The idea that bubbles exist in asset markets is often traced back to Keynes (1936). In Chapter 12 of his influential work, *General Theory of Employment Interest and Money*, he introduced the metaphor of financial markets as a beauty contest. Keynes argued that asset markets operate in an environment in which market participants may not be governed by an

objective view of fundamentals but by “what average opinion expects average opinion to be.” Linking this to the model of beauty consent, he writes:

“Professional investment may be likened to those newspaper competitions in which the competitors have to pick out the six prettiest faces from a hundred photographs, the prize being awarded to the competitor whose choice most nearly corresponds to the average preferences of the competitors as a whole; so that each competitor has to pick, not those faces which he himself finds prettiest, but those which he thinks likeliest to catch the fancy of the other competitors, all of whom are looking at the problem from the same point of view. It is not a case of choosing those, which, to the best of one's judgement, are really the prettiest, or even those which average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practise the fourth, fifth and higher degrees.” (p. 156)

For Keynes, the game is won by those who can accurately assess what others think others think others think is beautiful. In financial markets, the knowledge of what others believe to be true about the movement of the market is crucial for identifying how markets will indeed move (Allen, Morris, & Shin, 2003). Therefore, the Keynesian view (1936) on bubbles refers to the argument that much of investment is driven by expectations about what other investors think everyone else think, rather than by expectations about the fundamental profitability of an investment. Keynes (1936, pp.161-162) sums up his exact view by mentioning that “there is the instability due to the characteristics of human nature that a large proportion of our positive activities depend on spontaneous optimism rather than on mathematical expectation, whether moral or hedonistic or economic. Most, probably, of our decisions to do something positive ... can only be taken as a result of animal spirit.” Here, animal spirit refers to the tendency of asset prices to rise and fall (or economic decisions to be made) based on human emotions rather than on intrinsic value. Proponents of behavioural economics share an identical view with Keynes, but a more comprehensive one. They claim that bubbles are real phenomena and that bubbles do exist on the basis of physiological factors that drive market participants to exhibit irrationally optimistic behaviour. As for the housing markets in particular, behavioural economists provide evidence that housing markets operate in an irrational pattern and that market participants do not put emphasis on fundamentals nor do they act rationally when making economic decisions to invest in housing assets. According to Thaler (2005), one of the biggest successes of behavioural finance has been a sequence of theoretical papers revealing that in a market where both rational and irrational participants interact, irrationality can have a

considerable and long-lived influence on prices. In addition, as Shiller (2002, p.14) clearly indicates, “human patterns of less-than-perfectly rational behaviour are central to financial market behaviour, even among investment professionals.” Proponents of behavioural finance have also pointed to several survey results showing that housing markets consist of amateurs with no economic training and that market participants have the un-justifiable belief that property prices will always rise (Case & Shiller, 2003, 1989, 1988; Smith & Smith, 2006).

For behavioural economists, it is very difficult to obtain complete information on the property market. As a result, housing investors are always more inclined to look at the behaviour of others in deciding what to do (Baddeley, 2005). This issue can explain, at least partly, why market participants follow herd behaviour. The hypothesis that market participants are subject to herd behaviour is crucial to understanding the view of behavioural economists on bubbles. This is because herd behaviour has often been found to be a central factor in the formation of bubbles when it has corresponded with periods of high price optimism. This can be clearly understood through the main definition of housing bubbles from behavioural economists’ point of view. They define a housing bubble as a “peculiar kind of fad or social epidemic that is regularly seen in speculative markets; not a wild orgy of delusions but a natural consequence of the principles of social psychology coupled with imperfect news media and information channels” (Shiller, 2013, p.2). In this perspective, the social epidemic consists of feedback from price increases, leading to further price increases. The price increases attract investor attention, which is then spread by word of mouth, drawing more people in. Correspondingly, the social psychology, coupled with imperfect news, refers to the cognitive bias of the human mind, which is prone to being influenced by existing and promising stories related to the future. These stories are the main drivers behind bubbles and are what make people feel the bubble is right (Shiller, 2000). Similarly, Krugman cited in Holcombe and Powell (2009, pp.241-242) also agrees that a bubble is built on expectations (fed by stories) of capital gains. He asserts that “when people become willing to spend more on houses, say because of a fall in mortgage rates, some houses get built, but the prices of existing houses also go up. And if people think prices will continue to rise, they become willing to spend even more, driving prices still higher, and so on...prices will keep rising rapidly, generating big capital gains. That’s pretty much the definition of a bubble.”

3.4.4 Austrian economics: Bubbles do exist

The Austrian school of economic thought also accepts that bubbles do exist in asset markets. Proponents of the Austrian school argue that bubbles develop as a result of a government failure to manage the money supply and interest rates in an optimal and rational manner. They further claim that as long as central banks retain their authority to set controls on interest rates, such bubbles will periodically appear in the economy. The Austrian school sees bubbles as a combination of both real and psychological changes caused by manipulations of monetary policy. While behavioural economists emphasise the irrational nature of market participants to explain bubbles, the followers of Austrian economics claim that loose and failed monetary policy is the prime reason for the creation of bubbles. Particularly, when the government prints money and interest rates fall below their optimal rate, investment in real estate is encouraged in ways that it otherwise would not be. This drives prices to rise to unsustainable levels. Austrian economic theory holds that bubble prices result in higher demand for space, which in turn fuels the housing construction sector. In the meantime, housing bubbles cause a misallocation of resources and the labour market is re-allocated in the property industry. This exerts pressure for higher wages for construction workers. In such an economic environment, the price of land and construction material is expected to increase and as a consequence, further price increases would be anticipated. Simultaneously, this negatively affects other vital sectors like the manufacturing sector. Manufacturing will face higher costs for its inputs such as labour and materials and thus will produce a proportionately smaller output. This mismatch between resources and labour is what must be resolved after the inevitable bust (Holcombe & Powel, 2009; Rapp, 2015; Kennard & Hanne, 2015; Lemieux, 2011; French, 2009).

3.5 Bubble concepts

There are three concepts available in the literature in relation to types of asset bubbles: explosive, intrinsic, and momentum (Black, Fraser, & Hoesli, 2006). The explosive and intrinsic concepts constitute the rational bubble theory. The rational bubble theory holds that market participants (i.e. investors) know that the market is overvalued but have no incentive to leave the market because they expect that the bubble component will grow and compensate them appropriately (through the bubble premium) (Hardouvelis, 1998; Harrison

& Kreps, 1978; Flood & Hodrick, 1990). Rational bubble theory is grounded in the efficient market hypothesis, which usually implies some form of the expected present-value model (Shiller, 1992). The main difference between these two rational concepts is that in an explosive rational bubble, prices continuously deviate from fundamentals due to factors extraneous to asset value, whereas in an intrinsic rational bubble, prices periodically diverge from fundamental value due to exogenous fundamentals (Black et al., 2006). In contrast, the third concept (momentum) denotes the general or irrational bubble theory. Irrational bubble theory supports the idea that investors who stay in the marketplace do not focus sufficiently on fundamentals and do not know that the market is overvalued (Hardouvelis, 1998). On such a basis, market participants follow adaptive expectations²⁸ (rather than rational expectations) when they estimate future price outcomes. In contrast to rational theory, irrational bubble theory does not emphasise the use of present-value models to detect bubbles. Irrational speculative bubbles are caused by precipitating factors that have an immediate effect on demand as well as by amplification mechanisms that take the form of optimistic price-to-price feedback (Shiller, 2000; Case & Shiller, 2003). Following this logic, irrational bubble theory is akin to herd behaviour, where in the absence of complete information, housing investors are more inclined to look to the behaviour of others in deciding what to do (Baddeley, 2004).

3.6 The expectation and speculation parameter

3.6.1 Expectations

Expectations are a core element in understanding speculative bubbles. Malpezi and Watcher (2005) state that the most common and widely used expectation models are those of *myopic expectations*, *perfect foresight*, *rational expectations* and *adaptive expectations*. Myopic expectations assume that only “the current market situation matters for the formation of expectations about the future.” In other words, investors are going forward (Wijlnost & Wergeland, 1996; Malpezi & Watcher, 2005). Perfect foresight assumes that people have perfect information about the future, while rational expectations assume that people use all available information to make optimal forecasts about the future, although what ‘all available information’ actually means and how that information is used remain undefined.

²⁸ Individuals look to past experience to estimate future price outcomes.

Rational expectations assume that the participants in the housing market make optimal use of the information and that participants make decisions using rational rules (Diappi, 2013). Finally, adaptive expectations or backward looking assumes that people make investment decisions based on the direction of recent historical data. Flood and Garber (1980, p.745) explain that “when current house prices depend partly on the expected rate of market price change, it is possible that the market will launch itself onto a price bubble with price being driven by arbitrary, self-fulfilling elements in expectations.” Recently, a growing body of literature on inflation expectations has suggested that individuals look to past experience to estimate future inflationary outcomes, thus generating ‘adaptive expectations’ (Malpezi & Watcher, 2005). Regarding this view, Stiglitz (1990) supports the idea that the price of an asset will rise only if investors’ expectations change in such a way that they believe they will be able to sell the asset for a higher price in the future. Correspondingly, Case and Shiller (2003) argue that the expectation of rapid and steady future price increases is, in itself, a core motivating factor for buyers.

3.6.2 Speculation

Speculation is held to be one of the main factors behind the formation of housing bubbles.

According to Kaldor (1939),

speculation may be defined as the purchase (or sale) of goods with a view to resale (repurchase) at a later date, where the motive behind such action is the expectation of a change in the relevant prices relatively to the ruling price and not a gain accruing through their use, or any kind of transformation effected in them, or their transfer between different markets.

Kaldor adds that if the expectation of an impending change in the ruling market price acts as the sole motive for action (all else being equal), then the purchase or sale is considered to be speculative. This is the main difference between a speculative purchase or sale and a normal purchase or sale.

Following Kaldor and Keynes, Harrison and Kreps (1978) state that “investors exhibit speculative behaviour if the right to resell a stock (asset) makes them willing to pay more for it than they would pay if obliged to hold it forever.” Accordingly, speculation can be described as “a world in which investors’ expectations are formed in some inaccurate way.” For example, many models of speculative bubbles are based on adaptive expectations, or

extrapolations of recent trends. When prices are rising, speculators enter the market and demand increases. When prices are falling, they bail out. The authors also note that speculation correlates with the time horizon of an investment. In most cases, the term “speculation” applies to short-term investors, rather than those who buy and hold for the long term (Malpezi & Watcher, 2005). Similarly, Kaldor (1939) states that speculation is mainly a short time commitment, not a long-term investment; therefore, a successful speculator must possess better than average foresight. In a third proposition regarding speculation, Feiger (1976) asserts that “if all agents are identical in tastes, anticipations, and endowments, the speculative position will be sustained after nature determines the state.” This proposition is in accordance with the notion of a bubble, since the identical tastes, anticipations and endowments of market participants act to sustain speculative bubbles. However, Kaldor (1939) explains that not all economic goods can be used for speculative purposes. In general, certain main factors should prevail, viz. the existence of a perfect or semi-perfect market and low carrying costs. Furthermore, the presence of some attributes is required before a particular asset can be used for speculation. Some examples are as follows:

- The good must be fully standardized or capable of full standardization.
- It must be a good that has general demand.
- It must be durable (long-lasting).
- It must be valuable in proportion to bulk.

Stocks possess all these essential characteristics, whereas real estate ‘goods’ are less attractive for speculation (Kaldor, 1939). The fact that property assets are not standardized (identical) products and that they have high carrying and transaction costs minimize the potential for speculation in the real estate market. However, this does not mean that property is an asset immune to speculation. Kaldor (1939) observes that the core reason that speculation occurs is that imperfect foresight in the market allows speculators to behave with more foresight than the average individual in the system possesses. Conversely, in a world of perfect foresight, there is no possibility of speculative gain. If expectations were certain and if perfect foresight prevailed in the market, speculative activity would be unable to affect the current price.

There is a widespread belief among valuers and real estate academics that property markets are not efficient. The debate on whether and to what degree they are efficient is related to the three forms of efficiency: weak, semi-strong and strong. Property has a number of inherent characteristics that prevent it from being valued or priced in an efficient manner. Such characteristics highlight the differences between stocks and property as assets. The following property characteristics are the most important (Brown & Matysiak, 2000; Ibbotson & Siegel, 1984; Webb, Miles, & Guilkey, 1992; Kummerow & Lun, 2005; Farlow, 2004):

- It is lumpy.
- It is heterogeneous.
- It cannot be sold in small units.
- It is difficult and slow to sell (so it is an illiquid asset).
- It incurs high transaction costs.
- It is imperfectly marketable.
- It cannot be traded internationally.
- Information is costly.

Ibbotson and Siegel (1984) note that in real estate, the appraised price is only a good approximation of the market price, which is, in itself, unknown. The transaction price may differ from the appraised price. The uniqueness of real estate assets is one of the most significant causes of valuation errors, providing strong evidence of the imperfect foresight that allows speculative gains. Research done by Brown and Matysiak (2000) in the US used the physical characteristics of residential properties as proxies for current public information and found that the market was semi-strongly efficient after transaction costs were taken into consideration. However, it is a controversial matter as to whether and to what degree the property market is efficient, with the research remaining inconclusive. The majority of studies indicate that the real estate market is not efficient (Gunther & Shanaka, 2009), but different views on its efficiency are reported by Evans (1995), Darrat & Glascock (1993) and Brown (1991). However, such a discussion is beyond the scope of this thesis.

According to Evans (1995), it is more difficult to earn large returns in the stock market than in the property market, since the stock market efficiently discounts the available information.

However, Kaldor (1939) notes that if the market is imperfect and/or carrying costs are large, the difference between buying price and selling price will be large, thus making speculation far too expensive to undertake. It must be noted, though, that the carrying costs of real estate in relation to the transaction price are not excessive. Thus, it can be concluded that the real estate market is open to speculation, although stocks possess all the essential characteristics required for speculation. Generally, Kaldor (1939) argues that in order for speculation to be price destabilizing, one of two things must be assumed: either a change in the current price leads to a greater change in the expected price, or there are impulsive changes in the expected price that are speculative in origin and are not justified by the movement of fundamental factors. The issues discussed above, together with the historical examples, lead us to believe that real estate markets are prone to speculation.

3.7 What creates a real estate bubble?

There are three core views held by economists regarding what creates housing bubbles: the view held by the Chicago school, the view of Keynesians and behavioural economists and the view of the Austrian school.

The Chicago school denies the existence of bubbles, as it assumes efficiency in the marketplace. However, some of the followers of the Chicago school and some adherents of mainstream economics claim that what is normally considered as a bubble is really the result of real factors (Holcombe & Powel, 2009). Economists who hold such views can be classified as “fundamentalists.” They claim that real macro-economical fundamental factors alone can explain the formation of housing bubbles. For instance, Muller, Almy, & Engelschalk, (2009) list the general factors that contribute to the creation of house price bubbles as including changes in demand and in supply, shifts in population trends, growth in the number of households and in GDP, and changes in purchasing power via affordable credit and tax deductions. Glaeser and Gyourko (2002) review data derived from the Wharton Land Use Control Survey²⁹ and conclude that a close correlation exists between ‘zoning stickiness’ and the ratio of existing housing prices to the cost of new construction. In consequence, zoning is seen as a fundamental factor limiting the supply of housing and thus making houses expensive in some areas. Conversely, the study found little correlation

²⁹ The survey was conducted in 1989 in 60 metropolitan areas in the US. However, due to lack of data, the authors only consider observations from the central cities of 45 metropolitan areas.

between population density and house prices, although economic theory suggests the opposite. Glaeser et al. (2008) support the idea that supply inelasticity is a crucial determinant of the duration of a bubble. When housing supply is elastic, new construction quickly comes on line as prices rise, which causes the bubble to unravel quickly. Nevertheless, Herring and Watcher (2002) note that construction lags are responsible for the inelastic supply of housing. In the short run, increases in demand, together with inelastic supply of housing and developable land, cause inventories of for-sale properties to shrink, while vacancies decline and price rises accelerate as a consequence. Once prices overshoot or supply catches up, inventories begin to rise, time on the market increases, vacancy rates rise and price increases slow, eventually leading to downward stickiness. Following this, Glaeser et al. (2008) emphasise that continuously rising prices reflect a continuously rising housing supply, which means that supply will eventually outstrip current market demand. During a housing bubble, there is a rapid surge in prices and in new housing construction. When the bubble bursts, housing prices fall below their pre-bubble levels and below what they would have been if the bubble had not happened. In real terms, the end of the bubble symbolizes the end of the oversupply period. Consequently, the severity of boom-and-bust cycles has been attributed to developers lagging behind optimum timing, building too late in the boom and continuing to build into the bust (Wheaton & Torto, 1988). Gouldey and Thies (2012) clearly indicate that exogenous forces such as government initiatives for wider homeownership could artificially result in bubbles. For example, developers and builders can be surprised by the dynamic force of demand and the number of houses demanded due to the government initiatives (help-to-buy schemes). As a result, builders may begin to build in advance of confirmed demand, in anticipation of a greater number of new buyers. If developers and builders were able to predict the housing demand with accuracy and thus predict the right number of houses to build, demand would be satisfied on an equilibrium level. Hence, no bubble would be created in the first place. However, since potential demand for housing cannot be measured with accuracy, it could be argued that the housing market is inevitably prone to producing bubbles. In relation to the government initiatives for wider homeownership, Austrian economists Holcombe and Powel (2009, p.257) note that “what at first appeared to be the government trying to help improve homeownership has been a giant government failure.” It is worth clarifying that government initiatives to increase homeownership are considered as a cause of bubbles from the perspective of the Austrian school of economics because such initiatives are directly linked with low mortgage rates and lax lending standards. Other fundamental factors contributing to the formation of bubbles

on the demand side include demographics, employment and income growth, changes in financing techniques, interest rates and changes in location characteristics (e.g. schools, crime, traffic systems, etc.), while on the supply side they include building costs, the age of housing inventory and the “industrial organization of the housing market.”

The second view as to what causes the formation of housing bubbles is held by Keynesians and behavioural economists. They claim that housing bubbles are caused by psychological factors among participants. The Keynesian view (1936) of bubbles refers to the argument that much of investment is driven by expectations about what other investors think everyone else think rather than by expectations about the fundamental profitability of an investment. Keynes (1936, pp.161-162) sums up his exact view by mentioning that “there is the instability due to the characteristics of human nature that a large proportion of our positive activities depend on spontaneous optimism rather than on mathematical expectation, whether moral or hedonistic or economic. Most, probably, of our decisions to do something positive ... can only be taken as a result of animal spirit.” Here, animal spirit refers to the tendency of asset prices to rise and fall (or economic decisions to be formed) based on human emotions rather than intrinsic value. Following this, Keynesian economist Krougman, cited in Holcombe & Powel, 2009, pp.241-242) suggests that bubbles are built on the expectation of capital gains: “So when people are willing to spend more on houses, say because of a fall in mortgage rates, some houses get built, but the prices of existing houses also go up. And if people think prices will continue to rise, they become willing to spend even more, driving prices still higher, and so on... prices will keep rising rapidly, generating big capital gains.” That is the definition and the cause of a bubble. Reed and Wu (2010) cite Stoken (1993) and Shiller (2000), who claim that “boom-bust” cycle theories are not self-reliance theories, since key events immediately triggering major cycles in property markets are often explained by irrational human or crowd behaviour. In line with this, Shiller (2000) and Case and Shiller (2003) note that speculative bubbles are caused by “precipitating factors” that change public opinion about markets or that have a direct impact on demand, as well as by “amplification mechanisms” that take the form of price-to-price feedback. Such mechanisms include word-of-mouth communication. For example, if prices are moving up, there is widespread word-of-mouth communication that is a hallmark of the creation of a bubble. Once the amplification mechanism is in place, listing prices for houses can exceed transactions prices (Gouldey & Thies, 2012). Pyhrr et al. (1999) argue that during bubbles, most investors view the present economic conditions as lasting into perpetuity when making

forecasts. This has led investors to play the dangerous game of buying high during a boom and selling low during a bust. They adopt mass psychology and follow the herd instinctively.

Similarly, Case and Shiller (2003) have observed the tendency, during a housing bubble, for market participants to view housing as an investment. Expectations of the future capital appreciation of a home are a motive for buying the home, while considerations of how much one must pay for housing services are ignored. The authors conclude that what drives the development of bubbles is “buying for the future price increases rather than simply for the pleasure of occupying the home” (p.321). Shiller (2000) further summarises that a bubble is caused by “feedback and enthusiasm among investors, who then bid up prices more, and then it feeds back again and again until prices get too high. During that period, people are motivated by envy of others who made money doing it, regret in not having participated and the gambler’s excitement. Stories develop that justify the bubble, they become current and then people think they’re right because everyone’s confirming the stories. So, that happens, eventually prices get too high and the bubble bursts.”

The third view, held by the Austrian School, sees the formation of bubbles as a combination of psychological and real factors caused primarily by manipulations of monetary policy (Holcombe & Powel, 2009). For Austrian economists, a bubble develops as a result of failed government-monetary policy. They support the idea that loose monetary policy, alongside artificially low interest rates, is the prime reason that can explain bubbles, since investment in real estate is encouraged in ways that it otherwise would not be. This causes prices to rise to extreme levels. Austrian economic theory also holds that bubble prices will result in higher demand for space, thus leading to hyper supply in the housing construction sector (Holcombe & Powel, 2009; Kennard & Hanne, 2015; French, 2009). To this extent, Allen and Gale (2000) argue that housing bubbles consist of three distinct phases. In the first phase, financial liberalization and monetary easing take place and an expansion in credit is accompanied by an increase in the prices of housing assets, often resulting in an affordability illusion (Barlevy, 2007). This first phase continues for some time, possibly several years, as the bubble inflates, leading to the second phase, the burst. When the bubble bursts, asset prices collapse in a short period of time. Nevertheless, the collapse may occasionally take longer. The final phase is then characterized by defaults on loans and a banking crisis, which often leads to problems in the real sector of the economy for a number of years. The relationship between housing bubbles and lending is strongly emphasised by Zhou and Sornette (2003). They argue that a housing bubble is part of a more general credit bubble and

that a housing bubble cannot exist without the existence of a credit bubble. Ermisch (1990) also suggests that mortgage market conditions can explain rising house prices more so than tax distortion. Similarly, Allen and Carletti (2010) and Agnello and Schuknecht (2011) note that the loosening of monetary policy can lead to the formation of a real estate bubble, while for Gouldey and Thies (2012) and Muller et al. (2009), asset bubbles are usually, if not always, associated with an expansion of money and credit. This view is consistent with a study by Hubbard and Mayer (2009), which found that housing prices and real interest rates are negatively correlated. Finally, Alan Greenspan remarked that growing house prices in the US in the 2000s were mainly a by-product of low mortgage rates (Zhou & Sornette, 2003).

3.8 Why housing bubbles recur

3.8.1 The role of disaster myopia

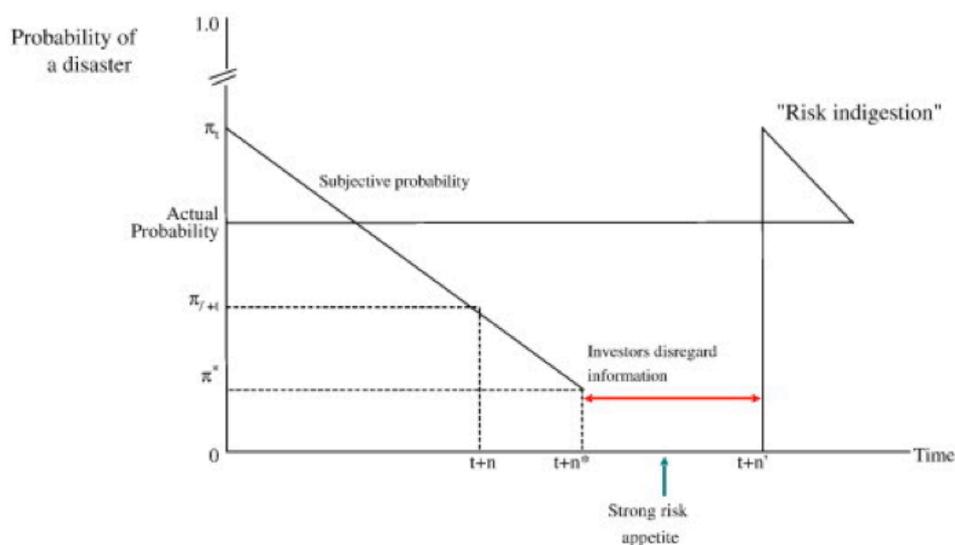
This sub-section discusses the theme of disaster myopia, a theoretical construct used to explain why economic bubbles and shocks such as financial crises and asset collapses tend to recur. Broadly, disaster myopia leads market participants to adopt risky behaviours and might contribute to the formation of an asset bubble. The theory of disaster myopia claims that under very optimistic conditions, market participants tend to disregard any relevant information related to an increased degree of risk.

Cornand and Gimet (2012) explain disaster myopia in terms of how easily a decision-maker can imagine that an event will occur; put simply, the longer the time since an event last occurred, the harder it is to imagine it happening again. Tversky and Kahneman (1973) argue that the estimation of the probability of an event occurring is determined by the assessment of 'availability.' For example, if the period since the last major crash is relatively long, market participants will have strong appetites because they will assess the probability of a major negative event occurring as close to zero. Haldane (2009) expresses it thus: "the longer the period since an event occurred, the lower the subjective probabilities attached to it." Therefore, the degree of ease with which an event can be imagined is positively correlated with the frequency at which such events occur. People assess the probability of an event through the ease with which occurrences can be brought to mind. Nevertheless, other elements, such as time elapsed since the last time an event occurred, also influence the ease of recall (Caprio, Hunter, Kaufman, & Leipziger, 1998; Tversky & Kahneman, 1974). As

Stroh, Northcraft, Neale, Kern, and Langlands. (2008) explain, “that which is most easily remembered occurs most frequently.” Generally, the easier it is to recall the consequences of an event, the more likely people will perceive these consequences to be. Although frequently occurring events are more memorable, it is not always true that familiar events occur frequently.

Haldane (2009) calls the ease with which one can imagine the occurrence of a shock the “availability heuristic.” The availability heuristic rule implies the following: “that which is most easily remembered occurs most frequently” (Stroh et al. 2008). On the other hand, once the probability falls below a certain threshold, the subjective probability is set at zero. Once this threshold amount (near zero in Figure 5) has been reached, it seldom causes changes in the behaviour of market participants. For instance, it is widely known that rising vacancy rates are a sign of a declining real estate market. A clear example of disaster myopia is one in which commercial or residential real estate lending continues despite obvious evidence of rising vacancy rates (Herring & Watcher, 2002; Caprio et al., 1998).

Figure 5. The disaster myopia hypothesis



Source: Cornard and Gimet (2012), adapted from Herring (1998)

The availability of an event is also affected by factors other than frequency and probabilities. As a result, the reliance on availability leads to predictable biases caused by, for example, the familiarity, salience, time and effectiveness of a search set. Salience has a significant role in terms of recalling an event (‘retrievability of instances’). For example, if one sees a house

burning, the impact upon one's subjective probability of such an event occurring is greater than the impact of reading about a house fire in a newspaper (Tversky & Kahneman, 1974). Similarly, there is a tendency for drivers that have witnessed an accident to slow down and then speed up once the accident has become more distant in their memory. By applying the reasoning of disaster myopia to the re-occurrence of bubbles in housing markets, I can argue that market participants (e.g. mortgage providers, borrowers, first-time buyers, government, professionals, etc.) tend to unwittingly repeat those actions that lead to the occurrence of bubbles because the previous bubble is a distant event in their memory. As a result, in their eyes, the subjective probability of a bubble re-occurring is close to zero. On this basis, market participants do not feel that their actions are associated with the bubble risk. This led Herring and Wachter (1999, cited in Pugh & Dehesh, 2001) to mention that the majority of investors do not learn the lessons associated with risk because memories are short due to disaster myopia.

Cornand and Gimet (2011) make it clear that there is no standard metric that allows a precise computation of the likelihood of a particular event occurring. However, past experience is a useful tool for measuring these probabilities with greater objectivity. Generally, in uncertain conditions, individuals tend to use their subjectivity in a reasonable assessment. Haldane (2009) notes that since today's financial products are extremely complex and opaque, disaster myopia turns out to be an important theory; although disaster myopia seems like a "useless" tool or informational failure, it is, in practice, a well-established tool in cognitive psychology.³⁰ The author further suggests, "economic agents have a tendency to base decision rules around rough heuristics or rules of thumb." For Haldane, "it is perhaps no coincidence that the last three truly systemic crises – October 1987, August 1998, and the credit crunch which commenced in 2007 – were roughly separated by a decade. Perhaps ten years is the threshold heuristic for risk managers." By applying this argument to UK real estate bubbles, one can argue that it is no coincidence that the last three bubble-bursts, in 1974, 1990 and 2008, are roughly separated by 16 years. Perhaps, 16 years is the threshold heuristic for real estate market participants, especially for banks. Within living memory, it seems that several bubbles have burst, but we appear not to remember them when the next boom comes along. Once a shock occurs, disaster myopia turns into 'disaster magnification' (Herring & Watcher, 2002). As Caprio et al. (1998) and Herring and Watcher (2002) argue, after the occurrence of a shock event, it is easy to imagine a recurrence. Thus, the subjective

³⁰ Cognitive psychology examines in detail questions such as how memory works, how we perceive our environment and how we think (Brasby & Gellatly, 2012).

shock probability will rise well above the actual shock probability, and people will perceive more risk than actually exists. Consequently, it is easy to imagine a decline in real estate prices after a bust (Hunter et al., 2005).

3.8.2 The role of perverse incentives

Real estate developers usually seek to operate with a minimum of capital in order to shift the risk as much as possible to the loan provider. Banks, on the other hand, seek to protect themselves by requiring low loan-to-value ratios, guarantees and strict loan covenants. However, when the property market becomes overheated, these standards may weaken from the banks' point of view (Herring & Watcher, 2002). As Weiss (1991) puts, in such market conditions, history reveals that many property lenders ignore prudent underwriting standards and give credibility to overly optimistic property appraisals and market analyses with the aim of maximising their profits. Rising property prices also motivate banks to hold real estate assets, as this improves their financial position. Hence, banks become eager to increase their lending, since they want to expand their profits (Kindleberger & Aliber, 2005). Moreover, if housing values are rising while outstanding mortgage-property loans are declining, this means that the risk of loss is also reduced. Consequently, it is possible for banks to lend more without increasing the probability of default³¹. This situation creates a key perverse incentive than can explain the recurrence of bubbles from a lending perspective (Herring & Watcher, 2002). In addition, there is another issue that acts as a perverse incentive from the banks' perspective. If banks hold their risk exposure in line with those of other banks, the regulatory response will be much lighter if a shock event occurs. Regulators cannot terminate or treat harshly all of the banks (Herring & Watcher, 2002). As Haldane (2009) notes, if a bank owes a small amount it is the bank's problem, but if many banks owe a huge amount it is the authorities' problem. Furthermore, Hunter et al. (2005) warn that the existence of a safety net makes banks more willing to provide risky and massive lending than they would in the absence of such a net. According to Caprio et al. (1998), this is the classic moral hazard problem. The insurance of a safety net actually undermines the incentive for depositors to be more concerned about the banks taking risks. On the other hand, bank decision makers find that if depositors do not seek greater compensation when greater risks are taken, they can

³¹ However, in real terms, the willingness of banks to lend in an aggressive manner for real estate for the sake of rising prices may elevate the risks to fatal levels

boost expected returns to their shareholders by assuming greater debt exposure. Turning back to developers, Weiss (1991) claims that during housing booms developers are reluctant to interfere with the status quo (e.g. by cutting their supply) while returns are still rising. As a consequence, profit maximization by developers is a perverse incentive that can explain why bubbles tend to re-occur.

Weiss (1991) claims that government initiatives to reorganize the real estate industry are made either during the downward slide after a boom or in the early stages of an economic recovery, whereas few if any public policy changes take place at the high bubble point. When the real estate sector is booming, “too many people have a vested interest in letting development and sales proceed without any further encumbrances, and thus significant reforms are temporarily blocked” (Weiss, 1991). The most plausible explanation is that the introduction of regulations and other measures to prevent or fix certain issues before over-development is initiated is not a politically viable policy for governments, as it would generate adverse public opinion. Geraskin and Fantazzini (2011) identify another perverse incentive from the perspective of governments. They assert that after the financial collapse of 2008, governments adopted a new politically viable measure for addressing existing bubbles-busts: creating new ones. Another perverse incentive for governments is that they are often willing to launch schemes to increase homeownership. Such actions are publicly accepted measures in today’s societies. However, such schemes create artificial demand that can negatively affect the housing market, particularly if it is not measured appropriately (Gouldey & Thies, 2012).

The third perverse incentive relates to the nature of housing as an asset. Case and Shiller (2003) observe that when property prices are rising, there is a tendency for market participants to view housing as a mode of consumption. This leads households and investors to feel assured that there is no need to save as much money as they otherwise might, since they expect that the increased value of the property will do the saving for them via the ‘wealth effect’ of housing values. Benjamin et al. (2004) showed that, historically, the marginal propensity to consume in housing is higher than that of consuming in financial assets. To this extent, households prefer to hold or invest in real estate assets (in the form of housing) rather than in financial assets, since housing assets provide an ideal “good asset” for both consumption and investment, while financial assets do not provide direct consumption to their holders. This reveals that housing as an asset has an exceptionally strong demand and that there is also a perverse incentive from the household point of view for acquiring

housing. In relation to this, Kaldor (1939) found that a good or asset must have a general demand in order to be used for speculation. In turn, speculation is one of the main elements in the formation of bubbles. By linking the studies of Kaldor (1939), Case and Shiller (2003), and Benjamin et al. (2004), one can explain that housing bubbles are recurrent events given that housing as an asset is fundamentally prone to speculative behaviours.

3.9 How does a housing bubble end?

If A is an event, the probability that A will occur can be written as $P(A)$. For example, $P(A) \leq 1$ means that the event has a finite probability. On the other hand, $P(\phi) = 0$ denotes an empty or impossible event. , $P(A \cup B) = P(A) + P(B) - P(A \cap B)$, where $A \cup B$ is the event in which either A or B occurs and $A \cap B$ is the event in which both A and B occur. If A and B cannot occur simultaneously, we say that A and B are mutually exclusive events. This can be symbolized as $A \cap B = \phi$, then $P(A \cap B) = 0$ (Golberg & Cho, 2010). Therefore, if $P(A \cap B) = 0$, the two events are mutually exclusive, which means that they have no interaction. Fundamentally, where the occurrence of one of the events in a set rules out the possibility of the remaining events of the set occurring, then the members of the set are mutually exclusive (Vasishtha & Vasishtha, 2008). Based on this theory, Case and Shiller (2003) and Zhou and Sornette (2003) state that housing bubbles do not necessarily end in a sudden crash. There is a finite probability that a bubble will instead end in a transition to another regime, such as slow deflation. Following this logic, Yan (2011) adds that there is also a finite probability that no crash will occur during the lifetime of the bubble. These end regimes and their probabilities are applicable to the point after the bust of a bubble (after the lifetime of the bubble). To sum up, there are two probable ways in which a housing bubble can end: either with a sudden crash or with a slow deflationary process.

3.10 Why does real estate crashes last so long?

The IMF (2003) found that housing bubble-busts are less frequent than stock market bubble busts, although they last twice as long. Gouldey and Thies (2012) and Black et al. (2006) raise the fundamental issue of why stock markets always recover earlier than real estate markets so that property bubbles have such severe effects on financial and banking systems. Hlaváček and Komárek (2009) also emphasise that housing busts tend to last longer than stock market

crashes. Herring and Wachter (1999, cited in Pugh & Dehesh, 2001) suggest three reasons for this. First, property assets are illiquid and are not traded frequently and smoothly like other assets due to lumpiness, taxes, etc. There is a lack of information, resulting in the fundamental value often being overestimated. This reason is supported by the study of Allen and Carletti (2010). Secondly, banks are motivated to increase the size of loans in order to increase their revenues, but such a policy induces higher risk. The third reason is that financial institutions and banks are very slow to recognise forthcoming recessionary problems in the property market, believing that recovery will occur rapidly. Unlike the stock market, in which transactions are fast, real estate transactions are inherently less frequent and slower due to several reasons (lumpiness, taxes, etc.). Moreover, during a housing bust, the combination of high loan-to-value mortgages and the high cost of foreclosures make housing transactions even more problematic and infrequent. Houses that have less value than their mortgage balance due to the bursting of a bubble cannot be sold unless lenders are willing to carry the credit losses. Thus, many homeowners and market participants are unable to complete housing sales under such conditions. These factors prevent house prices from falling quickly to a new equilibrium, causing the market to freeze. The result is that real estate recessions are long-lasting (Gouldey & Thies, 2012). As a remedy for this issue, Gouldey and Thies (2012) suggest that public policy should enable house prices to fall quickly to a new equilibrium instead of focusing on sustaining demand. Houses prices should be adjusted quickly to their new long-run equilibrium levels. Therefore, barriers to housing sales during recessions should be removed and measures for switching homeowners from non-qualified sellers to qualified sellers should be promoted. Hlaváček and Komárek (2009) suggest that the prolonged period of housing busts might be because their impact distorts the economy through changes in household consumption.

Similarly, Farlow (2004) mentions another interesting reason for why real estate recovery might be long and slow: it involves the behaviour of homeowners. He considers that in the early stages of a housing market collapse, households are reluctant to sell their properties because they apparently dislike incurring losses. This leads them to hold on to their assets too long with the view to avoid the losses or because they believe that the recovery will begin soon. However, this strategy causes greater losses to households and also negatively affects the length of the housing recovery. This argument is consistent with the study of Case and Shiller (2003), which found that the favourite strategy among sellers was to “hold up until you get what you want” (i.e. waiting for a buyer to offer the original asking price while only a few respondents said they would have “lowered the price until I found a buyer”). It is clear

that such behaviour prevents home prices from falling at the onset of a downturn, thus prolonging the crash. Moreover, governments may be unwilling to increase public spending and thus the income of people due to government deficit issues while at the same time supervisory authorities may hesitate to act once the collapse has occurred, in the hope that the passage of time will eliminate the problem. Generally, a long delay occurs before insolvencies and weaknesses are recognized and solved. These issues further affect the prolonged period of housing crashes (Herring & Watcher, 2002).

Chapter 4

4.0 State of the Art: Approaches for housing bubble detection

This chapter outlines the approaches used to detect bubbles that are accessible in the literature. It starts with a review of the on-going debate as to the challenges of housing bubble detection and which methodologies are appropriate for the diagnosis of bubbles. A number of models are then selected for more detailed examination, placing particular emphasis on their methodologies and theoretical frameworks. This review is followed by a summary of the current trends, weaknesses and gaps in the existing bubble methods. Finally, the review is extended to look at which variables best demonstrate the phenomenon and their associated relationship.

4.1 Housing bubbles as a market challenge

There exists an enormous body of literature describing the challenges and importance of attempting to identify and measure bubbles (Hunter et al., 2005; Reed & Wu, 2010; Case & Shiller, 2003; Flood & Hodrick, 1990, cited in Glaeser et al., 2008; Geraskin & Fantazzini, 2011; Allen & Carletti, 2010).

Case and Shiller (2003) have observed the tendency during a housing bubble for market participants to view housing as an investment. Expectations of future price appreciation provide a motive for buying a house, while considerations of how much one must pay for housing services are ignored. However, positive housing changes, even at unprecedented rates, are not in and of themselves sufficient to define a situation as a bubble. For instance, Cadil (2009) mentions that there are several factors that may result in house price acceleration without the necessity for a price bubble; these include low interest rates or strong population volume. Allen and Gale (2000) and Holcombe and Powel (2009) argue that a housing price bubble is part of a more general credit bubble and thus cannot exist without the existence of the latter. Credit both helps and protects speculative expectations if they are also irrational. Therefore, the relationship between credit (i.e. lending) and the bubble phenomenon is crucial in a housing market. This has become evident since the 1980s, where the integration of real estate markets and capital markets has

created a new situation in which financial impacts are more important than housing supply levels (Barras, 2009). However, as to the mortgage rates in particular, Muellbauer and Murphy (1997) provide empirical evidence suggesting that mortgage rates are not relevant to the identification of housing bubbles in the UK. This is explained by the fact that in the 1980s, bubble case study interest rates were not particularly low.

It is known that housing supply in the UK is inelastic, at least in the short term (Pugh & Dehesh, 2001; Reed & Wu, 2010), and that the UK housing market has tended to suffer from under-supply (Dolphin & Griffith, 2011). However, these tendencies do not necessarily imply that supply is not relevant to the detection of UK bubbles. Regarding this concern, Mueller and Pevnev (1997) and Baum and Hartzell (2012) note that building development activity in housing markets increases during a boom. Developers are always more incentivized to invest in the construction sector (i.e. supply) when prices are rising because business profit-maximisation is inherent in rising prices when costs are held relatively constant. In support of this, Holcombe and Powel (2009) and Baum and Hartzell (2012) note that the quantity of houses built often helps in measuring bubbles and can be described as a *quantity dimension* of bubbles.

A further review of the literature on housing bubble theory suggests that income and affordability measurements are crucial variables for bubbles. Yan (2011, p.16) explains the collapse of a bubble in terms of its instability: “Think of a ruler held up vertically on your finger: this very unstable position will lead eventually to its collapse as a result of a small (or an absence of adequate) motion of your hand or due to any tiny whiff of air. The collapse is fundamentally due to the unstable position; the instantaneous cause of the collapse is secondary.” Following this statement, a housing bubble is characterised by unsustainable price increases. Therefore, detecting unaffordable house prices becomes a vital challenge for detecting housing bubbles. According to Case and Shiller (2003), Dolphin and Griffith (2011) and McCarthy and Peach (2004), affordability indices can be used to assess house prices and therefore identify unsustainable price regimes within housing markets. This is because the demand for housing depends on the ability to purchase houses and thus on earnings. On this basis, affordability benchmarks can be used to effectively monitor self-occupancy demand and thus to determine whether prices are too high (Himmelberg et al., 2005; Tsai, 2013). Campbell and Trass (2011) confirm another interesting element of affordability in relation to detecting bubbles. They suggest that housing becomes least

affordable at the beginning of a slump or at the end of a boom, and is most affordable during the recovery phase.

4.2 General overview of the approaches

This sub-section briefly outlines the approaches used in the literature to detect housing bubbles. It seeks to present an initial review of the theoretical framework behind the detection of bubbles.

The approaches can be categorised into four broad themes:

- The descriptive statistic-ratio approach,
- Survey method
- The single equation (SE)
- The structural approach based on the log periodic power law (LPPL)

The descriptive statistic-ratio approach makes use of several statistical tools and ratios and may also involve surveys. Most often, these ratios are expressed as affordability measures (e.g. house-price to income ratio, house-price to rent, mortgage payment to income, etc.). These tools and ratios express mean reversions and help to explain statistical relationships. Most of the studies that have adopted a descriptive approach have used a mixed-approach design. Some of these studies have shown evidence of bubbles utilising a mostly descriptive approach, while others have used a combination of other techniques alongside descriptive. The survey method for bubble analysis has mostly been used as proposed by Robert Shiller and Karl Case (2003). Generally, questionnaire surveys in economics are used to learn about investors' behaviour. In bubble identification analysis, the survey method is based on the view that the phenomenon of housing bubbles is defined in terms of people's thinking in relation to their expectations and their qualitative characteristics. Existing studies using the single-equation approach have tested whether housing prices are supported by fundamentals or whether they are temporarily deviating from what should be according to a model of fundamentals. The equation can be either the product of a statistical equation (regression-based model) or an asset-pricing model. Regarding regression-based models, the motivation

for using such an approach comes from the fact that the price of housing is determined by the forces of supply and demand for the housing. Therefore, many economists have naturally attempted to relate prices to variables that might shift supply and demand, such as interest rates and disposable income (Krainer & Wei, 2004). As for the asset-pricing model, the motivation for using dividend-based models in valuing equity or assets is expressed well by the following quote from the creator of asset pricing theory, Williams (1938, p.80):

“[A] stock is worth the present value of all the dividends ever to be paid upon it, no more, no less...Present earnings, outlook, financial condition, and capitalization should bear upon the price of a stock only as they assist buyers and sellers in estimating future dividends.”

Another form of the single equation approach is the equilibrium model. Equilibrium models are based on the fundamental assumption that an equilibrium point exists within the housing market and that the expected annual cost of owning a house should not exceed the annual cost of using it. The third category refers to the econophysic approach of the Log-Periodic Power Law (LPPL), as proposed by Zhou and Sornette (2003). This approach involves looking for signatures of faster-than-exponential growth from the perspective of log periodic power.

4.3 The debate in housing bubble detection

Adherents of descriptive approach frequently start a bubble analysis by assessing the house price appreciation rate (Hendry, 1984). Blanchard and Watson (1982) note that a rapid increase in asset price is a vital indicator of the presence of a bubble. A bubble warning might rise when the price appreciation rate exceeds a predetermined rate (Himmelberg et al., 2005; Finicelli, 2007), usually the long-term mean. Following simplistic theories, the existence of sales above asking prices could be seen as a symptom of housing bubbles (Case & Shiller, 2003). The initial point of the debate is centred on the aforementioned argument of price appreciation. Barlevy (2007) argues that positive changes, even at unprecedented rates, are not in and of themselves sufficient to define a situation as a bubble. Also, high price appreciation does not mean that prices are deviating from underlying value; it may instead mean that prices are driven by fundamentals such as the risk premium. Himmelberg et al. (2005) explain that acceleration in the growth of house prices is not an intrinsic sign of a bubble, given that the sensitivity of house prices to changes in fundamentals is higher when

real long-term interest rates are already low. Meltzer (2002) also mentions that the first lesson about bubbles is that all explosive movements are not bubbles. He further states that a price could accelerate as a systematic response to monetary acceleration, for example. Dolphin and Griffith (2011) also appreciate that simply comparing price levels from historical periods has the limitation of not taking into account other factors such as the general rate of inflation in the economy or whether housing was undervalued at the start of the comparison period. Despite these arguments, Case and Shiller (2003) and Agnello and Shuknecht (2009) highlight the relevance of the descriptive approach in identifying the magnitude of deviations in house prices from long-term trends. Additionally, Hou (2009) claims that applying variable appreciation rates to statistical confidence intervals is a plausible approach for interpreting long-term deviations in the housing market. The second point of the debate is about the appropriateness of relying heavily on a ratio analysis of affordability indices for the detection of housing bubbles. Flood and Garber (1980) emphasise that the "normal" housing price should not exceed the household annual income by an excessive amount. Cameron, et al. (2006) and Himmelberg et al. (2005) claim that this approach is not adequate for diagnosing bubbles because these ratios fail to consider several other significant factors such as demographic changes, housing supply and credit conditions. Cadil (2009) shares the same view, but adds that the descriptive approach using real house prices and affordability ratios is somewhat alarming for bubble assessment.

As for the survey approach, Case and Shiller (2003) raise the importance of employing the survey method to 'catch' the investment motive and the expectations of market participants. However, as was shown in Case and Shiller (2003), survey results would be more beneficial for assessing bubbles if comparable surveys from previous bubble case studies already existed. Shiller (1992) found that questionnaire surveys are a useful research method because they are aimed at collecting specific facts about individual behaviour. He also argues that well-posed, open-ended questions aid in learning things that are not discoverable using closed-ended questions. Despite the several advantages of questionnaire-survey methods, Popper (1959) and Ackroyd and Hughes (1981) have identified a number of disadvantages involving surveys methods. First, they face validity problems. Moreover, there is no certain way to identify how truthful a respondent is being, or how much thought a respondent has put into answering the survey. Incorrect interpretation of questions by participants is another bias. Also, what is considered good to one person may be poor to another and as a result, there is a level of subjectivity that limits accurate interpretation. Additionally, questionnaires basically reflect the researchers' own decisions and assumptions as to what is important or

not important. Consequently, the questionnaire may be missing something that is of importance. Finally, open-ended questions increase the possibility of subjectivity by the researcher.

The fourth part of the debate revolves around the appropriateness of using rational bubble theory, rational market participants, and the efficient market hypothesis for qualifying housing bubbles. The opposing theory, the irrational bubble theory, holds that investors do not focus sufficiently on fundamentals and do not know that the market is overvalued. Additionally, market participants tend to follow adaptive expectations rather than rational expectations when they estimate future price outcomes and that a degree of herd behaviour is attached to the marketplace (Case & Shiller, 2003). According to Shiller (2002), psychologists have argued that human thinking leads to action, and even individual human thinking tends to be motivated by qualitative reasons and justifications rather than abstract weighing of probabilities and scenarios.

The debate continues with the efficient market hypothesis. In contrast to the premise of the efficient market hypothesis, Case and Shiller (2003, 1989) show that market participants actually have little knowledge about market conditions and about the risks associated with housing assets. In another study, Shiller (2002, p.20) shows that even investment professionals are subject to “less-than-perfectly rational behaviour.”

The ambiguous nature of the fundamental value concept (asset pricing model, i.e. cash flow over time) has been discussed by Hayek (cited in Budd, 2011) and by Krainer and Wei (2004). Stiglitz (1990) clearly demonstrates the main technical problems associated with determining the fundamental value. Principally, the problem of determining fundamental value has three aspects. The first relates to estimating future rents. The second relates to the problem of estimating the terminal value of the asset (at the end of the period). The third relates to the problem of deciding on the discount rates to be used for translating future returns into present values (Stiglitz, 1990). Similarly, Krainer and Wei (2004, p.1) highlight that “(housing) bubbles are difficult to detect because fundamental value is fundamentally unobservable. No one knows for sure what future dividends (rents) are going to be, or what discount rates investors will require on assets.” Glaeser and Gyourko (2007) also identify a number of potential concerns about the comparison of house prices with the present discounted value of rent. Concerning data limitations associated with cash flow models, Case and Shiller (1989, p.135) state, “We see no way of obtaining an accurate historical time series on implicit rents (i.e. cash flows) of owner-occupied homes.” In relation this, Taipalus (2006)

highlights another two interesting problems regarding rents. Even if there was a way to obtain accurate data on rents, he argues that in housing markets (unlike the stock market), “price rises advance rents which happen with a lag compared to the price developments” (p.12). Furthermore, unlike with the stock market, in which dividends are decided by a firm’s board, rents in housing markets are the outcome of a negotiation process. Equally, Flood and Hodrick (1990) assert that it is difficult to specify the intrinsic value using the three determinants for the absence of data extending infinitely far into the future. Similarly, Weeken (2004) and Glaeser and Gyourko (2007) identify the challenges in measuring rents by type of housing. For instance, no two houses are identical and repeat sales of houses are infrequent. The problematic nature of calculating rents in housing is also supported by the fact that most studies calculate housing rents data by using their own calculations/transformations, by employing non-reliable sources (i.e. real estate agents) or by using small samples. Shiller (1992) raises the difficulty of applying a regression-based fundamental value model to housing markets. This argument stems from the fact that regression-based models attempt to model real house prices as a function of several fundamental indicators like disposable income, long-term interest rates, population and others, while the price determinants of housing are far more complicated and unknown than they are for other assets. In relation to this, Duus and Hjelmeland (2013) mention that no existing model is able to capture all the relevant factors determining house prices. Moreover, Smith and Smith (2006) argue that econometric equations are likely to be improperly specified in that fundamental value is a highly non-linear function of many variables. Another problem for regression-based fundamental value models regards the interpretation of their results. For such models, the amount by which actual market prices deviate from the prices predicted by a regression-based model is interpreted as the extent to which house values are overpriced or underpriced. Therefore, to qualify a situation as a bubble, adherents of such models assert that actual prices should be higher than the predicted fundamental values. This allows us to question why any positive deviation in actual house prices (i.e. index values) from predicted fundamental house prices (i.e. model values) should be taken as bubbles and not as forecast error. Finally, another interpretation problem, particularly for regression-based models, is that such models tend to reject the presence of a housing bubble if house prices can be reconciled with variations in macroeconomic variables, or if the price change can be explained by both fundamentals and ‘reasonable’ shifts (Shen et al., 2005). However, the notion of reasonableness in interpreting results is absolutely subjective. Consequently, such results are open to interpretation bias.

The appropriateness of the user cost model for detecting housing bubbles is another ongoing debate in the literature. Glaeser and Gyourko (2007) argue that the cost approach is inaccurate because of appreciable differences between owners and renters and the types of residences in which they live. Mayer (2011) mentions another problem related to user cost models. He claims that such models are inherently static and that they need to incorporate factors such as dynamic risk premia. Dynamic risk premia are a debatable issue in terms of how large of a risk premium for housing is required to mitigate the true risk. Likewise, with fundamental values, approaching the user cost involves the usage of housing rental data. Thus, the same degree of data uncertainty is attached to the user cost approach because such data are not available through any formal means. Moreover, without loss of generality, the user cost model is crucially dependent on the estimated (“true”) fundamental user cost of housing assets. This led us to conclude that modelling the challenging determinants of user cost cannot be avoided. Price to rent ratio is widely used metric when applying a user cost approach. Himmelberg et al. (2005) explain that differences in expected appreciation rates and taxes can lead to considerable variability in the price to rent ratio.

Zhou and Sornette (2003) use the Log-Periodic Power Law (LPPL) to identify signals of faster-than-usual performance. Cameron et al. (2006), however, are critical of this approach because it relies on house prices alone and thus ignores several other fundamental factors. Following this logic, Geraskin and Fantazzini (2011) argue that the original LPPL model was created for financial assets such as stocks rather than for housing, which is significantly different by nature. The authors also claim that to implement the LPPL model appropriately, it is necessary to make several assumptions related to dividends, interest rates, risk aversion and market liquidity constraints.

Seeking the optimal approach becomes more ambiguous when considering the different views about which variables best demonstrate the bubble phenomenon. For example, Bordo and Jeanne (2002) and Zhou and Sornette (2003) prefer to use house price deviations alone, while other studies (Dreger & Zhang, 2010; Weeken, 2004; Haines & Rosen, 2007; McCarthy & Peach, 2004; Hou, 2009; Shen et al., 2005; Black et al., 2006; Case & Shiller, 2003) argue that numerous other variables are relevant for detecting housing bubbles. The list includes housing affordability indices, construction costs and housing starts, population levels, house price to rent ratio, GDP, interest rates, unemployment rates and income. From the literature review, it appears that there is no consensus regarding an optimal approach to the measurement of housing bubbles. Thus, no single method or approach for investigating the

phenomenon seems to have universal approval. A lack of a consensus also exists concerning the optimal variables a model should incorporate.

4.4 The main housing bubble detection methods

This sub-section outlines the approaches in the literature for the detection of housing bubbles. It seeks to present a concise review of existing studies related to each detection method and their applicability.

4.4.1 Descriptive approach

The descriptive statistic and ratio approach has been extensively used by Case and Shiller (2003), Baker (2002), Haines and Rosen (2007), Chung and Kim (2004) Hlaváček and Komárek (2009), Cadil (2009), Weeken (2004), Dolphin and Griffith (2011), Hou (2009) and Shen et al. (2005). Most of these studies used the descriptive approach along with other methods whereas Dolphin and Griffith (2011) showed evidence of bubbles utilising a mostly descriptive approach. Currently, application of the descriptive approach to housing bubble detection involves the graphical analysis of a single or several indicators and might also involve the following: i) descriptive statistics (i.e mean, standard deviation, maximum and minimum values); ii) correlation analysis; and iii) supportive analytical tools such control charts. The study by Dolphin and Griffith (2011) is an ex-post analysis for the detection of bubbles. The descriptive analysis applied in this study was limited to searching for unusual performances on the basis of the graphical trajectory of house prices, consumer spending growth vs. house prices, affordability indices, lending, rental indices, and house building completions. The main course of action used by Dolphin and Griffith (2011) was an analysis of the relationships between house prices and the aforementioned variables. The authors conclude that some metrics can be used on a descriptive level to indicate when a housing bubble is forming. Weeken (2004) applied a partly descriptive approach in conjunction with an asset pricing fundamental value approach to assess whether house prices were unsustainable. In the descriptive analysis part, historical series of house price to earnings ratio (HPE) were used. The results suggested that the HPE ratio was well above its long-term average. In the past, such a situation has coincided with periods in which house prices have fallen. However, Weeken concludes that data associating house prices to rental levels is

subject to several limitations. Similarly, Haines and Rosen (2007) combined a regression-based fundamental approach with descriptive analysis. On a descriptive level, the study focused on average house prices, the mortgage servicing index and mortgage rates. The analysis of these variables was primarily aimed at assessing the affordability levels of median households. The authors claim that mortgage payments and affordability indicators are essential variables that determine the prices households are willing to pay to purchase a house. Moreover, they used a descriptive statistics analysis on house prices, affordability index, income, unemployment, population density, construction cost and median age of the population. Shen et al. (2005) also employed a partly descriptive approach, utilising the descriptive statistics of house prices, disposable income, and vacancy rates. Hou's (2009) study used a combination of different quantitative indicators. Initially, he compared historic house prices with per capita disposable income growth. He continued by examining characteristics of housing demand and supply. From the demand side, Hou (2009) analysed the population structure, while from the supply side he compared houses completed with houses sold. A comparative analysis looking at house prices, gross domestic product and per capita disposable income was also done. The rich analysis in Hou's study was followed by an examination of the level of mortgage loans, price-to-income ratio and rent. Moreover, the statistical tool of a control chart was introduced to quantify housing bubbles. He applied the control chart to house prices to assess whether there was any unusual performance with regards to the rate of change of house prices. His results suggest that control charts provide a promising way to analyse housing bubbles and that simultaneous peak points for each fundamental indicator could be interpreted as evidence of a bubble. Case and Shiller (2003) also analysed the descriptive statistics of house-price-to-income ratio and house prices. They also presented descriptive regression results along with a graphical analysis of income per capita, expected rate of inflation and mortgage rates. Interestingly, Case and Shiller (1989) provided an analysis of the correlations between changes in house prices and other variables.

Garg et al. (2009) argue that the main determinants of house price on a demand level are population size and growth, income, price of housing, cost and availability of credit, consumer preferences, investor preferences and price of substitutes. The quantity of new supply is determined by the cost of inputs (i.e. land, labour and building materials), the price of the existing stock of houses and the available technology for production. They further claim that existing home sales, housing starts, housing affordability, mortgage rates, GDP, and unemployment rate are important for analysing bubbly house price levels. Kuenzel and Bjornbak (2008) used an in-depth descriptive analysis to assess UK housing booms. Their

analysis involved graphical/descriptive analysis of demand-side and supply-side indicators. On the demand side, the variables included real average house prices, population growth rates, household size and type, real disposable income, mortgage rates, buy-to-let yields and house-price-to-rent ratio. On the supply side, the list included housing stocks, changes in housing capacity and vacancy rates. Having examined the potential drivers of house price growth, the study moved towards integrating these into an overall identification of housing market equilibrium. The study concluded that a downward adjustment of UK house prices could continue, as house prices were still above levels that could be judged as consistent with housing market equilibrium (long-term average). Cadil (2009) used a partly descriptive approach focusing on real house price growth and house price to earning ratio to assess bubbles in the Czech housing market. After applying a descriptive analysis of house prices and house-price-to-earnings ratio, he acknowledged that neither indicator provided any clear evidence of a housing price bubble. However, he concluded that basic indicators used for housing bubble identification are somewhat alarming. Chung and Kim (2004) used three estimating methods to assess a housing bubble in three Chinese regions. One of these approaches, a descriptive approach, is based on the assumption that bubbles are the variation in several macro-economic variables such as Gross Domestic Product and Consumer Price Index. The method can be summarised as follows:

$$B_t = \Delta P_t - \Delta GDP_t$$

$$B_t(\%) = \frac{B_t}{\Delta P_t} = \% \text{ Share of } B_t$$

Where B_t is the amount of bubble, ΔP_t is the rate of change in actual prices, and ΔGDP_t is the rate of change in GDP. The data for this approach cover the periods of the first quarter of 1997 and the first quarter of 2002. Relying on this approach, Chung and Kim (2004) found that the results appeared much more pronounced than what one might have expected and that all the three cities showed evidence of a price bubble.

Hlaváček and Komárek (2009) used a holistic descriptive analysis of several variables (along with other statistical methods) to assess the overall variability of the Czech housing market. The variables were distinguished on the basis of demand and supply. On the supply side, they included building plot prices, construction prices, and housing stock. On the demand side were marriages, divorces, natural population growth, net migration, unemployment rate, economic activity rate of the population, vacancies and labour force, average monthly wage,

rent per month and loans. Moreover, the study applied a graphical descriptive analysis of rental returns and price-to-income ratio. The descriptive analysis concluded that there were price bubbles in 2002/2003 and 2007/2008.

4.4.2 Behavioural-Survey approach

As far I am aware, none of the existing studies in the literature except Case and Shiller (2003) has attempted to identify housing bubbles using the survey/questionnaire method. In their influential work, Case and Shiller (2003) used a combination of descriptive, fundamental and survey analyses to examine the question of how to identify housing bubbles. They initially conducted a survey on a random sample in 1988. It worth mentioning that during the 1988 survey, a number of regional housing markets in the US were booming, while others were at their peak. In their 2003 study, they used the same survey as in 1988. The focus was on homebuyers' expectations, understanding of the market situation and behaviour. The survey's questions were built in such manner as to encourage participants to "write comments anywhere in the survey." The questionnaire was sent to 2,000 people who had bought a home between March and August 2002. These dates nearly coincided with a peak in media usage of the term 'housing bubble' in October 2002. In January and February 2003, the surveys were mailed to the selected sample of respondents. These dates allowed the researchers to gauge human behaviour during a purported bubble (i.e. period with intense public attention on the possibility of a bubble). From the initial 2,000 mailed surveys, just under 700 were returned completed and usable for analysis. Case and Shiller (2003) concluded that house prices in most U.S. regions appeared to be in line with market fundamentals. However, after considering the survey data, they concluded that evidence of speculative activity existed for a number of cities. In particular, the survey results revealed that most people did not perceive themselves as in the midst of a bubble, despite all the media attention on the possibility. Then again, neither did people perceive themselves to be in a bubble in 1988. Also, the survey analysis found elements of a speculative bubble in the single-family housing market, as strong investment motivation, high expectations of future price increases, and strong influence of word-of-mouth discussion were evident. The authors further found that in all cities in both 1988 and 2003, only a small percentage of buyers thought that housing involved a great deal of risk. Case and Shiller (2003) concluded that the single-family home market is dominated by amateurs who often overreact to price changes and to simple stories, resulting in a considerable momentum in housing prices.

4.4.3 Fundamental value modelling (single equation)

The most frequently used method used for determining whether there is a bubble in a housing market is to compare the house price with fundamentals. The ‘fundamentals’ are primarily classified into two groups: 1) fundamental value, and 2) market fundamentals. The first group is measured as a function of cash flow received over time. The second are exogenous macroeconomic variables that are fundamental to the housing market. Often, the second group takes the form of an econometric modelling. For both groups, the presence of a housing bubble is considered as any serious deviation between actual house prices and the estimated prices (Shen et al., 2005).

4.4.3.1 Asset-pricing models

The dividend discount model (DDM) is often traced to Williams (1938). DDM was developed with the view to assist with the calculation of the intrinsic value of a firm or a particular stock. Assuming an infinite forecast horizon, the present value of a firm (i.e. asset) can be obtained by discounting the expected stream of dividends/income. Formally, that is

$$V_t = \sum_{t=1}^{\infty} \frac{D_t}{(1+k)^n}$$

Where D_t is the expected dividend at time t , k is the investor’s required rate of return and n is the number of periods.

Weeken (2004) applied a simple asset-pricing model (i.e. dividend discount model) to examine whether the observed rate of increase in house prices was unsustainable. In this framework, P is the price of an asset, D is the expected future pay-offs of dividends, discounted at a rate R , which accounts for the risk associated with investing/holding the real estate asset. This can be written as:

$$P_t = \sum_{j=1}^{\infty} \frac{D_t + j}{(1+R)^j}$$

Additionally, Weeken (2004) introduced a constant real rate growth model. The dividend values in Weeken’s (2004) model implies the rental values. Such data is available from some

estate agencies and research institutes like the Investment Property Databank (IPD). Weeken (2004) found that 'housing dividends' are difficult to estimate and that asset-pricing models face several limitations. Briefly, those limitations include the following: arbitrage opportunities, lumpiness of housing, imperfect substitutability, distortionary taxes and regulations. The study suggests that no clear results can be produced due to data and model limitations. Black et al. (2006) proposed an advanced procedure of a time-varying present value approach to assess whether house prices deviate relative to fundamental house prices. An adaptation of the vector autoregressive (VAR) methodology was also used, along with other tests such as the Ljung-Box test statistic and Wald test statistics. Black et al.'s (2006) model was applied to UK housing data from Q4 1973 to Q3 2004, covering the variables of house prices, disposable income and retail price index. The house price data was taken from Nationwide, while the data on real disposable income and retail price index (RPI) came from the Office of National Statistics. The housing data were deflated by the RPI in order to convert prices into real terms. The results suggest that the time-varying present value model did not provide a good fit between the observed data and actual prices, resulting in periods of over and under valuation of prices. Particularly, deviations between actual and computed fundamental price were evident in the mid- to late 1980s. However, in the first year of the 1980s bubble (1986), actual prices were close to the fundamental values. As for the 2000s bubble, the model indicated that by the end of the sample time period (September 2004), there was a 25% gap between actual price and estimated fundamental price.

Hou (2009) used an asset-pricing approach to assess whether a bubble existed in Beijing and Shanghai. His approach is defined as follows:

$$B_t = P_t - P_t^*$$

Where B_t refers to a rational bubble, P_t is the actual market price at time t , and P_t^* is the estimated fundamental value (i.e. rational price – perfect foresight). P_t^* is calculated as $P_t^* = P_{t-1}(1+r) - D_{t-1}$, where r represents the equilibrium return to capital (i.e. the discount rate), composed of the risk-free rate and the risk premium and D_t the rent received from the owner of the property.

In Hou (2009), the risk-free rate is taken as the Chinese Treasury bond with a maturity of three years, while the risk premium is defined as the rate of 3%. The total rent D is replaced

with the net operating income (NOI) and is treated as the net cash flow of the property. NOI is equal to market rent minus the fees for property maintenance/operating expenses and vacancy. NOI is assumed to be 80% of the total rent. For the year 2000, the rent is estimated using the average monthly rent per square meter of typical housing apartments. The rents in the following years are obtained from the annual change of rent index. Based on these specifications, Hou (2009) concludes that house prices were abnormal in Beijing in the last decade and that the deviation from the fundamental value reached almost 30% in 2005 and around 40% in 2007. In Shanghai, the results indicate a deviation of around 25% in 2003 and 27% in 2004.

Chung and Kim (2004) also used a fundamental value approach based on the present value of future income streams (income on utility). The approach is as follows:

$$B_t = P_t - \hat{P}_t$$

$$\hat{P} = R / i$$

Where B_t is the amount of bubble, \hat{P} is the fundamental value, R is the income stream of housing, and i is the discount rate. Meese and Wallace (1994, 1999) collected data on housing prices, rents and the cost of capital to examine whether the present-value relationship holds for housing. They used the following approach:

$$P_t^* = \sum_{i=1}^{\infty} \left[\frac{1}{1+r_t} \right]^i E(R_{t+i} / I_t).$$

Where P_t^* is the fundamental house price, R_t is the rental cost index in month t , the discount rate is one over one plus the cost of capital of homeowners, or $1/(1+r_t)$, and $E(-|I_t)$ is the expectation operator conditional on the information set I_t .

Black et al. (2006) assessed the bubble hypothesis by employing a time-varying present value approach. Their model used UK housing data from Q4 1973 through Q3 2004. The model also used macroeconomic data on real disposable income and retail price index (RPI). The housing data were deflated by RPI to reflect 'real' house prices. It is worth clarifying that real disposable income data was scaled so that real disposable income would give a time series of disposable income in the same dimensions as rents (or dividends). The initial equation for calculating the fundamental value is:

$$V_t = \gamma E_t \sum_{i=1}^{\infty} \left(\frac{1}{\prod_{j=1}^i (1 + \rho_t^* + j)} \right) Y_{t+i}.$$

Where V_t is the real value of the representative agents of residential property, γ is the expected value of future real disposable income, Y_t is the real, possibly time-varying, discount rate and ρ^* represents the rate of return required by householders. The basis for the calculation of fundamental house prices in Black et al. (2006) is re-written as:

$$P_t = E_t \sum_{i=1}^{\infty} \left(\frac{1}{\prod_{j=1}^i (1 + \rho_t^* + j)} \right) Q_t + i.$$

Where P_t is the real price at the end of period t , and Q refers to real disposable income. The size of the deviation of UK residential real house prices from their fundamental value is captured by the adaptation of the vector autoregressive (VAR) methodology introduced by Campbell and Shiller (1987, 1988). The findings reveal deviations between the actual and computed fundamental prices for the mid- to late 1980s, with an overvaluation particularly noticeable from 2001 onward. In particular, the present value model estimated that UK house prices were overvalued by as much as 25% at the end of the sample period (September 2004).

4.4.3.2 Regression-based models

Haines and Rosen (2007) used a simple regression model to determine whether a bubble existed in the US property market in 2006. Their model defines a situation as a bubble if the actual index values of house prices are higher compared to the model's predicted house prices (i.e. a deviation from "where house prices should be"). A positive price gap is seen as sign of a potentially overheated market. In numerical terms, the price gap is calculated as actual price minus the predicted price, divided by the predicted price.

The model's inputs included the variables of actual house price index values (HP), affordability³², income, unemployment, construction cost, population density and median age. The data included the time period from 1980 to mid-year 2006. Their approach comprises of two aspects. One measures the function of the regression model on the basis of the nominal values of the model input (Equation 1), while the second aspect measures the function of the regression model on a percentage change level (Equation 2).

The empirical models are as follows:

Eq.1

HP = Affordability Index, Income, Unemployment, Construction Cost, Population Density, Median Age

Eq.2

ΔHP = ΔAffordability Index, ΔIncome, ΔUnemployment, ΔConstruction Cost, ΔPopulation Density, ΔMedian ΔAge

The study found that prices in many markets had increased more rapidly than the model predicted. This price gap grew to over 20% in some markets, particularly in the popular state markets such as San Francisco and New York. The study also concluded that prices in less popular state markets appeared to be below their predicted levels in the first half of the 2000s.

Kohn and Bryant (2010) proposed a multiple linear regression model using six independent variables, with median asking price (MAP) taken as the dependent variable. The model involves both demand and supply factors. Data was collected for the period of 1988 through 2007 for all variables. The model is as follows:

MAP= F (CPI, Housing Inventory, Mortgage rates, PI, Population, Vacancy Rates)

To determine the impact of a housing bubble, Kohn and Bryant (2010) split the entire data set into two sub-sets: 1/1988 to 12/1996 to reflect a more stable period for housing prices (pre-bubble) and 1/1997 to 12/2007, during which housing prices soared, reflecting the bubble effect. Data from the entire period (1/1988 – 12/2007) was also compared with the pre-bubble and bubble periods.

Cadil (2009) also dealt with the hypothesis of a housing price bubble, but in the Czech housing market. His approach involved two regression models on two variables: flat and

³² Median household income to the mortgage payment on a \$100,000, 20 percent down, 30-year fixed-rate mortgage

house prices. The model inputs (independent variables) included household income, interest rate, average construction cost, population and construction. The study found that the Czech housing market was strongly demand-determined, and a speculative demand bubble (based on adaptive expectations) was identified. By splitting the housing market into flats and houses, Cadil (2009) found that flats were probably being exposed to more speculation than family houses and that a potential bubble bust would have a stronger impact on them.

Similarly, Chung and Kim (2004) aimed to verify the existence of a housing price bubble in the Korean housing market. They used an OLS method on four different spatial units: Korea, Kyunggi, Seoul and Gangnam district. The model is as follows:

$$P_t = a_0 + a_1 I_t + a_3 P_{t-1} - a_4 i_t - a_5 H_{t-1} + a_6 C_t$$

Where P_t is housing price at time t , I_t is the household income at time t , P_{t-1} is the expected yield rate of housing investment, i is the yield rate of an alternative investment, H_{t-1} refers to housing stock at time $t-1$ and C is the housing cost (land cost, construction cost, etc.). The study found evidence of bubble-like behaviour.

Yifei et al. (2009) established a regression model to measure correlations between real estate prices and relevant economic variables, and built the econometric model to measure speculative real estate bubbles. The model was applied in Chongqing City in China. The variable of house price is denoted as the real increasing rate, which is achieved after removing the growth in house prices resulting from increased income. Lag factors of one period and two periods are also included in the model in the form of coefficients for the house price rate of growth. Moreover, the model includes a coefficient of a “policy shock” to reflect the shock from an important speculation-related macro-economic policy initiated in 1994. The empirical analysis revealed that the housing market of Chongqing was on “the verge of a bubble.”

Hlaváček and Komárek (2009) also employed an aggregate OLS regression analysis of time series for the Czech Republic and Prague City to measure/identify potential periods of property price overvaluation. Quarterly data for the period of January 1998 to June 2009 was used, while panel regression across the Czech regions (including and excluding Prague) was performed using annual data for 1998–2008. The variable of real apartment price growth was used as the explained variable. The list of independent variables included building plot prices, construction prices, completed apartments, number of apartment per 1,000 inhabitants,

marriages, divorces, natural population growth, net immigration, unemployment rate, economic activity rate of population, vacancies/labour force, average monthly wage, rent per month and loans. The study gauged housing bubbles by a positive identified gap between actual and estimated prices. The study concludes that the periods of 2002/2003 and 2007/2008 might be seen as bubbles for the Czech residential market. However, the study points out that the level of overvaluation in 2007/2008 was lower compared to 2002/2003. This might be due to the fact that much of the rise in prices in 2007/2008 can be explained by the “fundamentals.”

4.4.3.3 User cost equilibrium models

Girouard, et al. (2005) examined 18 OECD³³ countries, including the UK, over the period of 1970 to 2005, with the aim of shedding some light on whether or not prices were in line with fundamentals. They used a simple user cost equilibrium model by borrowing the approach of Poterba (1992). The user cost of housing is calculated as:

$$= P(i^a + \tau + f - \pi)$$

Where i^a is the after-tax nominal mortgage interest rate and refers to the cost of foregone interest that the homeowners could have earned on an alternative investment. τ is the property tax rate on owner occupied houses, f is the recurring holding costs consisting of depreciation, maintenance and the risk premium on residential property, π the expected capital gain or loss, and P is the house price index. The data on nominal mortgage interest rates were taken from national statistics sources. Property tax rates were taken from the European Central Bank, the International Bureau of Fiscal Documentation, and Nagahata, et al. (2004). The parameter value for f is constant at 4% and the estimation of π is a moving average of consumer price inflation. The study concludes that evidence of a housing bubble in the UK appeared in the early 2000s.

Cameron et al. (2006) addressed the question of whether there was a bubble in UK house prices in the 2000s. In their analysis, they defined a bubble as a systematic but temporary deviation of house prices from fundamentals. The model consists of a system of dynamic equilibrium-correction (inverted housing demand) equations, incorporating spatial

³³ Organisation for Economic Co-operation and Development

interactions and lags and relevant spatial parameter heterogeneity. A simplified version of their house price equation is:

$$\ln(hs / pop) = \alpha \ln(y / pop) - \beta \ln r_h + \ln d$$

Where *hs* is the housing stock, *pop* refers to population, *y* is real income, *r_h* is the real rental cost of housing and *d* refers to other factors such as demography. The α and β coefficients are the income and price elasticities of the demand for housing services. The model used data from the period of 1972-2003. The results do not suggest that house prices in 2003 were substantially overvalued. Fitting the model to data for 1972-1996 and to the forecast data for 1997-2003, the study found no signs of systematic under-prediction, either for the full testing period or for the years 2000, 2001, 2002, or 2003. Revisiting this study, Muellbauer and Murphy (2008) suggest that by mid-2007, UK house prices looked “slightly overvalued.”

Barrell et al. (2004) attempted to measure whether and how far real house prices had deviated from their equilibrium. They used a simple inverted housing demand function (error correction) to determine the equilibrium of real house prices. Their model consists of real house prices (DLRHP), short-term interest rates (UKRR) and personal disposable income (LRPDI). In Barrell et al.’s (2004) model, the error correction relationship contains dynamic terms. Those are one- and two-period lagged changes in the log of real house price variable. The study found that house prices in the UK in 2003-2004 were around 30% above their equilibrium level. Alternatively, Ayuso and Restroy (2003) elaborated a user cost model by relying on an approach that allowed the examination of whether systematic transitory deviations of price-to-rent ratios from equilibrium conditions existed. The aim of the study was to obtain a measure of the potential overvaluation of housing in relation to rents in Spain, the United Kingdom and the United States. The paper used quarterly data covering the longest available common period for the three countries considered: Q1 1987 to Q2 2002. The results revealed that by 2002, marked increases in house prices had led price-to-rent ratios that were well above equilibrium in all three countries. Particularly for the UK, the price-to-rent ratio was around 20% above its equilibrium level.

Himmelberg et al. (2005) applied a user cost approach to assess the state of house prices, looking at both whether there was a bubble and what underlying factors support housing

demand in a way that is grounded in property economic theory. The authors used data spanning from 1980 to 2004. Their formula for the annual cost of ownership is as follows:

$$\text{Annual cost of ownership} = P_t r_t^{rf} + P_t \omega_t - P_t \tau_t (r_t^m + \omega_t) + P_t \delta_t - P_t g_{t+1} + P_t \gamma_t.$$

Where P_t is the price of housing, r_t^{rf} is the one-year foregone interest that the homeowner could have earned, ω_t is the one-year cost of property taxes, $P_t \tau_t (r_t^m + \omega_t)$ is the offsetting benefit to owning a property in terms of tax deductibility of mortgage interest and property taxes on income (taxes), δ_t represents maintenance costs (expressed as a fraction of home value), g_{t+1} is the expected capital gain or loss during a year, and $P_t \gamma_t$ is an additional risk premium for homeowners expressed as the higher risk of owning versus renting. Himmelberg et al. (2005) define equilibrium as situations in which the expected annual cost of owning a house is equal to the annual cost of renting it. An excess annual cost of owning compared to renting implies the presence of a bubble, while the opposite is considered a non-bubble condition. The study concludes that in the late 1980s, the cost of owning looked quite high relative to incomes or the cost of renting and thus, a bubble existed. However, in 2004, these same measures show little evidence of housing bubbles in almost all US states.

McCarthy and Peach (2004) also used a user cost equilibrium model to address the question of whether there was a “bubble” in US home prices. Their proposed approach uses the following equation:

$$R_t / P_t - \left[(1 - \tau_t^y) (i_t + \tau_t^p) + \delta_t \right] = -E(\pi_t^H).$$

Where R_t is the implicit rent, P_t is the home price index, τ_t^y is the income tax rate, δ_t is the depreciation (plus repair rate), i_t is the short-term interest rate (3-month Treasury Bill), τ_t^p is the property tax rate, and $E(\pi_t^H)$ is the expected capital gain from the housing asset. The study concludes that there is little evidence to support the existence of a national home price bubble and that the combination of strong economic growth and changes in fundamentals are more than sufficient to explain the rise in home prices since the mid-1990s.

4.5 Gaps in the current housing bubble models

This chapter contributes to the research on bubbles by refining the theories of bubble detection, highlighting their gaps, discussing the on-going debate regarding such theories and presenting their critiques. On-going research on housing bubbles can be divided into four groups: the descriptive statistic and ratio approach, the survey method (behavioural approach), the single equation, and the econophysics approach (based on the log periodic power). The descriptive approach attempts to verify the existence of bubbles using descriptive statistics, ratios and graph representations of several property and macroeconomic indicators, while the behavioural research (survey method) aims to model bubbles in line with individuals' behaviour. The single equation approach attempts to assess the presence of bubbles based on diversified assumptions and advanced econometric techniques, mostly associated with present value, regression and the user cost approach. The econophysics approach is devoted to explaining housing bubbles within the framework of log periodic power.

A review of the literature indicates the existence of limitations in bubble modelling that need to be addressed. For instance, the extensive use of ratios tends to misclassify the underlying fundamentals, particularly if the ratios are used alone. Comparing the annual growth levels of the fundamental variables to their long-run equilibrium can lead to incorrect conclusions if not supported by certain types of intervals. Therefore, it is imperative to subject these ratios and growth levels to normality tests and confidence intervals to indicate a range of irrational values relative to their long-run equilibrium. The only study reviewed here that included any kind of intervals to explain abnormalities in the fundamental variables was the study of Hou (2009). However, the control charts applied in Hou (2009) focused only on the Chinese property market. Conventional housing bubble modelling has had a tendency to ignore the germane issue of mortgage lending 'volume,' which is directly linked to the formation of housing bubbles. Such studies have also failed to consider the significant supply parameter of housing completions. This can be considered a gap in the existing research literature. Each macroeconomic variable has a different effect on house prices and thus a different level of importance. Another gap is that the housing bubble models lack even a basic hierarchical structure of the fundamental variables. None of the existing models has any form of hierarchical structure; neither has there been any attempt to assign a weight to each variable based on the description of the housing bubble phenomenon. Plausibly, any integration of such a structure into a housing bubble model should lead to a more precise conclusion.

Throughout this thesis, I have also provided sound justifications and evidence for the unrealistic theoretical framework of rational bubble theory, as well as its main limitations. Conventional rational bubble metrics for assessing bubbles in housing markets, such as asset-pricing models, regression and user cost methods (single equation approach), generally fail to accurately reflect the bubble dilemma. To the eyes of researchers employing such measures, housing markets can appear “exuberant” even when houses are in fact reasonably priced and undervalued in periods in which a bubble is actually present.

Moreover, conventional metrics do not enable researchers to test for the presence of housing bubbles using accurate pre-defined rules or thresholds. For instance, conventional models tend to accept the presence of a housing bubble if house prices are not reconciled with variations in macroeconomic variables, or if the price change cannot be explained by both fundamentals and ‘reasonable’ shifts. Therefore, the notion of how much actual prices must deviate from the so-called fundamental value or for how long in order to be classified as a bubble is open to different interpretations and thus to a profound bias. Also, existing studies using fundamental models were bound to treat house prices as the epicentre of their analysis. Paradoxically, a focus on the phenomenon as a whole has been neglected. This problem imposes a serious discrepancy in the study of bubbles. To challenge the aforementioned gaps, limitations and problems, the study of bubbles must move further toward identifying the magnitude of bubbles (as a whole). Particularly, the main question derived from this thesis is: Can we really estimate the magnitude of bubbles at a point in time? To answer this question, I attempt to propose a new approach for investigating bubbles. This approach must be profoundly different from the existing methods in terms of its theoretical foundations, framework, methodology and mathematical estimation/measurement methods. Therefore, the subsequent sections are devoted to developing and applying a new methodology and technique for estimating bubbles caused by irrationality in the marketplace.

Chapter 5

5.0 Research Methodology and Data

This chapter describes the research methodology adopted in this research to meet the research aim and objectives and to address the research questions. This chapter is divided into two stages. The first stage is concerned with the theoretical aspect of the methodology. It discusses, on a theoretical level, the philosophy, approach, design strategy, and data collection methods applicable in this study, whilst explaining the rationale behind the choices made. The second stage gives an overview of the technical basis of the methodology and the process followed in the development of the model.

5.1 Theoretical level

5.1.1 Research philosophy

Easterby-Smith, Thorpe, & Jackson (2004) emphasise the importance of understanding the philosophical issues in research design. The main unit of discussion with regards to our “philosophical methodology” is the epistemology (Grix, 2001). Epistemology is concerned with the theory of knowledge, and its nature, origin and scope, particularly with regard to methods, validation and the possible ways to gain knowledge of social reality (Grix, 2001; Saunders et al., 2012). In simple terms, epistemology focuses on how what is assumed to exist can be known, or as Saunders et al. (2012, p.132) states, it concerns “what constitutes acceptable knowledge in a field of study.” The two main contrasting epistemological positions known as positivism and interpretivism (Grix, 2001). For Saunders et al. (2012), those two positions are interpreted as being taken by a “resources researcher” and a “feelings researcher,” respectively.

Positivism is an epistemological position that studies what is clear, factual and open to observation (Pring, 2004). Positivistic solutions are based on facts obtained by means of scientific research (Jonker & Pennink, 2010). Saunders et al. (2012, cited in Gill & Johnson, 2010) states that the positivistic stance is applied through collecting data about an observable reality and by searching for regularities and causal relationships within the selected data in

order to create law-like generalisations similar with those produced by scientists. Mora, et al. (2012) mention that positivism assumes that the “truth is out there” and that it can be reached by the means of scientific methods. It aims to empirically verify causality using quantitative/empirical methodology. The positivistic position argues that only phenomena that can be observed will lead to credible data. If data is considered as being real (i.e. concerned with facts rather than impressions), then such data are far less open to bias and therefore more reliable and objective. According to the positivistic stance, the process of collecting such data is external in that there is little that can be done to alter the substance (content) of the collected data. By collecting such data, the researcher may use existing knowledge to develop hypotheses. In turn, these hypotheses can be tested and either confirmed or refuted, leading to further development of theory, which may then be tested by future research. Thus, positivistic research is theory-test based (Rombach, et al. 1993).

It is worth noting, however, that the positivistic stance does not necessarily start with existing theory. Alternatively, data collection and observation can be made prior to assessing the existing theory and prior to the development of any hypothesis (Saunders et al., 2012). An additional main component of the positivist position is that it is considered to be a relatively value-free way of conducting research (Saunders et al., 2012). With this in mind, positivism argues that the foundation of all knowledge must be the immediate experience that we have, and that is what counts as intelligible knowledge. Emphasis should be placed on quantifiable observations. Two kinds of proposition can be verified and thus are meaningful under the positivistic approach. Those are empirical statements, which science and theory are built upon, and logical/mathematical statements that are tautologically true by their nature (Pring, 2004). Also, use of a structured methodology is more likely within the positivistic position.

In this study, the development of knowledge relies on the position of positivism since the nature of this research reflects the elements of this philosophical position. The housing data sets for the UK property market are considered clear, trustworthy and objective sources. This study assumes that the UK housing data sets mirror and reflect the market participants’ actions and decisions (in an aggregate form). As a result, the selected housing indicators are the mode of observing the phenomenon of housing bubbles (in an aggregate form). Therefore, by combining the nature of the research data and the decision of the positivistic philosophical position, I focus on causality and law-like generalisations in order to reduce the phenomenon to its simplest elements. This will lead to the formation of theories, tests and

organisation of the facts into a coherent and useful form that will be applied towards answering the research question. Finally, the fact that structured methodology and quantitative empirical methods are appropriate for positivism as a stance is another component justifying my philosophical choice, since this thesis intends to follow a structured methodology using a quantitative-empirical approach.

5.1.2 Research approach

There are two core research approaches available: deductive and inductive. This sub-section will discuss these approaches, with emphasis given to the chosen approach, the deductive. Then, the reasoning behind my decision and the stages for using the deductive approach will be addressed.

Deductive research is associated with developing a conceptual framework or theory and then using it for testing purposes (Farquhar, 2012). Grix (2001) states that deductive research involves clear assumptions and solid previous knowledge in order to understand and find new answers for a particular problem. Above all, it is solidly theory-driven research. Correspondingly, Blaikie (2010) argues that the deductive approach requires an in-depth analysis of theoretical work prior to data collection. Collins (2010) notes that the deductive approach is more suitable and common when the research subject has a strong literature background that the researcher can rely on to define propositions and relationships. Also, the deductive approach is associated more with positivism, since the need to explain causal relationships between variables is an inherent element of the deductive approach. Another crucial element of the deductive research pathway is the need to select large size samples as well as apply controls to ensure the validity of the data (Saunders et al., 2012). The inductive approach, on the other hand, is more relevant when the subject is 'new,' with little published research on the topic. In such circumstances, it is more suitable to use the inductive approach to generate data in order to answer the research question. Also, the inductive approach relates more to flexible methodology rather than structured (Saunders et al., 2012).

The deductive approach involves objectivity since the research needs to be independent of what is being observed. Feelings and personal viewpoints should not enter into the research. Only the facts that can be measured can produce knowledge. Related research terms and propositions must be accurately defined (Collins, 2010). Deductive reasoning moves from a

pattern that might be logically or theoretically expected to observations with the view to test whether the expected pattern actually occurs in the real world (Maxfield & Babbie, 2012). Therefore, the deduction can be a hypothesis, prediction, or an explanation of the regularity, depending on the aim of the research (Blaikie, 2010). In addition, deductive research needs to explain the causal relationships between two or more variables or concepts (Collins, 2010; Saunders et al., 2012). On a statistical level, the deductive approach makes “use of general information to draw conclusions about specific cases” (Lee et al., 2009). Deductive reasoning is based on logical propositions. One of the main branches of deductive reasoning is conditional reasoning. Under this reasoning, the researcher attempts to draw conclusions based upon an “if-then proposition.” If antecedent condition (a) is met, then consequent event (q) follows (Sternberg, 2009). Collins (2010) highlights five basic stages for the use of the deductive research approach:

- 1) Set a testable proposition, the relationship between two or more variables or concepts.
- 2) Indicate how the variables can be measured.
- 3) Test this proposition.
- 4) Review the outcome with the view to confirm the theory or the model or to establish how the proposition needs to be modified.
- 5) Finally, if necessary, modify the proposition and the repeat the process.

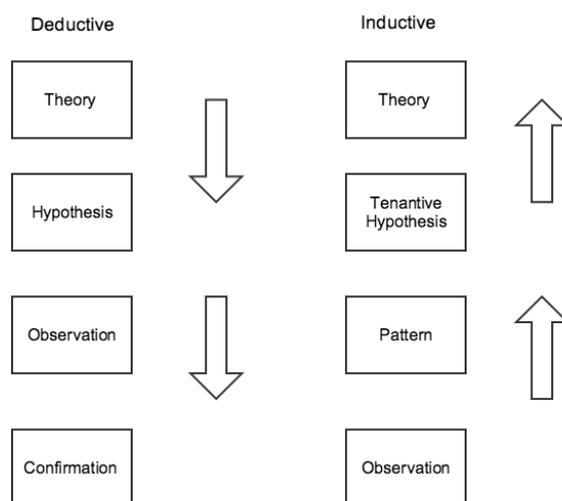
Similarly, Blaikie (2010, cited in Saunders et al., 2012) divides the deductive approach into six stages:

- 1) Put forward a testable proposition or hypothesis regarding two or more concepts or variables.
- 2) Use the existing literature and specify the conditions under which the theory is expected to be supported, thus deducing a testable proposition or number of propositions.
- 3) Examine the logical aspect of the argument by comparing it with existing theories to validate whether it offers an advance in understanding or not.

- 4) If it does, then test the hypotheses using appropriate data in order to measure the concepts or variables and provide an analysis.
- 5) If the findings are not consistent with the hypotheses, the test has failed. This implies that the theory is false and the researcher must either reject the hypotheses or modify them and restart the process.
- 6) If the results of the analysis are consistent with the premise/hypotheses, then the theory/model is validated.

Based on the above stages, the term “deductive” refers to research that relates to the method of proposing hypotheses in order to test their acceptability or falsity by examining whether they are compatible with empirical data (Grix, 2001). Inductive research, on the other hand, draws conclusion from specific empirical data (the particulars) and attempts to provide generalised theories leading to more abstract ideas (Grix, 2001). Similarly, as Lee et al. (2009) argue, an inductive approach in statistics involves drawing general conclusions from specific information rather than vice versa, as with deduction (Saunders et al., 2012). Within the framework of the inductive approach, emphasis is given to qualitative data (Collins, 2010). Commonly, the inductive approach uses interviews as the main data sample in order to understand and interpret the nature of a problem. Also, its methodology is less structured compared to the deductive approach (Saunders et al., 2012).

Figure 6. Deductive and Inductive Approaches



Source: Farquhar (2012, p.24)

Housing bubbles as a field of research have a strong academic background. The nature of the research topic requires an in-depth analysis of the existing literature prior to data collection. Moreover, a quantitative method is the most preferred tool of analysis for bubble research, as objectivity is a core characteristic in such research. Alternatively put, the topic of housing bubbles is, in itself, more oriented toward positivism. In addition, the need to explain causal relationships between variables is crucial for understanding the complex nature of housing bubbles. A large sample size is also a necessity for undertaking a reliable examination of housing bubbles, while the application of controls to ensure the validity of the data is also important. With this study, my intention is to build a new “structure methodology” to address the research question, with the view of providing empirical tests. Taking into consideration the differences between the deductive and inductive approaches, as well the research characteristics of housing bubbles described above, I conclude that the deductive approach is the most suitable route for this study.

5.1.3 Research design and strategy

5.1.3.1 Research design

Research design is divided into two broad types: quantitative and qualitative. The distinction between these two terms relies on the nature of the data, i.e. whether the data is numerical or non-numerical (Maxfield & Babbie, 2012; Saunders et al., 2012). Quantitative methods are generally concerned with measuring aspects of a phenomenon, while qualitative methods are more concerned with exploring and developing descriptions of a phenomenon by analysing social actors’ meanings and interpretations (Blaikie, 2010). Quantitative data is the term given to data that can be counted (quantified), whereas qualitative data is based on meanings that are expressed via language and words. Quantitative data is based on familiarisation of existing research and is concerned with establishing strong and separate relationships between a limited number of variables, whilst qualitative data seeks to understand how people view a situation and how their understanding affects their actions (Anderson, 2004). Via a quantitative research design, the researcher seeks to obtain abstractions from repeated observations (Anderson, 2004) with the view of opening up the possibility of statistical analysis, ranging from simple descriptions to more complex testing of relationships between variables (Maxfield & Babbie, 2012). Saunders et al. (2012) explain that quantitative research

is most often associated with the positivist philosophy and deductive research approach, particularly when predetermined (secondary) data is used. The researcher is seen as independent of the research, and any personal opinions or feelings are kept as far away as possible, in a value-free way.

My work looks at predetermined data (housing indices and housing indicators) and uses quantitative statistical analysis with the aim of examining the bubble relationships among selected variables. In turn, this analysis is aimed at providing the compulsory foundations for developing a new measure (using a specified model) for identifying housing bubbles in the formation process. Moreover, the selected research philosophy (positivism) and research approach (deductive) are highly related with the quantitative research design. Taking into consideration all of the above reasons, I conclude that the quantitative research design is the most appropriate for the purpose of this study.

5.1.3.2 Research strategy

Research strategy is defined as “a plan of how a researcher will go about answering her or his research question” (Saunders et al., 2012, p.136). This sub-section will describe the two strategies chosen for this research and will then focus on explaining how these strategies will contribute to solving the main problem of the study.

Yin (2012, p.18) defines a case study as “an empirical inquiry about a contemporary phenomenon, set within its real-world context especially when the boundaries between phenomenon and context are not clearly evident.” Kothari (2004) states that the case study method also involves the recognition of the status of a phenomenon, the collection of data, and the examination of the history of the phenomenon. Similarly, according to Saunders et al. (2012), a case study explores a phenomenon within its context or within a several real-life contexts. ‘Why,’ ‘what’ and ‘how’ are three basic questions types that a case study has the ability to answer. The case study approach also involves the detailed examination of a historic event in order to develop and test existing historical explanations (George & Bennett, 2005). Simons (2009) highlights that the case study approach is “useful for exploring the process of and dynamics of change.” By combining Hunter et al.’s (2005, p.27) definition of economic bubbles “as a name we assign to events that we cannot explain with a standard hypothesis ... [and] we are unlikely to exclude all alternatives except the bubble explanation” and Barlevy’s (2007, p.45) argument that most economists would find the

classical definitions of “bubbles” to be problematic and ambiguous and would question “how much the price of an asset must rise, or how quickly, in order to qualify a situation as a bubble,” I can claim that the boundary between the housing bubble phenomenon and its context is not clearly evident. As such, I can assert that the use of the case study strategy seems useful.

Saunders et al. (2012) notes that case studies are carefully selected on the basis and the anticipation that similar results can be produced from each one of the selected case studies. Yin (2009) describes this as “literal replication.” For instance, if all results from the selected case studies are as similar as expected, then this will undoubtedly provide strong support for the study’s theoretical proposition and its testing procedure. However, if the findings derived from the selected case studies are contrary and thus not coherent with the anticipated results, then no further knowledge can be produced. “Particularistic” is one of the main characteristics of case study research. Particularistic implies that the focus of the study is on a particular phenomenon, making it a reliable method for studying practical real-life problems (Tayie, 2005). In this research, the case study strategy focuses on the last two UK housing bubble. My study also intends to compare the last two UK housing bubble cases and thus to use a “comparative case study” approach (Albarran et al. 2006). Therefore, the case of “UK housing bubbles” is the research’s “object/phenomenon,” and the “case” itself becomes the centre of attention. As such, the use of the case study strategy is appropriate. A combination of statistical analysis with the case study approach is helpful for refining concepts and for establishing useful meanings among variables on a real-life basis (George & Bennett, 2005). Galliers (1991) shows how case studies lead to a research question that leads to theory building. This theory can then be tested and extended using laboratory and field experiments. Due to the highly iterative nature of the strategy and tight links to data, case studies can provide new insights grounded in empirical observations (Strauss & Corbin, 1994)

Based on the above discussion, this research adopts a case study approach because it suits the study’s interpretive character. It is a suitable mechanism to elicit data and knowledge from real-life events as well as to provide a deep analysis and understanding of the complex context in which bubbles exist and their evaluation is applied. What case studies do I expect to use in this study? Briefly speaking, according to the studies of Scott (1996), Dolphin and Griffith (2011), Kuenzel and Bjornbak 2008) and Fraser (1993), the 1980s bubble lasted for four years, from 1986 to 1989, while for the first decade of the new millennium, the period

of 2001/2-2007 is seen by many as a classic example of what we call a housing bubble (Rapp, 2009; Clark et al., 2010; Dolphin & Griffith, 2011; Kuenzel & Bjornbak, 2008).

Saunders et al. (2012, p.141) describes the experimental strategy as “the gold standard.” In applying the experimental strategy, the researcher aims to find out exactly how a relationship works by observing and measuring what happens during an experiment, rather than exploring whether or not a relationship exists between two variables (Walsh & Wiggins, 2003). However, as Diamond (2001, p.8) states, “an experiment can only produce an estimate of the true state of nature.” As Suppes (1960, p.15) asserts, “sentences of the theory are asserted as if they are the one way of describing the universe...[and] experimental results are described as if there were but one obvious language for describing them.” However, as George and Bennett (2005) highlight, the “statistical method, case studies, and models should be regarded as complementary, rather than competitive. Research can progress more effectively through diverse methods than it can through any one method alone.” Research that uses the experimental strategy commonly aims to generate quantitative data; therefore, a positivist approach is most commonly adopted for such investigation (Walsh & Wiggins, 2003). These characteristics are in line with the current study’s chosen philosophy and design position. However, prior to the experiment (test), in-depth observation (case study strategy) of the research data will take place in order to provide empirical knowledge on the housing bubble phenomenon in the UK. These observations will lead to the development of our housing bubble model, which will then be tested through the experimental strategy of the research, using on-going data.

5.2 Technical level

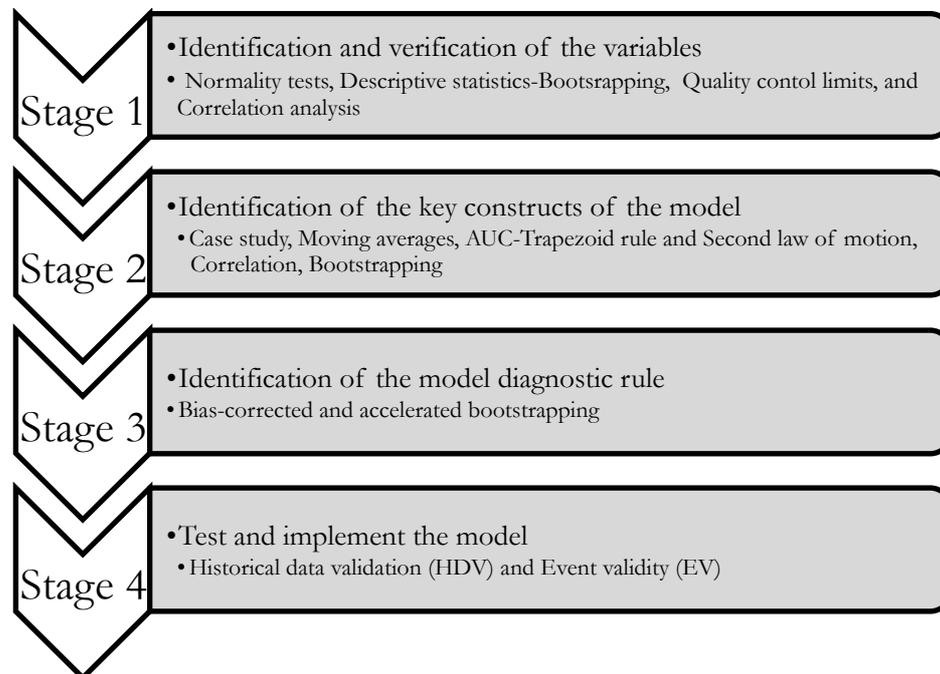
The research methodology in this study is divided into four stages. The stages are driven by the normal distribution theorem coupled with the aforementioned research philosophy, approach, design and strategy. In this thesis, the application of normal distribution theory is allowed through normality tests, descriptive statistics with bootstrap intervals, control limits, bias-corrected and accelerated bootstrapping. The case studies used in this research include the last two housing bubbles that occurred in the UK housing market. These occurred in the periods of 1986-1989 (Scott, 1996; Fraser, 1993; Kuenzel & Bjornbak, 2008; Dolphin & Griffith, 2011) and 2001/2-2007 (Rapp, 2009; Clark et al., 2010; Kuenzel & Bjornbak, 2008; Dolphin & Griffith, 2011).

Using an ex post approach, I seek to confirm whether accepted historic bubble episodes (UK housing bubble cases) are in line with the model's rule violations. The data used in this study have been collected from various national sources such as Nationwide, Halifax, the Council of Mortgage Lenders, the Department of Communities and Local Governments and the Home Office for National Statistics. The geographical scope of the collected data is limited to the UK at a national level. Further description of the data used is provided in Section 5.3.

5.2.1 Research process

The research process defines the plan for the development of the housing bubble model. It also details and justifies which methods and techniques are used in each stage of the research process in relation to data collection, analysis and validation.

Figure 7. Stages of the research process



5.2.1.1 Stage 1: Identification and verification of the variables

The first stage involves a longitudinal time series analysis for the period between 1983 and 2011 using multiple housing variables. This analysis aims to empirically identify and explore whether the selected variables exhibited extreme behaviour during the reported housing bubble periods, so as to consider them as symptoms of the phenomenon in the first place. In other words, the analysis intends to compare whether the growth of such symptoms is associated with the periods of housing bubble formation in the UK and whether the bubble periods differ significantly from non-bubble periods in terms of these variables. The tools used to examine this relationship include normality tests, descriptive statistics with traditional bootstrapping, quality control limits and correlation analysis.

5.2.1.2 Stage 2: Identification of the key constructs of the model

The second part of the research process focuses on establishing the key constructs of our model. These include:

- I. *Hierarchical order of the variables*
- II. *Specific time frame of analysis*
- III. *Measurement process*
- IV. *Main Multiplier*

For the hierarchical order of the variables, I seek to calculate three components.

The first component is the area under the economic curve (AUC), calculated using the trapezoid rule. The second component is the acceleration rate and involves the difference between the average performance (long-term) and the average abnormal performance (during bubbles). The third component is calculated by applying a bubble factor to the second law of motion. Further details regarding the application and the results of these techniques can be found in Section 7.2.1.

The specific period of analysis is the period that the model considers that a bubble. This period has been established through a comparative analysis relying on UK housing bubble

cases. Further justification for this can be found in Section 7.2.2. The measurement process covers the application of the model and allows for correct data transformation for the key constructs of the model. Further details and explanation regarding these can be found in Sections 7.2.1 and 7.2.3. The main multiplier is the main multiplicand factor in the proposed model. For the selection of the main multiplier variable, I use two methods. The first involves quantitative analysis using existing research tools, and the second includes theoretical reasoning from the literature. The analysis and explanation of that model construct is presented in Section 7.2.4.

5.2.1.3 Stage 3: Identification of the model diagnostic rule

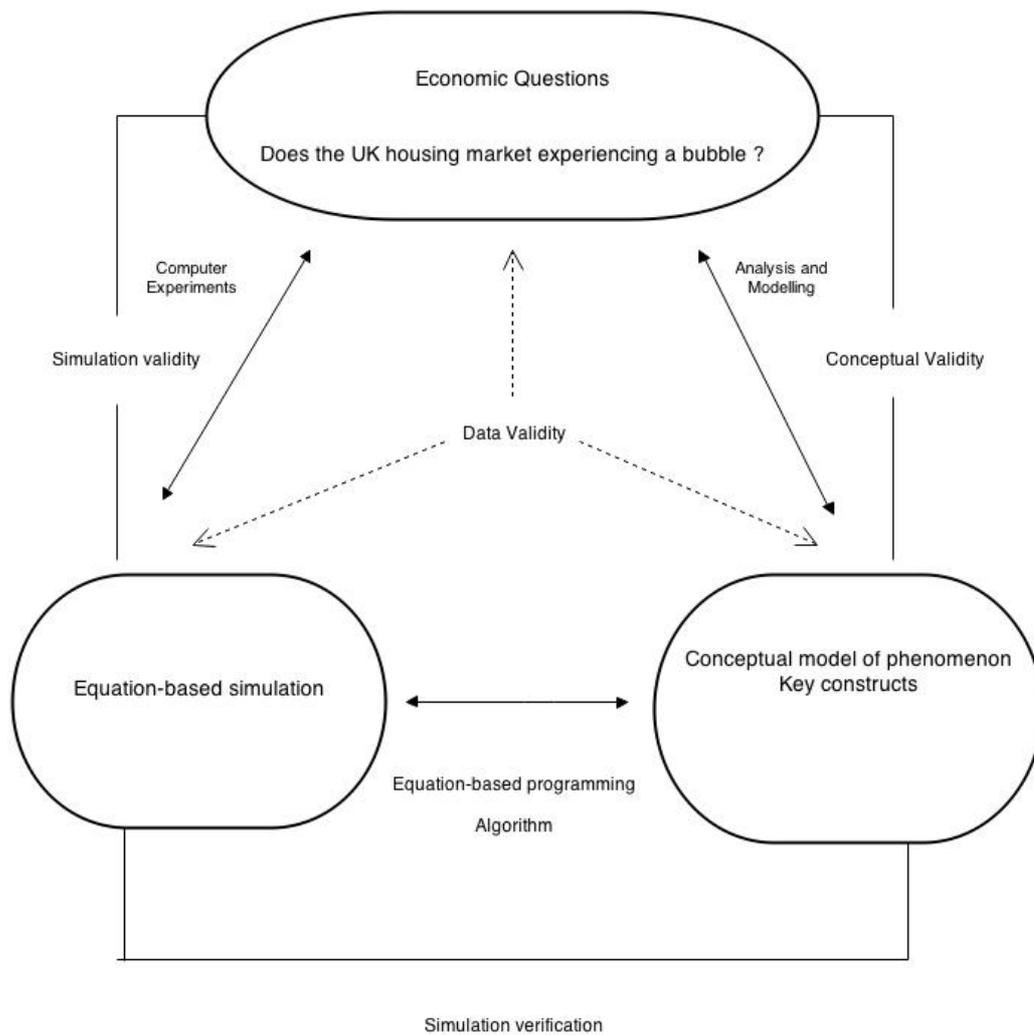
The third part of the research process concentrates on establishing the model rule and proposing the model. The tool used to establish the diagnostic bubble model rule is the bias-corrected and accelerated bootstrapping (BC_a) method. The rationale for using the BC_a method, and further details on this approach can be found in Sections 7.3.3 and 7.3.4.

5.2.1.4 Stage 4: Tests and implementation for the bubble case studies

For the testing procedure of our model, I use the historical data validation (HDV) and event validity (EV) techniques. These techniques aim to test the reliability of our model. HDV involves considering historical input to determine whether the model reproduces real historical output. One example is to determine whether meteorological conditions that have always produced rainy days in reality will produce rainy or sunny days in the model (Kennedy et al. 2005; Sargent, 2005; Yoe, 2012). In this analysis, HDV and EV involve the use of historical bubble input to determine whether the model reproduces an out-of-rule state that in turn corresponds to the bubble component, and whether historical non-bubble input reproduces a state of rule control. Following this method, part of the dataset is used to build the model rule (using the BC_a tool) and the remaining datasets are used to determine whether the model represents reality (Kennedy et al., 2005; Sargent, 2005). Figure 8 shows an adapted version of Kennedy et al.'s (2005) verification and validation process for economic model-simulations. It has been modified based on the main question of this thesis. Figure 8 demonstrates the methodology used for its verification and validation. Note that both the

verification of input and the verification of the rule are fundamental parts of the model development process.

Figure 8. Verification and validation process for the bubble model



5.3 Data

The study uses longitudinal data analysis. In our case, longitudinal analysis is the only way to obtain a rich understanding and to capture the sequence of evolutionary changes through which all the key variables progressed over the period of study. The UK datasets range from 1983 to 2011. The rationale for choosing 1983 as the beginning period of our analysis is because 1983 is the earliest available common period for the entire selected data sample. Table 9 provides a summary of the variables used in this study. Initially, these variables were identified through the literature review as the main influencing factors in the development of housing bubbles (in the UK housing market). To make the data truly comparable, all data sets have been converted to annual figures (averages) and to percentage form, except for house-price-to-income ratio, which is analysed in its annual nominal value form.

Table 9. Data description

No.	Name	Description	Period Covered	Source
α	House Prices	All houses, all buyers, average nominal house prices	1983-2011	Nationwide
β	D/B Ratio	Mortgage payment as a percentage of main take home pay (first-time buyers)	1983-2011	Nationwide
γ	Gross Lending	Gross regulated mortgage lending £m of loans for house purchase (average) Nominal prices	1983-2011	Council of Mortgage Lenders
δ	Housing Completions	House: permanent dwelling completions by tenure; private enterprise (average)	1983-2011	Department for Communities and Local Government
ε	Income	Median equivalised disposable household income at 2011/12 prices	1983-2011	Office for National Statistics
λ	HP-to-Income	House-price-to-income ratio (all buyers)	1983-2011	Halifax

5.3.1 Rationale for choosing the selected variables

5.3.1.1 House Prices

The house price is the foremost variable used to begin to answer the question of whether the market is undergoing a bubble. Not surprisingly, all contributors to the literature on detecting housing bubbles have incorporated house prices in their analyses. It has been used either as a benchmark for fundamental value or user cost or as an important variable in a descriptive and ratio analysis. Generally, a rapid increase in house prices is a necessary first component to define a situation as a housing bubble. This can be justified by the fact that most available definitions of housing bubbles put emphasis on house prices in describing the phenomenon:

- i) “any significant increase in the price of an asset...that cannot be explained by the fundamentals” (Kindleberger & Aliber, 2005, p.30)
- ii) “a situation where an asset’s price exceeds the fundamental value of the asset” (Barlevy, 2007, p.46)
- iii) “if the reason the price is high today is only because investors believe that the selling price will be high tomorrow—when ‘fundamental’ factors do not seem to justify such a price—then a bubble exists” (Stiglitz, 1990, p.13)
- iv) “an unsustainable price surge that does not fit with societal fundamentals” (Reed and Wu 2010, p.41)
- v) “a situation in which the market prices of an asset (such as stocks or real estate) rise far above the present value of the anticipated cash flow from the asset” (Smith & Smith, 2006, p.2)

5.3.1.2 Debt-Burden Ratio

Affordability is a core element in detecting overheating property markets (Himmelberg et al., 2005; Dolphin & Griffith, 2011). A large number of studies have employed affordability ratio analysis as a tool for bubble detection (Case & Shiller, 2003; McCarthy & Peach, 2004; Hou,

2009; Shen et al., 2005; Dreger & Zhang, 2010; Weeeken 2004). Yan (2011, p.16) explains the collapse of a bubble in terms of its instability:

“Think of a ruler held up vertically on your finger: this very unstable position will lead eventually to its collapse as a result of a small (or an absence of adequate) motion of your hand or due to any tiny whiff of air. The collapse is fundamentally due to the unstable position; the instantaneous cause of the collapse is secondary.”

Looking at affordability helps to uncover such an unstable position. As Higgins (2013) states, since prices within a bubble “expand above the value that is warranted by normal returns and demands, they cannot continue to rise.” With this in mind, demand can be measured using affordability indices, which should therefore not be neglected when examining the possibility of a housing price bubble.

The debt-burden ratio (D/B ratio) is one of the main indicators of housing affordability. This ratio measures total home ownership costs, taking mortgage payments as a percentage of a typical household’s monthly (pre-tax) income. If the ratio rises too far above what is regarded as normal, households become increasingly dependent on rising property values to service their debts. Simply put, debt-to-income ratio considers the ability of households to meet their mortgage liabilities (Tsai, 2013). Similarly, Farlow (2004) notes that the debt-burden ratio is relevant for identifying purchasing power in the housing market and explaining the sustainability of property prices. A rule of thumb is that 25% (or sometimes 30% or higher) of household monthly income being spent on housing is considered affordable and sustainable (Ndubueze, 2009). However, each market has its own rule of thumb. For example, Glindro, Subhanij, Szeto, and Zhu (2008) assert that average levels for a particular market provide a good rule of thumb for affordability. Bordo and Jeanne (2002) state that debt burden is closely related to the expected price of assets, while Tsai (2013) argues that housing has a unique characteristic: as prices increase, expectations of further price increases stimulate demand and mortgage expenses grow accordingly, thus reducing affordability. Dolphin and Griffith (2011) assert that D/B ratio measurements fully reflect the long-term performance of nominal interest rates and act as an indicator by which to track the money illusion. The literature suggests that the debt-burden ratio can be useful in terms of providing an indication of how stable the ability of households is to service their loans and how willing new households are to enter the market. These are key determinants in uncovering any instability or abnormality in housing prices.

5.3.1.3 Gross Lending

The lending parameter is frequently discussed in the housing bubble literature. Several authors have explained the vital contribution of real estate lending to house prices and to banks' capital assets (Herring & Watcher, 2002; Kindleberger & Aliber, 2005; Hou, 2010). Zhou and Sornette (2003) argue that a housing bubble is part of a more general credit bubble. In this framework, a housing bubble cannot exist without the existence of a credit bubble. Similarly, Hou (2009) notes that the rapid growth of mortgage loans contributes to higher housing demand since credit transforms the purchasing power of house buyers. According to a large number of studies, two factors can explain the tendency of housing bubbles to recur. One is disaster myopia, which is linked to human cognitive issues, while the other is the presence of perverse incentives (Caprio et al., 1998; Tversky & Kahneman, 1974). Both of these factors were discussed in Section 3.8. As for the presence of perverse incentives, this is directly linked with the gross lending parameter. As a result, gross lending is seen as an important indicator for the early detection of housing bubbles (Herring & Watcher, 1999, 2002; Cornand & Gimet, 2011; Hunter et al., 2005; Stroh et al., 2008; Haldane, 2009). However, few studies have incorporated variables related to lending. Some, like the studies of Cameron et al. (2006), Case and Shiller (2003) and Allen and Gale (2000), have used nominal or real mortgage rates to represent the lending variable, while others (e.g. Hou, 2009) have used the average percentage growth in mortgage lending in monetary terms to denote the lending aspect of the phenomenon. Alternatively, McCarthy and Peach (2005) examined the lending aspect indirectly by employing debt-burden ratios in their analysis. The above discussion demonstrates that lending plays an important role in terms of the formation and identification of housing bubbles and should therefore be used as an individual variable.

5.3.1.4 Housing Completions

Housing completions are a core element in terms of measuring the supply of housing in the market. The UK has had a well-documented undersupply of housing. According to some studies, undersupply is one of the main factors responsible for the historic UK housing bubbles (Dolphin & Griffith, 2011; Kuenzel & Bjornbak, 2008). Ermish (1990) argues that supply inelasticity becomes a crucial determinant of the duration of a bubble. When housing supply is elastic, new construction quickly comes on line as prices rise, which causes the

bubble to unravel quickly. Despite this, Mueller and Laposa (1994, cited in Pyhrr et al., 1999) suggest that oversupply is one of the four phases in property cycles—together with recession, recovery and expansion—while at the same time is the inflection point that triggers a gap between demand and supply. However, during oversupply conditions, most participants do not recognize that this transition has occurred, since the market still looks good. Pugh and Dehesh (2001) and Reed and Wu (2010) explain that the lag (gap) between demand and supply exists because real estate cannot be produced instantaneously, as ordinary consumer goods can. During the oversupply phase, supply growth is higher than demand. At such weak equilibrium points, house prices are very vulnerable to collapse. Housing supply is not only informative in terms of the length and the performance of housing cycles, but also plays a crucial role in tracking the expectations of market participants and housing bubbles. The literature suggests that housing supply is an important indicator of overheated housing markets and hence this variable must be included when the presence of a housing bubble is examined. For instance, Mueller and Pevnev (1997) and Baum and Hartzell (2012) note that building development activity in housing markets increases during a boom. Developers are always more incentivized to invest in the construction sector (i.e. supply) when prices are rising (or when they exceed construction costs). In support of this, Holcombe and Powel (2009) and Baum and Hartzell (2012) note that the quantity of houses built often helps in measuring bubbles and can be described as a quantity dimension of bubbles. This study accepts that housing completions ideally describe the supply parameter of housing markets. All of the above considerations provide a solid justification for using this variable in this analysis.

5.3.1.5 Income

Income has been extensively used in housing bubble research, either as part of an affordability indicator or as an individual variable (McCarthy & Peach, 2004; Cameron et al., 2006; Baker, 2006; Hou, 2009; Shen et al., 2005; Dreger & Zhang, 2010; Case & Shiller, 2003; Weeken, 2004). Income is considered a fundamental factor in bubble theory (Case & Shiller, 2003; Dolphin & Griffith, 2011; Hou, 2009). The significance of income to housing bubble theory can be better understood by looking at Kindleberger and Aliber's (2005) definition of a bubbles as “any significant increase in the price of an asset...that cannot be explained by the fundamentals.” This can be interpreted as follows: if house prices can be explained by market fundamentals like income, then no bubble exists. Alternatively, if house

prices cannot be explained by changes in income then a bubble exists. Notably, Case and Shiller (2003), McCarthy and Peach (2004), Dolphin and Griffith (2011) and Hou (2009) all consider income to be a fundamental factor in housing bubbles; hence, it cannot be ignored when attempting to identify housing bubbles. Cameron et al. (2006) and Hou (2009) note that income is a core demand shifter, influencing the consumption of housing from the demand side. A review of the literature on housing bubble theory suggests that income has been used almost as often as house prices. In fact, income is perhaps the second most widely used variable (after house prices), particularly if both of the possible forms of use, as affordability indicator or as a single variable, are taken into account. For these reasons, this study necessarily includes the income variable in order to produce reliable conclusions.

5.3.1.6 House-Price-to-Income Ratio

The house-price-to-income (HP/I) ratio is the basic affordability measure for housing in a given region or country. It is the ratio of median or average house prices to the median or average familial disposable income, and can be expressed as a percentage or as years of income. The relationship of the HP/I ratio to housing bubbles is important, since the ability of households to purchase houses is, in large part, dependent on their earnings (Dolphin & Griffith, 2011). This ratio can be used to measure whether housing prices are too high (McCarthy & Peach, 2004) and seem to be suited to advanced economies with well-established housing markets (Ndubueze, 2009). Based on the assumption that house prices and incomes share some common trends in the long term, aggregate demand for homes is proposed to be a stable function of the average income. An extreme price-income ratio indicates that a higher percentage of income is required to purchase a house. This implies the existence of 'overvalued' houses (Himmelberg et al., 2005; Girouard et al., 2005; Finicelli, 2007). According to Flood (2001), ratios between 3:1 and 5:1 are regarded as normal and are therefore the "best measure of pressure on the housing market," while Reed and Wu (2010) note that the accepted affordability standard is normally 3:1. Nevertheless, for each market there are different rules of thumb (Hancock, 1993; Freeman, Chaplin, & Whitehead, 1997; Lerma & Reeder, 1987; Ndubueze, 2009). For instance, Dolphin and Griffith (2011) and Glindro et al. (2008) propose that values well above the historical average can be used as good proxies for the presence of bubbles. Generally, the issues mentioned above offer a valid justification for incorporating such a measurement in this study.

5.4 What variables have been neglected in this study? Why?

I have concluded that some variables such as mortgage base rates have relatively little explanatory power in the study of UK housing bubbles; thus, these were ignored. This study also neglects to use some other variables, such as GDP and house-price-to-rent ratio. The following sub-sections will provide brief explanations for the exclusion of these variables.

5.4.1 Base Rates

The existing standard theory claims that low interest rates are a primary trigger for housing bubbles. Surprisingly, UK housing market records show that base rates are not as relevant as the theory would suggest. This conclusion can be drawn from the large recorded difference in base rates between the bubble of the late 1980s and that of the early to mid-2000s (Table 10). During the first three years of the 1980s housing bubble, the base rate varied between 9% and 11%, significantly higher than the rates of around 4% in the early 2000s. This evidence shows that a bubble can equally arise, at least in the UK housing market, in conditions of relatively high and relatively low nominal/real interest rates. Thus, it is appropriate to neglect the base rate in this study. Moreover, this conclusion can be justified by the findings of Muellbauer and Murphy (1997), who argue that the housing boom of the 1980s cannot be explained by interest rate differences alone, as real interest rates were not particularly low during that period. This view is also consistent with that of Kuenzel and Bjornbak (2008), who showed that a large gap exists between UK nominal and real mortgage rates when comparing the period of the late 1980s to the early to mid 2000s period.

Table 10. Official Bank Rate of The Bank of England, house price inflation rate and Historic Composite Price Index, Selected Periods 1986-1988, 2002-2004

Period	Base Rate %	Magnitude of house price inflation %	Inflation Rate % (CPI)
1986	11.01	9.40 (Median)	3.4
1987	9.54	14.80 (Serious)	4.2
1988	9.37	18.90 (Serious)	4.9
2002	4.00	19.70 (Serious)	1.7
2003	3.75	19.90 (Serious)	2.9
2004	4.25	16.90 (Serious)	3.0

Source: Bank of England, Nationwide Building Society, Office for National Statistics (ONS)

5.4.2 GDP (Gross Domestic Product)

GDP is the most widely used measure of the total economic activity within a nation and some researchers have found it useful when examining the presence of housing bubbles. At its most basic level, GDP can be derived in three measures. The first is the income approach (what all people earned on an annual basis), the second is the expenditure approach (what all people consumed or spent) and the third is the output approach (the sum of the values added at each stage of production). Conceptually, these measures are the same and statistically are expected to yield the same results. In particular, GDP would be expected to equal aggregate income (Zhang, 2008; Stonecash, Gans, King, & Mankiw, 2011; Brezina, 2012; Mukherjee & Ghose, 2002; McEachern, 2014). In relation to this, the Office for National Statistics (2013) reported that “growth in (UK) median household income closely mirrors growth in GDP per person for much of this time, rising during periods of economic growth and falling during or immediately after recessions.” Since this study includes the variable of median household income, it can be considered as already taking into account the GDP effects, even if indirectly. This view justifies the exclusion of the variable of GDP from this study.

5.4.3 House-Price-to-Rent Ratio

Another popular ratio used to gauge the presence of housing bubbles is the house-price-to-rent ratio (Kuenzel & Bjornbak, 2008; Ayuso & Restroy 2003; Weeken, 2004; Dolphin & Griffith, 2011). Simply put, this ratio is the house price divided by the house rents. A higher house-price-to-rent ratio would suggest high or unsustainable house prices and indicates how many years it will take to regain the original amount invested, reflecting the return on investment of housing (Hou, 2009). Despite the advantage of this variable in assessing housing bubbles, a serious data limitation is seen with the use of this ratio. Concerning this limitation, Case and Shiller (1989) state, “We see no way of obtaining an accurate historical time series on implicit rents of owner-occupied homes.” Similarly, Weeken (2004) and Glaeser and Gyourko (2007) cite challenges in measuring rents by type of housing. The problematic nature of calculating rents in housing is also evident through the fact that most studies calculate data on housing rents using their own calculations-transformations, by employing non-reliable sources (i.e. real estate agents) or by using small samples (Weeken, 2004). To the best of my knowledge, there is no official source available that has house-

price-to-rent data for the UK. In studies where this ratio has been used for the UK housing market, it appears to have been calculated by individual researchers, with each calculation suffering its own limitations (Weeken, 2004). Therefore, considering the aforementioned arguments, it is reasonable to ignore this variable in this analysis, as its use would have limited the study's reliability.

Chapter 6

6.0 Bubble case studies in the recent UK housing market

This chapter aims to present the selected UK housing bubble case studies historically and empirically. It also aims to compare these cases in terms of persistence, magnitude and severity, and to examine whether house price changes alone can explain the presence of bubbles in the UK housing market. Finally, this chapter will distinguish between the terms “boom” (i.e. upswing) and “bubble,” and will elaborate upon whether the phenomenon of housing bubbles can be seen as a part of the UK housing cycle.

6.1 Bubble case studies: A historical perspective

Over the last 35 years, two housing bubble-busts in the UK have occurred, both resulting in deep and prolonged recessions. The first occurred during the mid to late 1980s and the second during the 2000s. According to the studies of Scott (1996), Dolphin and Griffith (2011), Kuenzel and Bjornbak (2008) and Fraser (1993), the 1980s bubble lasted for four years, from 1986 to 1989, while the period between 2001/2 and 2007 is seen by many as a classic example of what we call a housing bubble (Rapp 2009, Clark et al. 2010, Dolphin and Griffith 2011, Kuenzel and Bjornbak 2008).

6.1.1 1986-1989 UK property bubble

During the 1980s, strong deregulation initiatives were implemented in the United Kingdom's domestic financial markets. The result was to “encourage” competition between financial institutions and to encourage banking expansion (Bayoumi 1993, Reitan 2003). The economic backdrop between 1982 and 1986 saw low inflation and steady growth of the UK economy, together with rising confidence (Fraser 1993). At that time, investor confidence in the UK real estate market was high (Balchin et al. 1995). A real boom in London's real estate market began and thereafter literally spread out like a “ripple” (Fraser 1993). Between 1983 and 1987, house prices grew at an average level of 12% per annum. During the “hot years” from 1988 until the first half of 1989, house prices inflated more than 20% (Wellings 2006). The UK residential construction industry also saw a massive expansion, with 200,000

completions in 1988 compared to 115,00 in 1981 (Wellings 2006). In general, the frenzy in the housing markets in the late 1980s was sustained by a concurrent credit bubble, as happened in 1970s. Between 1982-1986, bank lending to property firms grew at over 25% per annum. In 1987, lending continued as the development boom gathered pace. According to Fraser (1993), bank lending to property firms doubled to £34 billion between 1988 and 1990. This peaked in 1991 at over £40 billion (Brett 1997).

It is also worth mentioning that a new and innovative lending product was developed during the 1980s—housing equity withdrawal (HEW)³⁴. This product further boosted the housing market demand in the UK, as housing was seen as a medium of further lending for consumption purposes (i.e. new cars, luxury goods, overseas holidays) (Reitan 2003, Balchin et al. 2003, Scott 1996, Fraser 1993). Another strategic change to mortgage products that exemplifies the credit euphoria of those times was the massive relaxation of the loan-to-value ratio (LTV) that occurred in 1982. For instance, during 1978-1981, only 10% of first-time buyers borrowed 94% or more of their house value. By 1983 to 1987, about 50% of mortgage borrowers took loans of about 95%-100% LTV, while about a quarter had 100% mortgage advances on their house value. With that new trend, banks adopted a market strategy of promoting their products to meet the existing mortgage demand rather than protecting existing borrowers or ensuring the viability of the loan provided (Ermisch 1990).

In parallel with this, during the early 1980s, the government introduced a right-to-buy scheme to help council and housing association tenants buy their homes at a discount. This measure contributed positively to home ownership and investment in the UK housing sector (Kay 2006). Another notable issue of the late 1980s was the rapid increase of overseas investors due to the recent internationalization of financial markets. This led many overseas banks to establish a well-diversified portfolio of loans worldwide, including in the UK. Also, foreign investors such as Japanese, Scandinavian, American and Middle Eastern investors showed great interest in the UK property market. During the eighteen months leading up to December 1988, they were involved in about one-third of London's total real estate purchases, with a total investment near £1 billion (Scott 1996). All of these circumstances led prices to escalate even further and investment euphoria in the UK property market was evident. However, in 1991, UK economy went into recession and interest rates began moving up in order to squeeze inflation out of the system (Fraser 1993). At the same time, a peak in housing completions coincided with a downturn in housing demand due to

³⁴ Housing equity withdrawals encourage spending since increasing housing values encourages individuals to withdraw or borrow against their housing equity (Dolphin and Griffith 2011).

recession, causing substantial fall in values (Fraser 1993, Scott 1996, and Brett 1997). The consequences were dramatic: in 1992, construction output had fallen 30% compared to its high in 1988, individual investors, and households and several property companies such as Olympia and York Alpha Estates, Erostin and Sheraton went bust (Wellings 2006, Scott 1996, Fraser 1993). The year 1996 signalled the recovery of the UK housing market (Nationwide statistics 2013). From then onwards, the UK property market began to move towards the next bubble era.

6.1.2 2000s-The first housing bubble of the 21st century in the UK

The first housing bubble of the 21st century was a global event. Many countries, including the UK, experienced housing bubbles at the same time. The list includes the United States, the Netherlands, Italy, Spain, Portugal, Greece, Cyprus, Israel, Romania, Bulgaria and others (Kennard and Hanne 2015, Phang 2013). In the early 2000s, the UK housing market was dominated by high returns, low interest rates and attractive lending schemes for property investors (Adair et al. 2009). In line with this, housing supply was low while population was rising rapidly (Clark et al. 2010, Jowsey 2011). As to the extent of a credit bubble, between 2002 and 2007, gross mortgage lending in the UK rose by 65% (Adair et al. 2009, Barrel and Davis 2008). As the real estate market was performing extremely well in early to mid 2000s, there was a common belief among participants that properties prices would increase indefinitely (Adair et al. 2009). All of these factors led prices to increase by 142% between December 1999 and December 2007. That is, a home price of £75,000 in December 1999 rose to £182,000 in December 2007 (Adair et al. 2009). Soon, however, the UK housing investment mania came to end. On 14 September 2007, the Bank of England announced a liquidity support to Northern Rock. This was the first shock for the UK housing market (Acharya et al. 2009). On 17 February 2008, the UK Government announced the temporary nationalization of Northern Rock. As a result, investment confidence in the UK real estate market was greatly damaged. This led UK house prices to fall over 18% between November 2007 and December 2008. At the same time, housing completions decreased by 13%, while housing start applications fell by 50%. In line with this, there was a considerable reduction in the volume of property sales transactions (Adair et al. 2009). On 21 April 2008, the Bank of England launched its Special Liquidity Scheme (SLS) to allow banks to temporarily swap their high-quality mortgage-backed and other securities for UK Treasury bills (Acharya et al. 2009). On 13 July 2012, the Bank of England and HM Treasury launched the “funding for

lending scheme (FLS).” This help-to-buy mortgage guarantee scheme sought to help first-time buyers as well as existing property owners purchase houses by providing them access to a 95% loan-to-value mortgage ratio for houses valued up to £600,000 (Bergstein 2014). The help-to-buy scheme can be considered as one of the biggest government intervention in the housing market since the right-to-buy scheme of the 1980s. In the wake of this policy, property prices saw a slight increase, with signs for a promising recovery in 2013.

6.2 Bubble case studies: An empirical perspective

6.2.1 Descriptive Analysis

There is an obvious interest in conducting an empirical analysis of the last two UK housing bubbles. This sub-section aims to observe and compare the graphical trajectory of the selected bubble case studies and to examine them on the basis of persistence, magnitude and severity. For the purpose of analysing the selected case studies with regards to persistence, magnitude and severity, the study adopts the approach of Agnello and Schuknecht (2011). The persistence (i.e. duration) of each bubble case is calculated as the temporal distance from the beginning to the end of each event. The magnitude is defined as the size of price change from the beginning to the end of the bubble. Finally, the severity is computed by combining persistence and magnitude for each case i , via a triangle in which the base represents persistence D_i and height is the magnitude A_i . Hence, the severity is computed as $C_i = (D_i \times A_i) \times 0.5$. This sub-section utilises data on UK nominal average house prices, as provided by Nationwide statistics, for the periods of 1986-1989 and 1990 and 2002-2007 and 2008. I also use long-term data for the period of 1980-2011 to make price comparisons between bubble and non-bubble periods. The nationwide average house price is the nominal average price of all property types (i.e. new houses, modern houses, older houses). This dataset has been converted to annual figures to reduce noise from short-term “interruptions” of long-term trends.

Figure 9.0 shows the direction of house prices during the bubble periods of 1986-89 and 2002-2007. The broken line denotes the 1980s bubble, while the solid line indicates the equivalent values for the 2000s bubble. It must be clarified that in Figure 9.0, the last year of

each case has been ignored. This is because 1990 (i.e. the 5th year of the 1980s bubble) and 2008 (i.e. the 7th year of the 2000s bubble) are recorded as being the first bust years for each case. Figure 9.0 also reveals that the 1980s bubble ended in its fourth year (1986-1989), while the second bubble lasted two years longer, ending in its sixth year (2002-2007). However, in the 1980s bubble, house prices rose exponentially, while in the 2000s case, prices slowly moved into a period of disinflation (i.e. lower annual rate of increase). In terms of price magnitude, the results in Table 11 reveal that the 1980s case saw a total magnitude of 63%, while for the 2000s the magnitude was 77%. As for the severity, the 2000s case was almost twice as severe as the 1980s case.

Figure 9. UK housing bubble case studies: 1986-89 and 1990-bust vs. 2002-07 and 2008-bust

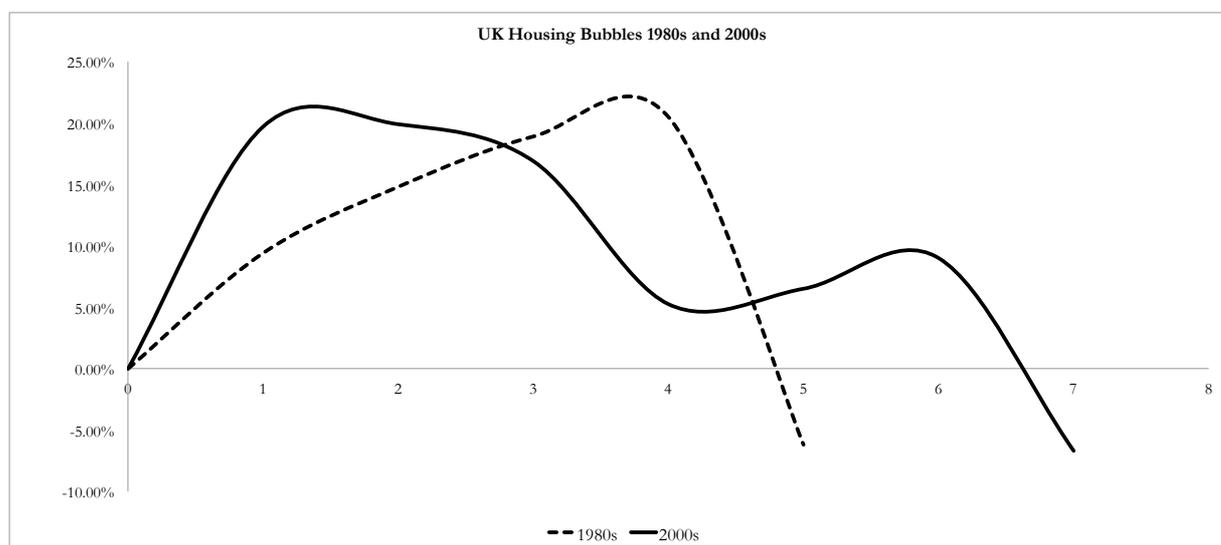


Table 11. Persistence-Magnitude and Severity of UK bubble case studies

Years	Persistence (Years)	Magnitude (%)	Severity
1986-1989	4	63	126
2002-2007	6	77	231

6.2.2 Correlation Analysis

This sub-section aims to examine the correlation pattern between house prices and selected variables, with the view to enhance my empirical understanding on the UK housing bubble cases. In particular, this sub-section will look at correlation patterns within several time frames and market conditions, including the long term, normal periods and bubble periods. With this approach, I seek to observe whether any 'special relationship' exists during bubble periods and whether a similar correlation pattern exists between the two selected bubble cases. For this analysis, I use log-transformed data based on the natural logarithm for each data set. The dataset covers the period of 1983-2011 and includes the variables of house prices, debt-burden ratio, gross lending, housing completions, income and house price to earning ratio. House prices and debt-burden ratios are available through Nationwide Statistics. Gross lending is available from the Council of Mortgage Lenders, whereas the data for housing completions comes from the Department for Communities and Local Government. Income figures come from the Office for National Statistics, while the house price to earnings ratio is available through Halifax Statistics. A full description of these datasets is provided in Section 5.3.

The study's Pearson correlation analysis involves the examination of five different time frames over the period of 1983-2011. Table 12.0 indicates the long-term correlation patterns of the selected variables. The first part (1) involves a long-term examination of the period of 1983-2011. The second part (2) covers the period between 1983 and 2011, with the difference being that it excludes the period of the bubble case studies. The third part (3) covers the years of 1983, 1984, 1985, 1996, 1997, 1998, 1999, and 2000. This time frame excludes both the bubble and recession periods, thus only taking into account the 'normal' market periods. The fourth (4) and fifth (5) parts of the correlation shown in Table 12.0 are related to the 1980s and 2000s bubble cases, respectively. It is worth clarifying here that the year 2001 has been taken into account only in the first part of Table 12. This is because there are different views in the literature regarding whether 2001 is considered the year that signalled the beginning of the 2000s UK housing bubble (Rapp 2009, Clark et al. 2010, Dolphin and Griffith 2011, Phang 2013, Kuenzel and Bjornbak 2008). Hence, to avoid any bias, the year 2001 has not been included in the analysis for parts 2, 3, 4, and 5 of Table 12.

The results in Table 12 indicate that over the long term (i.e. 1983-2011), the variables of Gross Lending, Income and H/P to income ratio show a strong positive relationship with House Prices, whereas the D/B ratio exhibits a weak positive relationship over the long

term. Paradoxically, over the same time frame, I observe that Housing Completions are negatively correlated with House Prices. By excluding the bubble years over the period of 1983-2011 (part 2), the results reveal no significant changes. The only notable change is that the variable of Housing Completions has changed from -0.22 to -0.78, indicating an even more negative correlation. The third part (3) of Table 12 excludes the recessionary years from the second part (2). Based on these results, I find that the D/B ratio; Housing Completions and the H/P to Income ratio are negatively related to House Prices, while Gross Lending and Income are strongly correlated to House Prices. However, after focusing on the bubble years for each case, the correlation results (between house prices and the rest of the variables) are vastly different, indicating that “something happened” in these two bubble periods. For instance, in the fourth part (4) of Table 12, that is, the 1980s bubble, all of the variables tend to move in the same direction as house prices, with D/B ratio, Income and H/P to Income ratio displaying a particularly high positive correlation. As for the 2000s bubble represented in part five (5), the results reveal strong positive correlations between house prices and all the selected variables. Generally, the results in Table 12 lead us to conclude that it is not by coincidence that the selected variables tend to move in the same direction as house prices during bubble periods. This pure-positive tendency can be justified by the occurrence of the phenomenon it self.

Table 12. Correlations between house prices and other variables during various durations

	House Price	Log House Price	Log D/B Ratio	Log Gross Lending	Log Housing Completion	Log Income	Log H/P-to-Income
1	Log (1983-2011)	1	.35	.88	-.22	.96	.70
	N	29	29	29	29	29	29
2	Log (1983/84/85/90/91/92/93/94/95/96/97/98/99/2000/08/09/10/11)	1	.32	.83	-.78	.96	.67
	N	18	18	18	18	18	18
3	Log (1983/84/85/96/97/98/99/2000)	1	-.62	.99	-.33	.99	-.81
	N	8	8	8	8	8	8
Bubble Case Studies							
4	Log (1986/87/88/89)	1	.96	.35	.46	.98	.99
	N	4	4	4	4	4	4
5	Log (2002/03/04/05/06/07)	1	.99	.80	.96	.98	.99
	N	6	6	6	6	6	6

6.2.3 Theoretical validity of the Correlation results

By employing a compressive Pearson product-moment correlation coefficient in Sub-section 6.2.2, the study found that during bubble periods, D/B ratio, Gross Lending, Housing Completions, Income and House Price to Earning ratio exhibit a tendency to move in the same direction (i.e. a positive correlation) as House Prices. This sub-section is devoted to providing theoretical support for the above-mentioned finding by examining whether any existing theoretical framework of housing bubbles supports the empirical evidence presented in Section 6.2.2.

House Price vs. Gross Lending: Allen and Gale (2000) and Holcombe and Powel (2009) argue that a housing price bubble is part of a more general credit bubble and thus cannot exist without the existence of the latter. On a statistical basis, during housing bubbles, the index representing values of Gross Lending in housing is expected to show signs of a positive change (i.e. an increase). Therefore, given that house prices are always changing in a positive direction during bubbles, it is plausible to expect a positive relationship between House Prices and Gross Lending during housing bubbles.

House Price vs. Housing Completions: Mueller and Pevnev (1997) and Baum and Hartzell (2012) note that building development activity in housing markets increases during a boom. Developers always have greater incentive to invest in the construction sector (i.e. supply) when prices are rising because business profit-maximisation is inherent in rising prices when costs are held relatively stable. In further support of this argument, Holcombe and Powel (2009) and Baum and Hartzell (2012) note that the quantity of houses built often helps in the measurement of bubbles and can be described as a *quantity dimension* of bubbles. Housing completions are inherently prone to show an increase (positive change) during housing bubbles. The same applies to house prices. Therefore it is plausible to expect that during housing bubbles, prices and housing completions would move in the same direction.

House Price vs. Housing Affordability Indicators (D/B ratio and H/P to Income ratio): An increased affordability index value is translated as a decrease in housing affordability, while a decrease in the affordability index value implies an increase in housing

affordability. During housing bubbles, prices increase disproportionately to changes in income. As a result, affordability decreases (Case and Shiller 2003, Tsai 2013). Therefore since a decrease in affordability is translated as a positive change in the affordability indices, and since during bubbles, prices are always increasing³⁵, it is logical to expect that house prices will move in the same direction as the affordability indices during bubble periods.

House Price vs. Income: According to the study of Case and Shiller (2003) on the US housing market, there is a remarkable tendency for income to show positive performance along with house prices during housing bubbles. As for the UK housing market, the studies of Dolphin and Griffith (2011) and Kuenzel and Bjornbak (2008) have provided evidence that income tends to move in a positive direction during housing bubbles, as house prices do.

6.3 Can housing price-rate-of-change explain the presence of bubbles alone

The literature review reveals that adherents of a descriptive approach frequently start a bubble assessment by looking at the house price appreciation rate (Hendry 1984). Some studies argue that a rapid price increase in assets can be seen as a vital bubble warning (Blanchard and Watson 1982, Finicelli 2007, Himmelberg et al. 2005). Moreover, other studies mentioned that mean reversion in housing prices is an important mode for assessing bubbles (Case and Shiller 2003, Agnello and Schuknecht 2009). However, Barlevy (2007) argues that positive changes, even at unprecedented rates, are not in and of themselves sufficient to define a situation as a bubble.

This section aims to examine whether the argument made by Barlevy (2007) is applicable to the selected UK housing bubble cases. In particular, I aim to compare the price rate of change during bubble periods with the price rate of change during non-bubble periods in order to observe whether the rate of change was higher in any non-bubble periods compared to time frames in which the market was indeed experiencing a bubble.

³⁵ Bubbles are never negative (Diba and Grossman 1987, 1988).

The results of our analysis in Table 13 show that the price rate of change in some non-bubble years, such as 1984, 1985, 1997, 1998 and 2000, were higher than in the bubble years of 1986, 2005, 2006 and 2007. Remarkably, even the price rate of change for the year 2010 (a year in which the UK housing market was moving towards an upcoming recovery) saw a higher rate of change compared to the “hot bubble year” of 2005. By relying on these observations, I can argue that the statement of Barlevy (2007) that positive changes, even at unprecedented rates, are not in and of themselves sufficient to define a situation as a bubble; is profoundly true for the UK housing market. The empirical evidence in Table 13 confirms that high accelerations in prices can often be misleading when assessing the presence of housing bubbles. Therefore, this observation enhances my view that the bubble phenomenon (in the UK) should be measured and studied by assessing it “as a whole” rather than exclusively as a price acceleration issue.

Table 13. Long-term changes (%) in nominal UK house prices over the period of 1984-2011

1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
12.5	10.6	9.5	14.7	19.1	19.7	-6.2	-5.3	-5.1	-1.2
1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.8	-0.8	4.2	10.9	10.1	9.1	13	10.5	19.8	19.6
2004	2005	2006	2007	2008	2009	2010	2011		
16.8	5.2	6.5	8.9	-6.8	-7.4	5.7	-0.2		

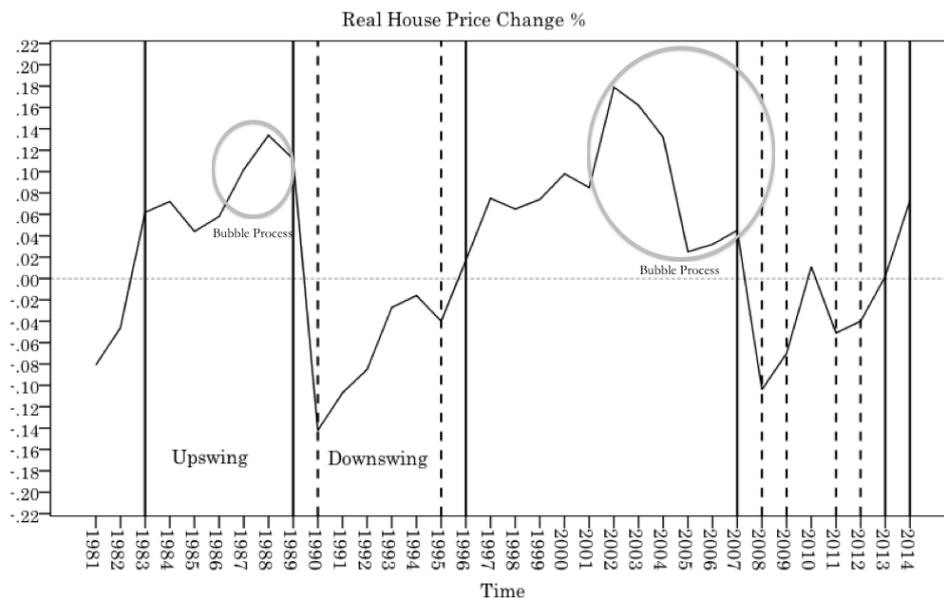
6.4 UK housing bubbles and UK housing cycles

The current literature on housing cycles makes clear that housing bubbles do not currently constitute an official phase of the housing cycle. Bubble events are basically seen as historically rare and abnormal events. However, some recent studies on housing cycles assert that since the 1980s, the integration of real estate and capital markets has created a “new situation” in which financial impacts shape tremendously the performance of housing markets, more so than ever before (Barras 2009, Pugh and Dehesh 2001). Given this “new situation,” I observe that in the last two complete UK housing cycles in particular, the second half of the upswing phase became a bubble process before the downswing phase was

initiated. This observation is evident in Figure 10. Therefore, one can assert that during the upswing phase of UK housing cycles, it is somehow a common pattern for the UK housing market to become “inflected” by the bubble component. Hence, the problematic part of the UK housing market’s cyclical pattern is to clearly identify when the upswing process has become a bubble process. This is the aim of the remaining chapters. However, before I commence this analysis, I must first properly distinguish the upswing process with the bubble process.

To the best of my knowledge, the first work that attempted to distinguish between these two processes is that of Case and Shiller (2004). These authors argue that the term “upswing” (i.e. boom) is much more neutral than the term “bubble.” They suggest that the rise in prices (i.e. upswing) may be an opportunity for investors, while the term “bubble” connotes a negative judgement of the phenomenon, with the opinion that prices levels cannot be sustained. Continuing in this logic, they claim that the term “bubble” denotes the process that underlies the upswing process. Moreover, Merk (2010) notes that the difference between an upswing market and a bubble market is that an upswing market maintains a healthy dose of risk. In contrast, a bubble market includes an abnormal dose of risk.

Figure 10. UK housing cycles and housing bubbles



Chapter 7

7.0 Development of the Model

This chapter presents the development process of the model in accordance with the research process formulated in Chapter 5. It also presents the algorithm (model) formula. It starts with an application of Stage 1: Identification and verification of the variables. This stage aims to empirically identify and explore whether the selected variables exhibited extreme behaviour during the reported housing bubble periods, so as to consider them as symptoms of the phenomenon in the first place. It continues with the application of Stage 2: Identification of the key constructs of the model. The second stage of the development process of the model focuses on establishing the key constructs of the proposed algorithmic model. Then, the Stage 3 is applied. Stage 3 involves the Identification of the model's diagnostic rule – and the presentation of the algorithmic model. Particularly, this stage concentrates on establishing the bubble diagnostic rule and proposing the algorithmic model. The final stage, that is Stage 4: Test and Implementation of the model, is presented in the next chapter.

7.1 Identification and verification of the variables

To recall, our UK datasets span from 1983 to 2011. Table 14 provides a summary of the variables used in this study. These variables were identified through the literature review as the main factors influencing the development of housing bubbles (in the UK housing market). To make the data truly comparable, all data sets have been converted to annual figures (averages) in percentage form, except for house-price-to-income ratio, which is analysed in its annual nominal value form.

Table 14. Data description

No.	Name	Description	Period Covered	Source
α	House Prices	All houses, all buyers, average nominal house prices	1983-2011	Nationwide
β	D/B Ratio	Mortgage payment as a percentage of main take home pay (first-time buyers)	1983-2011	Nationwide
γ	Gross Lending	Gross regulated mortgage lending £m of loans for house purchase (average) Nominal prices	1983-2011	Council of Mortgage Lenders
δ	Housing Completions	House: permanent dwelling completions by tenure; private enterprise (average)	1983-2011	Department for Communities and Local Government
ϵ	Income	Median equivalised disposable household income at 2011/12 prices	1983-2011	Office for National Statistics
λ	HP-to-Income	House-price-to-income ratio (all buyers)	1983-2011	Halifax

Table 15 shows the “big picture” of the data used in this study. For all variables except house-price-to-earnings ratio, the data involves the year-over-year percentage change from 1983 to 2011. For the house-price-to-earnings ratio, the data involves the nominal values. Table 15 also shows the mean, standard deviation and the z score for each data input.

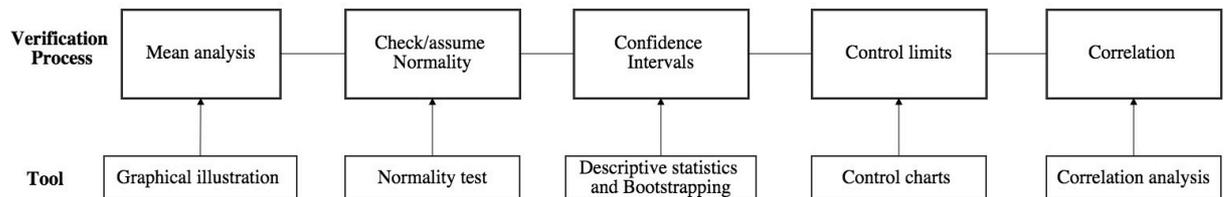
Table 15. ‘Big picture’ of the data: Year-over-year percentage change between 1983 and 2011 and z-scores

Year	House Price	Z	Gross Lending	Z	D/B Ratio	Z	Housing Completions	Z	Income	Z	H/P To Income Ratio (Nominal)	Z
1984	12.5	.64	25	.90	11.7	.67	8.1	1.06	0.9	-.56	3.51	-.69
1985	10.6	.42	8.4	.05	13.2	.76	-1.2	-.04	4.8	1.04	3.54	-.65
1986	9.5	.30	36.1	1.47	-9.5	-.73	8.4	1.09	3.6	.55	3.67	-.49
1987	14.7	.90	-3.8	-.58	5.8	.28	8	1.04	5.7	1.40	3.88	-.22
1988	19.1	1.41	37.4	1.54	11.9	.68	8.5	1.10	6.5	1.73	4.47	.51
1989	19.7	1.48	-22	-1.51	34.6	2.18	-9.6	-1.04	2.9	.26	4.83	.96
1990	-6.2	-1.52	-1.5	-.46	-9.2	-.71	-13.8	-1.53	4.7	1.00	4.41	.44
1991	-5.3	-1.42	-2.2	-.49	-27.9	-1.95	-0.9	-.01	1.3	-.39	4.05	-.01
1992	-5.1	-1.39	22.3	.76	-26.3	-1.84	-10.2	-1.11	-1.1	-1.37	3.59	-.59
1993	-1.2	-.94	10.9	.18	-22.1	-1.56	1.9	.32	-1.2	-1.41	3.37	-.86
1994	0.8	-.71	5.9	-.08	-5.4	-.46	5.8	.78	1.8	-.19	3.30	-.95
1995	-0.8	-.89	-14.4	-1.12	-2.1	-.24	0.8	.19	1.8	-.19	3.13	-1.16
1996	4.2	-.32	26.4	.97	-4.2	-.38	-2	-.14	5.3	1.24	3.11	-1.19
1997	10.9	.46	24.2	.86	20.3	1.23	4.7	.65	2.4	.06	3.13	-1.16
1998	10.1	.37	4.6	-.15	11.4	.65	-3.8	-.35	3.9	.67	3.12	-1.17
1999	9.1	.25	28.9	1.10	-3.3	-.32	3.9	.56	4.8	1.04	3.18	-1.10
2000	13	.70	-2.8	-.53	12.3	.71	-4.8	-.47	4.2	.79	3.29	-.96

2001	10.5	.41	26.3	.97	-1.5	-.21	0.5	.16	4.5	.91	3.40	-.82
2002	19.8	1.49	18.8	.58	5.7	.27	7	.93	4	.71	3.96	-.12
2003	19.6	1.47	4	-.18	14.1	.82	4.9	.68	1.6	-.27	4.54	.60
2004	16.8	1.14	11	.18	26.7	1.66	7	.93	2.5	.10	5.16	1.38
2005	5.2	-.20	-10.5	-.92	5.8	.28	2.8	.43	-0.6	-1.17	5.21	1.44
2006	6.5	-.05	27.2	1.01	2.8	.08	1.3	.25	1.8	-.19	5.44	1.73
2007	8.9	.23	-1.3	-.45	14.7	.86	-1.3	-.06	1.1	-.47	5.75	2.11
2008	-6.8	-1.59	-51.1	-3.00	-9.6	-.74	-23.6	-2.69	-1.3	-1.45	5.07	1.26
2009	-7.4	-1.66	-8.3	-.81	-20	-1.43	-18.6	-2.10	1.7	-.23	4.53	.59
2010	5.7	-.14	13.7	.32	-1.4	-.20	-11.2	-1.23	-2.4	-1.90	4.62	.70
2011	-0.2	-.83	-4.4	-.61	-3.4	-.33	4	.57	-1.8	-1.66	4.46	.50
μ	6.93		7.45		1.61		-0.83		2.26		4.06	
σ	8.64		19.50		15.16		8.46		2.45		0.80	

The verification process seeks to reject or provide proof for whether the combination of annual growth levels (of the selected variables) are extreme, correlated, and relevant to early bubble diagnosis. The verification process is illustrated in Figure 11.

Figure 11. Verification process of inputs

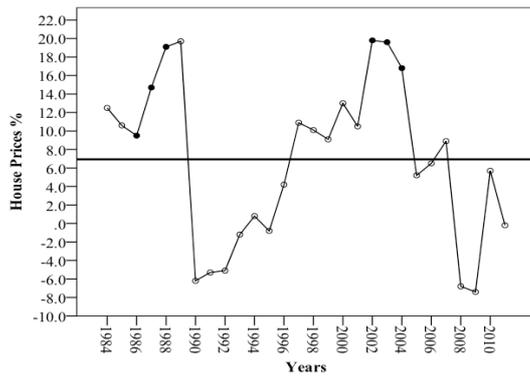


The tools used in the verification process involve Pearson correlation, normality tests and parametric statistical techniques such as bootstrap confidence intervals and control limits.

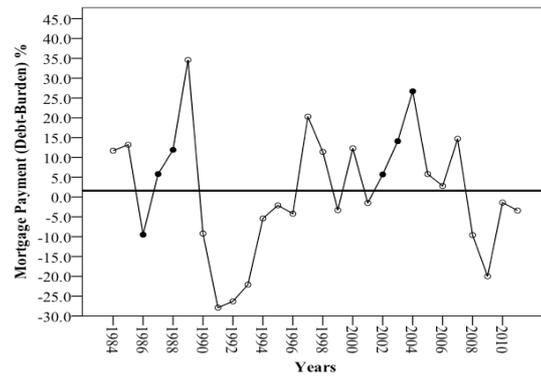
7.1.1 Mean analysis

The mean analysis presented in Figure 12 aims to observe whether changes between the early first three years of each of the last two UK housing bubbles showed performance well above their average long-term levels. The bold line denotes the average value of each variable.

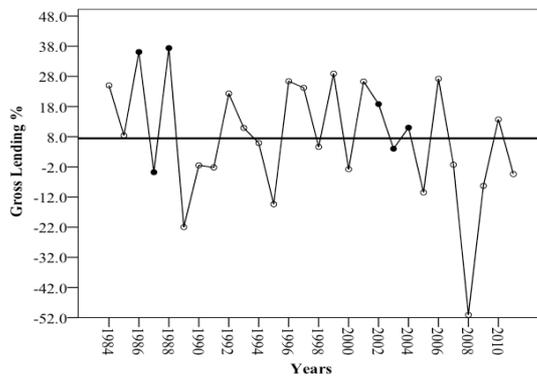
Figure 12. Graphical representation of the variables' performance and their mean values



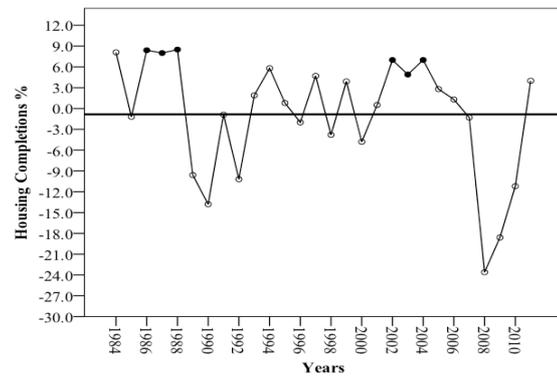
House Price: 6.93% (mean value)



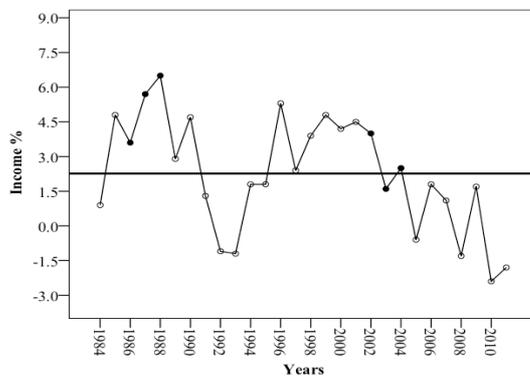
Debt-Burden ratio: 1.61% (mean value)



Gross Lending: 7.45% (mean value)



Housing Completions: -0.83% (mean value)



Income: 2.26% (mean value)

Our findings confirm the theory that during the early stages of housing bubble formation, house price, debt burden, gross lending and housing completions tend to grow rapidly above their long-term average performance in anticipation of the bubble component. Following this, our findings also confirm that income changes during bubble periods are not as extreme and consistent as the other selected variables. Not surprisingly, income is the only variable in this analysis for which extreme performance would suggest a rejection of the bubble

hypothesis rather than an acceptance. This can be explained by the prevalent view in the literature that income changes tend to grow disproportionately during bubble periods compared to house prices, for example (Case & Shiller, 2003).

7.1.2 Normality test

I use the Shapiro and Wilk test to examine departures from a normal distribution since this study make use of several parametric statistical tools that assume normality. The null hypothesis for the Shapiro-Wilk test is that the data is normally distributed.

Table 16. Normality test

Variables	Shapiro-Wilk test		
	Statistic	df	Sig. (p-value)
House Price	.940	28	.113
Debt-Burden Ratio	.976	28	.749
Gross Lending	.942	28	.127
Housing Completions	.890	28	.007
Income	.959	28	.322

The chosen alpha level is 0.05. Therefore, if the p-value is greater than 0.05, the null hypothesis is accepted. By applying the Shapiro-Wilk test for normality, I observe that the data have a normal distribution since all the p-values (except for one variable) are greater than the chosen alpha level of 0.05. However, the p-value for housing completions reveals that this data set is not normally distributed. While, this violation of the normality assumption does not unduly affect the overall results, it does not provide the most desirable process.

7.1.3 Descriptive statistics and traditional bootstrapping

This study employs descriptive statistics using the bootstrap method. Through this analysis I aim to set an upper confidence interval for each variable. In particular, the upper confidence interval (UCI) helps us to observe and measure statistically whether the selected variables exhibit abnormal behaviour during the early bubble years. For example, if during the early bubble development process the selected variables show (at least approximately)

performance that is above the upper confidence interval of the sample mean, then their speed of change will be regarded as relevant for bubble identification. Further details regarding the mathematical expression of the traditional bootstrapping technique can be found in Section 7.2.3 below.

Table 17. Descriptive Statistics and Bootstrapping

Variables	n=28		Descriptive Statistics						Bootstrap ^a 95% Confidence Interval			
	Min	Max	Mean	Std. Dev.	Skewn.	Std. Error	Kurtosis	Std. Error	Bias	Std. Error	Lower	Upper
H. Price	-7.4	19.8	6.9	8.6	-.18	.441	-1.03	.858	-.068	1.57	3.53	9.72
D/B	-27.9	34.6	1.6	15.1	-.08	.441	-.068	.858	.064	2.77	-3.92	7.08
Gross Lending	-51.1	37.4	7.4	19.5	-.841	.441	1.52	.858	-.028	3.66	-.27	14.45
Housing Comp.	-23.6	8.5	-.8	8.4	-1.140	.441	.792	.858	.042	1.60	-4.08	2.16
Income	-2.4	6.5	2.2	2.4	-.272	.441	-.840	.858	.022	.462	1.40	3.18

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples.
Bootstrap statistics are related to the Mean.

This analysis shows that for the early bubble years of the 1980s, house prices exhibited abnormal behaviour in the second two out of the first three bubble years, whereas for the same time frame in the 2000s case, house price changes for all of the first three bubble years were far above their upper confidence interval, indicating extreme behaviour. Regarding gross lending changes, it was observed that its UCI in the 1980s was violated by 2.50 times in the first year and by 2.57 times in the third. For the 2000s bubble, the first year outstripped the UCI, while for the third year it was slightly below that limit.

In terms of the speed of change of the D/B ratio in the 1980s, our results reveal that the second year was slightly below its UCI, whereas the third year demonstrated abnormal behaviour beyond its UCI. For the 2000s bubble, that interval was violated in the second year, whereas for the third year the speed of change was approximately 2.2 times more than its UCI, thus representing extreme performance. In relation to housing completions, our findings reveal that for the first three years of the 1980s bubble, the supply increased approximately 4.00 times above its UCI for each corresponding year, thus supporting its relevance to bubble detection. For the 2000s bubble, housing completions were also extreme since they indicated a performance about 3.20 times above their confidence interval for the

first and third years. However, for the second year of the 2000s bubble, the speed of change was also abnormal, at approximately 2.25 times its upper confidence interval. Finally, the income variable did not show hugely abnormal behaviour like the rest of the variables. The upper confidence interval of income of 3.18. was violated two times in the 1980s bubble and only one time in 2000s bubble, thus confirming again that income increases significantly less abnormally compared to house prices and the other variables during the early stages of bubble periods.

7.1.4 Control Limits (Skewhart Charts)

To enhance the analysis of extreme performance, I use control limits. These limits are based on a two-sigma level using the average moving range for each variable's performance. Recall that since our analysis is based on percentage performance and since confidence limits of control charts are calculated on the average moving range (\overline{mr}), which in turn means that any negative moving ranges between observations are converted into positive ones, it is reasonable to expect less explanatory results compared with the bootstrapping method, in which the confidence prediction intervals are constructed by percentiles. The bold points in Figure 14 show the performance of the first three years of each bubble case. The control limits for the individual control charts were found using the following equations (Figure 13) based on the average of the moving range (Montgomery, 2005, cited in Walker, 2008).

Figure 13. Control limits formula

$$UCL = \bar{x} + 2 \frac{\overline{mr}}{1.128} \qquad CL = \bar{x} \qquad LCL = \bar{x} - 2 \frac{\overline{mr}}{1.128}$$

UCL: Upper Confidence Limit

CL: Central Limit

LCL: Lower Confidence Limit

\bar{x} = average value of x variable

\overline{mr} = average moving range

Figure 14. Control Charts

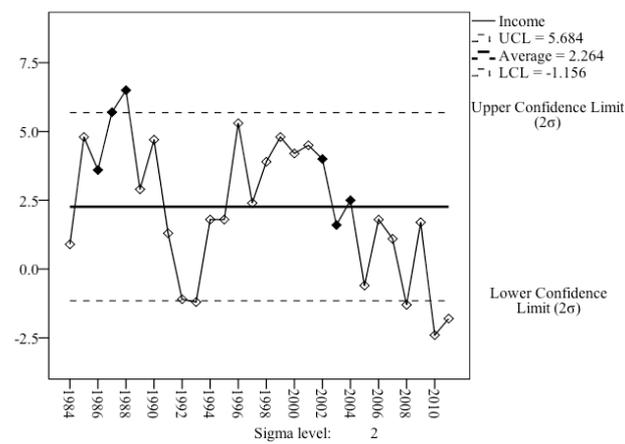
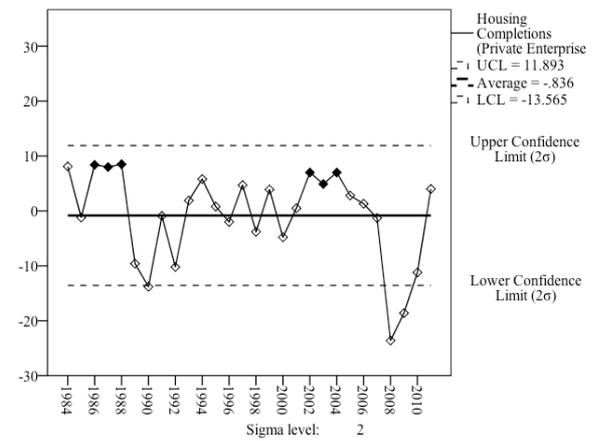
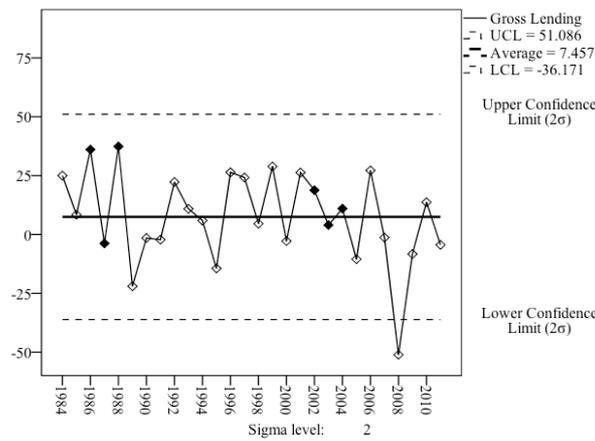
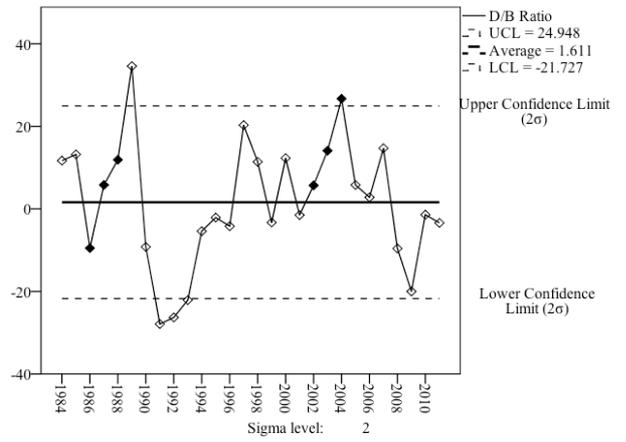
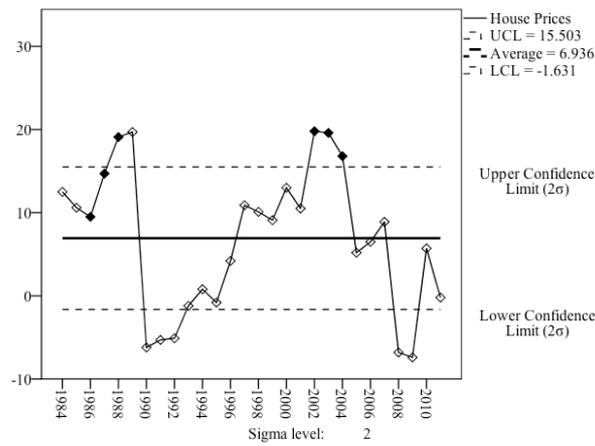


Figure 14 reveals that house price change outperformed its UCL in the third year of the 1980s bubble; for the 2000s bubble, in the first three years the rule of the two-sigma level was continually violated. For gross lending, the first and third years of the 1980s bubble show peak values for the entire historical period. For the 2000s, the performance of the first and third years is above its central tendency. With respect to the debt-burden ratio, the results reveal a steep upwards trend during the early bubble years of the 1980s. The same trend becomes evident for the 2000s bubble, with the distinction that its third year outstripped its UCL.

With regard to housing completions, the whole process was under control. Nevertheless, values for the first three years of the 1980s and 2000s bubbles exhibited the greatest positive change when the historical trend was taken into account. The control process of income reveals that in the 1980s bubble, the second and third years are not much above their UCL, whereas for the 2000s bubble the first year is within statistical control, the second and third years are located on the average line and the subsequent bubble years are below the average line and close to the lower confidence limit.

7.1.5 Correlation Analysis (Natural Log-Transformed Data)

The correlation analysis aims to examine the pattern between the direction of house prices and the other selected variables in different time frames. The first row of the correlation table (Table 18) relates to the long-term historical trends, whereas the second and third rows are devoted to the early years of each bubble case individually. For this analysis, I use log-transformed data based on the natural logarithm for each data set. This data transformation will help the study to produce patterns in the data that are more interpretable.

Table 18. Correlations between house prices and other variables in various durations

House Price	Log House Price	Log D/B Ratio	Log Gross Lending	Log Housing Completion	Log Income	Log H/P-to- Income
Log (1983-2011) N	1 29	.357 29	.887 29	-.222 29	.964 29	.702 29
Log (1986/87/88) N	1 3	0.988 3	0.844 3	0.999 3	0.999 3	0.984 3
Log (2002/03/04) N	1 3	0.983 3	0.957 3	0.990 3	0.986 3	1.000 3

Regarding the correlation analysis for 1983-2011, it is observed that gross lending, income and H/P-to-income ratio have a strong positive relationship with house prices. Paradoxically, housing completions are negatively correlated with house prices and D/B ratio also has a weak positive relationship over the long term. However, for the correlation analyses for 1986/87/88 and 2002/03/04, our observation reveals that the correlations between house prices and all other variables are highly positive when the sample is limited to the first three years of each bubble. This indicates that “something happened” in the periods of 1986/87/88 and 2002/03/04.

7.2. Identification of the key constructs of the model

This section seeks to outline the key constructs of the model. These include:

- Hierarchical order of the variables
- Specific time frame of analysis
- Data transformation and measurement process
- Main multiplier of the model

7.2.1 Hierarchy of variables

In Section 7.1, it was revealed that during the reported bubble periods, the selected variables showed a tendency to experience abnormal growth. Therefore, I conclude that the speed of change (%) of the selected variables can be considered as a symptom for the diagnosis of UK housing bubbles. Nevertheless, I consider that each of these symptoms has an *unknown* independent weight and effect for uncovering the phenomenon. This sub-section attempts to assign to each data point its proper amount of explanatory power over the phenomenon. In particular, I seek to discover which variable best explains the presence of the phenomenon if its velocity is positive over an economic curve. For example, a rapid speed of growth (%) in house prices provides stronger evidence of the presence of a bubble than does a rapid increase in income, whereas if income increases rapidly (all other things remaining

positive and constant), this explains the absence of a bubble better than its presence. Put differently, higher (%) house prices should increase the suspicion of a potential/impending bubble, whilst a rising disposable income should have the opposite effect. The time frame (t) for this analysis involves the total length of both bubble case studies combined, that is, the periods between 1986-1989 and 2001-2007. These observations lead us to conclude that since 1983 and until 2011, the UK housing market was in a bubble for eleven years in total (t_{11}).

7.2.1.1 Analysis of hierarchy

The question leading to the quantitative hierarchal order of the variables is the following. What is the external bubble-force on each variable during the experience of the phenomenon? The higher the bubble-force acting on the variables, the greater their relevancy for uncovering bubbles. For the analysis, I use two approaches to detect the weight. First, I use the trapezoid rule to identify the area under the economic curve (AUC). The area under the curve from point 0 to time t_{11} is estimated by application of the trapezoidal rule, which illustrates the curve as a series of straight lines, enabling the area under the curve to be divided into a number of trapezoids. The number of trapezoids in Figure 15 is equal to the total number of bubble years between 1983-2011 (i.e. t_{11}). The AUC for each variable in each t_n during t_{11} is calculated as:

$$AUC = \sum_{i=0}^n \frac{C_i + C_{i+1}}{2} h$$

Where,

$C_i = \text{parallel in } t_i$

$C_{i+1} = \text{parallel in } t_{i+1}$

$h = (t_{i+1} - t_i) = 1$

Through this approach, I aim to measure (m) (i.e. bubble magnitude). The m is equal to the sum of all incremental areas resulting from each trapezoid (AUC) over t_{11} , as indicated in Figure 15. To this extent, m is calculated as:

$$\frac{\sum(x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10} + x_{11})}{n}$$

Where x_n is the (%) AUC for each variable during t_{11} , n is the number of cases used (in our case, 2 case studies – see Section 7.2.1). This approach allows us to apply the second law of motion. The equation of the second law of motion is $F = ma$. For the implementation of this equation I incorporate a bubble factor. F is the external bubble-force for each variable, m is the bubble magnitude (AUC) for each variable, and a is the bubble-acceleration rate. It is worth clarifying here that a is calculated as the difference between the long-term mean and the bubble-mean (i.e. mean performance during t_{11} for each variable).

The total sum of force for all variables is the total bubble force caused by the phenomenon. The weight for each variable is calculated as the ratio between the total sum of force for all variables (i.e. the total force of the phenomenon) and the forces absorbed by each variable. This ratio is the weight that each variable possesses for explaining the presence of bubbles. The data used in this method take the form of percentage change, as with the analysis in Section 7.1. The results for AUC and the second law of motion are presented in Table 19. The weight approximations are indicated in Table 20.

Figure 15. Application of the trapezoid rule for area under the curve (AUC)

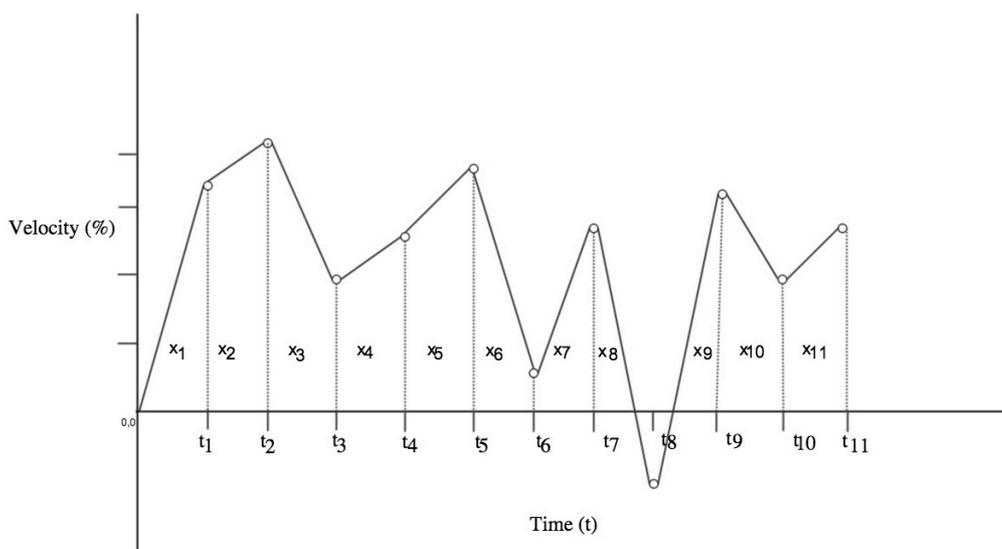


Table 19. Analysis of hierarchy results

Variables %	$n = 11$ (t)	$\sum_{n=1}^{11} X_n$	$\frac{\sum_{n=1}^{11} X_n}{2}$	Bubble-mean B (μ) %	Long-term L (μ) %	Acceleration B (μ) - L (μ) %	F= Bubble Force
House Prices	(1986-1989, 2001-2007)	145.7	72.8	13.6	6.93	6.67	485.5
D/B Ratio	(1986-1989, 2001-2007)	114.5	57.2	10.1	1.61	8.49	485.6
Gross Lending	(1986-1989, 2001-2007)	160.6	80.3	11.2	7.45	3.75	301.1
Housing Completions	(1986-1989, 2001-2007)	48.25	24.1	3.4	-0.83	4.23	101.9
Income	(1986-1989, 2001-2007)	33.60	16.8	3.0	2.26	0.74	12.4
		AUC in %	Average AUC per bubble (m)			(a)	$\sum F = 1386.5$

Table 20. Weight approximation for selected variables

Variables	F Bubble Force	F Force ratio to $\sum F = 1386.5$	Weight Approximation	
α	House Prices	485.5	≈ 0.35	0.35
β	D/B Ratio	485.6	≈ 0.35	0.35
γ	Gross Lending	301.1	≈ 0.21	0.20
δ	Housing Completions	101.9	≈ 0.73	0.10
ϵ	Income	12.4	≈ 0.008	0
		$\sum F = 1386.5$		

Following the results in Table 20 and also by reasoning from previous work, one can assert that house price seems to be the variable that best describes the phenomenon if all variables move positively during t_{11} (the bubble period).

This can also be validated by the accepted definitions of Kindleberger and Aliber (2005), Smith and Smith (2006), Barlevy (2007) and Blanchard and Watson (1982), who state that an asset bubble is a situation in which prices increase rapidly, at levels that cannot be explained by the fundamentals. The rapid increase in price is therefore what first describes (in our minds) and defines the phenomenon, since negative bubbles cannot occur (Diba & Grossman, 1987, 1988). Despite this reasonable conclusion, the study's results reveal that is only a half-truth. In particular, Tables 19 and 20 reveal that the rapid and positive increase in house prices is an *equally important symptom* for uncovering bubbles as the rapid and positive increase in debt-burden ratio during bubble periods (i.e. t_{11}).

7.2.2 Specific time frame of analysis

The specific time frame of analysis is defined as the pre-specified time frame that the model takes into consideration when dealing with real-time data. This time frame is three years. Thus, when the model is applied in practice at a given time t , it measures the historical variation of the each of the selected variables within the previous three years (t_{-2}, t_{-1}, t_1) (i.e. the three-year moving average). The rationale for choosing this time frame is based on the lengths of the last two UK housing bubbles. According to the studies of Scott (1996), Fraser (1993) and Dolphin and Griffith (2011), the 1980s bubble lasted for four years, between 1986 and 1989, while for the first decade of the new millennium, the period between 2001/2-2007 is seen by many as a classic example of a housing bubble (Rapp, 2009; Clark et al., 2010; Kuenzel & Bjornbak, 2008; Dolphin & Griffith, 2011). This implies that none of the recent UK housing bubbles has lasted for less than three years. Three years, therefore, appears to be enough time for a bubble to develop and mature, making it relatively possible to detect and smooth out short-term fluctuations. In that logic, the threshold of three years constitutes a reasonable time frame within which to act accordingly in case of a bubble warning. The adoption of this value is also consistent with the work of Bordo and Jeanne (2002), who consider a three-year moving average a reasonable time frame for capturing and testing property boom events.

7.2.3 Data transformation and measurement processes

7.2.3.1 Data transformation

First, let us recall that the values of the variables differ in terms of scale, so that what is considered a high value for one variable can be a low value for another and vice versa. Given this asymmetrical nature of the data used in our analysis, the measure adopted should be one that can be used to monitor and normalise the magnitude of variation for each variable. For that reason, the data transformation of percentage change ($\% \Delta$) is suitable because it provides an equivalent metric for each variable and therefore lends itself to comparison when different periods are tested or current periods are examined. Also, a data transformation on a percentage change basis is akin to measuring the “speed” of “change.” Given the fact that a bubble is a phenomenon that draws on “acceleration” and “motion” (e.g. Zhou & Sornette, 2003; Bordo & Jeanne, 2002; Kuenzel & Bjornbak, 2008;

Kindleberger, 2005; Barlevy, 2007), this constitutes additional support for the suitability of such a data transformation. This form of transformation was also used in the analysis presented in Section 6.1. The standard formula for transforming the selected data is:

$$\% \Delta = \frac{P(t_2) - P(t_1)}{P(t_1)}$$

7.2.3.2 Measurement process

The measurement process for each model input (variable) is inherently related to the data transformation above, the weight of each variable and the specific time frame of analysis. For each variable, a different weight has been established (see Table 20). The specific time frame of analysis is three years (see Section 7.2.2). The transformation of the data involves percentage changes (see Section 7.2.3). The equation used to measure the weighted moving average for each variable (i.e. α , β , γ , and δ) is the following:

Example for (α) house price input

$$w_a = \frac{(a_{t-2} + a_{t-1} + a_{t1})}{3y} \times c$$

Where:

- w_a = weighted variable a
- a_{t-2} = $\Delta\%$ percentage change of t_{-2}
- a_{t-1} = $\Delta\%$ percentage change of t_{-1}
- a_{t1} = $\Delta\%$ percentage change of t_1
- $3y$ = three years
- c = respective weight of variable a

This process involves the calculation for the model inputs of (α) House Price, (β) D/B ratio, (γ) Gross Lending and (δ) Housing Completions. t_1 refers to the yearly rate of change at the end of each current year, t_{-1} refers to the yearly rate of change at time -1 and t_{-2} refers to the yearly rate of change at time -2. For instance, in order to calculate the weighted average for a at the end of year 2012, one should apply the yearly rate of change in 2012 as t_1 , 2011 as

t_{-1} and 2010 as t_{-2} . Table 20.0 shows the respective weight (c) that is applicable for each of these inputs. For (α) this is 0.35, for (β) 0.35, for (γ) 0.20 and for (δ) 0.10.

For instance:

$$w_a = \frac{(a_{t-2} + a_{t-1} + a_{t1})}{3y} \times 0.35$$

$$w_\beta = \frac{(\beta_{t-2} + \beta_{t-1} + \beta_{t1})}{3y} \times 0.35$$

$$w_\gamma = \frac{(\gamma_{t-2} + \gamma_{t-1} + \gamma_{t1})}{3y} \times 0.20$$

$$w_\delta = \frac{(\delta_{t-2} + \delta_{t-1} + \delta_{t1})}{3y} \times 0.10$$

As for the income variable (ε), since its weight is 0, I calculate income as the simple three-year moving average (without accounting for any weight (c)). That is:

$$\varepsilon = \frac{(Income\Delta\%_{t-2} + Income\Delta\%_{t-1} + Income\Delta\%_{t1})}{3y}$$

7.2.4 The main multiplier of the model

This sub-section aims to demonstrate the relevance of the house-price-to-income ratio (HP/I) to housing bubble detection and to our model. To that end, this study employs the bootstrap method, using 1,000 re-samples based on the nominal ratios of HP/I.

Instead of using the rate of change of the HP/I variable, this study uses the nominal form of HP/I, since this metric is more useful for diagnosing housing bubbles (Case & Shiller, 2003; Himmelberg et al., 2005; Dolphin & Griffith, 2011; Dolphin & Griffith, 2011; McCarthy & Peach, 2004). Section 7.1.5 revealed high correlation levels between HP/I and house price movements. Table 21 below reveals that the upper confidence interval for the HP/I ratio is 4.36. This interval was violated once during the first three years of the 1980s bubble. This occurred in 1988 (i.e. the third year of the 1980s bubble), when the upper value was violated, indicating that extreme conditions were in place. However, I also observe that the second year was quite close to that limit, with a difference of just 0.48. These extreme conditions

were clearer in the first three years of the 2000s bubble, when the rule was violated twice, that is, in the second and third years. Nevertheless, for the first year of the 2000s bubble (2002), the difference between the upper confidence interval and the observed value was 0.40. The results imply that the higher the HP/I ratio, the higher the probability of a bubble. Our ex ante analysis shows that as the HP/I ratio exceeds its upper confidence interval, the bubble becomes more mature. It is no coincidence that this rule was not violated in the first bubble year of either case study. Not surprisingly, for the remaining bubble periods (i.e. after first three years), this interval is consistently violated. The rationale for assigning the HP/I variable as the main multiplier of our diagnostic model relies also on the special concept of this variable with regard to bubble detection. In particular, the HP/I ratio takes no account of interest rate policies and does not depend on government monetary or non-monetary initiatives to increase home ownership, which have often been found to misrepresent the true affordability of homes, therefore misrepresenting the true market instability (Holcombe & Powel, 2009; Adair et al., 2009; Barras, 2009; White, 2008; Pirounakis, 2013; Farlow, 2004; Barrel & Davis, 2008).

The measurement process for the main multiplier is applied using the **nominal values** of the HP/I ratio and utilising the equation in Section 7.2.3.2 without accounting for any weight (c). The main multiplier is denoted by λ , with the equation as follows:

$$\lambda = \frac{(HPI_{t-2} + HPI_{t-1} + HPI_{t1})}{3y}$$

Table 21. HP/I ratio 1984-2011 – nominal values

Variable	N=28		Descriptive Statistics		Bootstrap* 95% Confidence Interval			
	Min	Max	Mean	Std. Dev.	Bias	Std. Error	Lower	Upper
H/Price to Income	3.11	5.75	4.06	0.80	-.0030	.1485	3.76	4.36

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples. Bootstrap statistics are related to the Mean.

7.3 Identification of the model diagnostic rule

This sub-section presents the approach for the establishment of the model's rule. It furthermore provides the reasoning enabling the application of the selected approach. Finally, I provide evidence for the quantification of the rule.

7.3.1 The approach

For the development of the model rule, I use part of the data in combination with a statistical procedure, as the historical data validation technique (HDV) advises us (Kennedy et al., 2005; Sargent, 2005; Yoe, 2012). The statistical procedure chosen for the rule development is the BC_a method. The time frame used for the development of the model's rule involves; selected observations (see Section 7.3.2) for the period between 1983 and 1999. For rule testing purposes, I used the rest of the datasets to test whether the model can determine bubble values for the period of 2001-2007 and subsequently detect the succeeding recessionary years.

7.3.2 Selected observations

Recall that for the development of the model we use part of the data, that is 1983-1999. Initially, the data chosen for the development of the rule were the three-year moving average periods of 86³⁶, 87, 88, 89, 91, 92, 93, 94, 95, 96, 97, 98, and 99 over the period of 1983-1999. I have excluded the three-year moving average of 90 (i.e. 1988,89,90) since the output for that moving average is biased due to being based on two bubble years and one recessionary year, and thus not reflecting recession. The inclusion of that observation in the development of the rule would have increased the bias of the rule itself. For the identification of the model's rule, I apply the model-algorithm (in Section 7.4) (without accounting for any rule ρ) and then seek to filter and re-select only the "positive output values" from the above-mentioned observations. This filtering process, in conjunction with the BC_a method, will

³⁶ i.e. $(t_{-2} + t_{-1} + t_1)$
1984/85/86 (86)

allow us to distinguish the *abnormal-extreme positive value* (within the positive filtered sample). The calculated abnormal/extreme positive value (rule) of the filtered sample will be attributed to the presence of the phenomenon.

Following the process, I have therefore selected the three-year moving observations of (86), (87), (88), (89), (96), (97), (98), and (99). These observations were the only positive observations within the initial selected sample. To confirm this result and avoid confusion, all model observations are presented in Chapter 8. (8.2 section).

7.3.3 Bias-corrected and accelerated bootstrap

Our time series for developing the rule are not very long, as they only involve eight observations. Therefore, there are a limited number of model outputs suitable for developing the rule. To overcome this shortcoming as effectively as possible, I adopt an improved method of bootstrapping percentiles from Efron (1987), called bias-corrected and accelerated bootstrapping (BC_a), based on 1,000 resamples. The theoretical details of BC_a are beyond the scope of this thesis, but the main concept is as follows. The bias-corrected and accelerated method is the most accurate form of percentile procedure (Diciccio & Romano, 1988) and is a computer-based way to carry out approximate confidence intervals. The idea behind the standard/traditional percentile bootstrapping method is simple. It creates 1,000 resamples (i.e. bootstrap statistics, means) from the actual data and then ranks these bootstrap statistics in ascending order. The lower and upper confidence intervals (for 1,000 bootstrap samples) at 95% confidence are found by counting the 25th largest mean value and the 975th largest mean value of the 1,000 bootstrap means (Devore, Farnum, & Dol, 2014; Ritz & Streibig, 2008; Wilcox, 2003). The bottom and top 2.5% of the sample means are discarded and therefore the remaining range of sample means are an approximate 95% C.I for the average difference in precision (Peters, Braschler, Gonzalo, & Kluck, 2003). Principally, the bias-corrected and accelerated method of bootstrapping is an improvement on the traditional bootstrapping approach since it involves the additional inclusion of two other parameters. The first is \hat{z}_0 and attempts to correct the bias (i.e. the difference between the mean of the n stored bootstrap samples and the original estimates). The second is \hat{a} and is called the acceleration coefficient. This approach therefore adjusts for both bias and skewness (Woodward, 2014). Further theoretical details of BC_a and the computation of these

two parameters are discussed by Efron (1987), Diccio and Efron (1996) and Efron and Tibshirani (1998). The application of BC_a proposed by Efron is given by:

$$a_1 = \Phi \left(\hat{z}_0 + \frac{\hat{z}_0 + z^{(a)}}{1 - \alpha \left(\hat{z}_0 + z^{(a)} \right)} \right)$$

$$a_2 = \Phi \left(\hat{z}_0 + \frac{\hat{z}_0 + z^{(1-a)}}{1 - \alpha \left(\hat{z}_0 + z^{(1-a)} \right)} \right)$$

Here, Φ is the standard normal cumulative distribution function, a_1 is the lower confidence interval and a_2 is the upper. For a 95% confidence level, $z^{(a)}$ is the 0.025 percentile point and $z^{(1-a)}$ is the 0.975 percentile point. It is worth clarifying that in the BC_a method, coverage accuracy for small samples can be erratic (Efron & Tibshirani, 1998), as with most statistical tools. However, when the sample size is small, this approach is preferred (Salsburg, 1992).

7.3.4 Reasoning for selecting BC_a

The reason for using the BC_a method instead of an alternative method is due to the link between the upper confidence interval of BC_a and the bubble phenomenon. For instance, the housing bubble phenomenon has been conventionally seen as an extreme and abnormal event. The same applies to the values above the upper confidence interval (UCI) of BC_a . Thus, I infer that the output of the model in historic bubble periods should be above the upper confidence level of BC_a to correctly reflect the bubble component. In such a case, I conclude that the force underlying an outlier model value has a bubble origin. In contrast, I reason that during historic non-bubble periods, the model output should be below the UCI of BC_a to correctly reflect the absence of a housing bubble.

7.3.5 Model diagnostic rule

This section aims to present the BC_a results for the selected observations in Section 7.3.2. The rule of the model indicates the threshold upon which any excess value of our model is associated with positive bubble diagnosis. This threshold (rule) is the upper confidence interval of the BC_a method. Table 22 below shows the UCI (i.e. the model rule) at 95% and 90% confidence. Our study adopts the rule of 95% confidence and proposes that a high risk of a housing bubble presence exists if the output of the model is above the selected threshold of 0.85. The Shapiro and Wilk test (first column of Table 22) shows that the sample used to develop the model rule comes from a normal distribution. It is worth clarifying that BC_a method assumes normality.

Table 22. Statistics for model diagnostic rule

Shapiro-Wilk Test			BC_a 95% Confidence Interval					BC_a 90% Confidence Interval				
Stat.	df	Sig.	Mean	Bias	Std. Error	Lower	Upper	Mean	Bias	Std. Error	Lower	Upper
.974	8	.927	.66	-.0031	.1154	.46	.85	.66	-.0031	.1154	.49	.82

7.4 The model

The proposed model for the early identification of bubbles is the following:

Model I

$$f(b) = \frac{\left[\left(\chi \left(w_\alpha + w_\beta + w_\gamma + w_\delta + \frac{1}{\varepsilon} \right) \right) \times \lambda \right]}{\omega} \geq \rho$$

Model II

$$f(b) = \frac{\left[\left(\chi \left(w_\alpha + w_\beta + w_\gamma + w_\delta + \sqrt{(\varepsilon)^2} \right) \right) \times \lambda \right]}{\omega} \geq \rho$$

Where $f(b)$ equals fraction of bubble, $w_{\alpha,\beta,\gamma,\delta}$ is the weighted three-year moving average of House Prices, D/B ratio, Gross Lending and Housing Completions. In terms of the weights, there is a different applicable weight for each variable, as previously established in Section 7.2.1. For (α) this weight is 0.35, for (β) 0.35, for (γ) 0.20 and for (δ) 0.10. Section 7.2.3.2 describes the measurement process for the weighted three-year moving averages. The footnote below recalls how each of these weighted three-year moving averages is calculated³⁷.

ε implies the simple three-year moving average of Income. The measurement process is also indicated in Section 7.2.3.2. It calculated using the same equation as the weighted moving averaged but without accounting for any weight. That is, $\varepsilon = \frac{(Income\Delta\%_{t-2} + Income\Delta\%_{t-1} + Income\Delta\%_{t1})}{3y}$.

λ is equal to the three-year moving average of the H/PI Ratio (nominal values). The measurement process of λ is described in Section 7.2.4. That is, $\lambda = \frac{(HPI_{t-2} + HPI_{t-1} + HPI_{t1})}{3y}$.

ω is a constant taking the value of 100 whereas ρ equals the conditional threshold of the housing bubble and takes the value of 0.85. χ is a constant and equals 2. The justification for $\chi=2$ is based on the following argument. Since the phenomenon and extent of the housing market is complex and involves an unknown number of *relevant*³⁸ variables, I assume that the sum of the equation in the parenthesis should multiplied by that constant (χ) in order to smooth out, as pragmatically as possible (for the model), the *unknown* number of variables that determine the velocity of the market.

Our proposed method utilises two models. The first (I) is used when the three-year moving average of income is positive, and the second (II) is employed when the three-year moving

³⁷ House Prices
 $w_{\alpha} = \frac{(a_{t-2} + a_{t-1} + a_{t1})}{3y} \times 0.35$

D/B Ratio
 $w_{\beta} = \frac{(\beta_{t-2} + \beta_{t-1} + \beta_{t1})}{3y} \times 0.35$

Gross Lending
 $w_{\gamma} = \frac{(\gamma_{t-2} + \gamma_{t-1} + \gamma_{t1})}{3y} \times 0.20$

Housing Completions
 $w_{\delta} = \frac{(\delta_{t-2} + \delta_{t-1} + \delta_{t1})}{3y} \times 0.10$

³⁸ Relevant variables: Unknown number of variables and parameters that move with the *same velocity* as the selected variables during each phase of the market (i.e. recession, recovery, expansion or bubble).

average of income is negative, although the empirical analysis shows that it is very rare for income to exhibit a negative value when three years are taken into account. The rationale for this relies on the view that the higher the growth in income (all other things remaining constant and positive), the less the probability of a bubble, whereas the more negative the income growth (all other things remaining constant and positive), the greater the probability of a bubble. Therefore, when income (three-year moving average) is positive, its absolute value should be divided by $\frac{1}{\epsilon}$ to reflect lower significance as income rises. When income (three-year moving average) is negative, I use $\sqrt{(\epsilon)^2}$ to convert its negative value to a positive number, thus reflecting higher significance as income declines. Via this approach, the model thus ensures that the relationship between income and the bubble phenomenon is captured proportionately. An example of the application of the algorithmic model using real data is presented in Appendix A.

7.4.1 Theoretical framework and the fundamental hypothesis of the model

This study conforms to the irrational bubble theory. Initially, our work was inspired by the housing bubble definition of Shiller (2000) and Shiller (2013, p.2), who considers a bubble a “peculiar kind of fad or social epidemic that is regularly seen in speculative markets; not a wild orgy of delusions but a natural consequence of the principles of social psychology coupled with imperfect news media and information channels.” This study also accepts the fundamental theoretical framework of irrational bubble theory, that during housing bubbles, a degree of herd behaviour is found in the marketplace. On this basis, this study also accepts that during housing bubbles market participants do not know that prices are overvalued or bubbly. One available approach to justify the presence of a housing bubble on such a basis is to measure the qualitative characteristics and opinions of house buyers. Qualitative evidence of speculative activities, coupled with risk unawareness of house buyers, leads to the conclusion that a housing bubble is present (Case & Shiller, 2003). This study proposes an alternative approach for detecting such speculative bubbles. Taking this further, this research is dedicated to developing a new technique/methodology for estimating housing bubbles caused by the interaction of irrationality.

But what is the central hypothesis of this model? To start, recall that the model accepts the above-described, existing theoretical framework as a “truth.” The original assumption of the model is that during housing bubbles, all speculative activities of market participants (i.e. individuals, investment firms, financial institutions, and builders) follow an approximate synchronisation. Consequently, the model expects that an irrational, synchronised and periodic increase in a wide range of relevant variables must occur to anticipate a bubble component. This exact concept, *an irrational and synchronised increase in a wide range of relevant variables*, shapes the definition of housing bubbles in our analysis and subsequently in our model. In this definition, the relevant variables are those that exhibit a periodic and irrational acceleration in the rate of change, which, in turn, is synchronised with other relevant variables. Therefore, the model views such variables as symptoms identifying housing bubbles. These “truths” provide the conceptual elements upon which the whole research is based.

Chapter 8

8.0 Tests and validation of the model on the UK case studies

This chapter focuses on testing the validity of the algorithmic model throughout the period of 1983-2011. The aim of this chapter is to assess whether the model reproduces an out-of-rule state that in turn corresponds to the bubble component, during known bubble periods; and whether historical non-bubble input reproduces a state of rule control. It commences with explaining in detail the reasoning behind the tests. Then, it presents the results of the algorithmic model between the period of 1983-2011. Subsequently it reviews results of past studies on UK housing bubbles; with the view to provide a snapshot of the conclusions reached by previous studies that examined the question whether a housing bubble existed in the UK. This review will undoubtedly help us to better understand the effectiveness of our study in relation to existing studies on the spectrum of diagnosing bubbles in the UK.

8.1 The reasoning behind the tests

“Model verification is getting the model right. This means that the code generating the phenomena being modelled correctly matches the abstract model. Model validation is getting the right model, meaning that the correct abstract model was chosen and accurately represents the real-world phenomena” (Kennedy et al. 2005, p.2).

In Chapter 5.0 and Section 5.2.1.4, I explained the process for testing the model using the UK case studies. To recall, the testing procedure for the proposed model applies the historical data validation (HDV) and event validity (EV) techniques, as documented by Kennedy et al. (2005), Sargent (2005) and Yoe (2012). HDV involves considering historical input to determine whether the model reproduces real historical output. One example is to determine whether meteorological conditions that have always produced rainy days in reality will produce rainy days in the model (Kennedy et al. 2005, Sargent 2005, Yoe 2012). Equally, event validity aims to examine whether the “events” in the simulation model are comparable to those of the real system (Sargent 2005). Our model is an equation-based model, which makes the HDV technique an ideal approach (Kennedy et al. 2005). The general aim of this chapter is to examine whether and how closely the simulation output resembles the output of the real system.

In this analysis, HDV and EV involve using historical bubble input to determine whether the model reproduces an out-of-rule state that corresponds to the bubble component, and whether historical non-bubble input reproduces a state of rule control. The bubble rule proposed in this study has been developed using the method of bias-corrected and accelerated bootstrapping (BC_a) (see Sections 7.3.3 and 7.3.4). But what makes the (BC_a) method ideal for testing and identifying housing bubbles? The answer relies on the fact that the phenomenon of housing bubbles and the (BC_a) method share a fundamental common link. Housing bubbles have been traditionally described in the literature as an extreme and abnormal event (Zhou and Sornette 2003, Kindleberger and Alisher 2005, Agnello and Schuknecht 2011, Case and Shiller 2003). At the same time, values that are above the upper confidence interval of the BC_a method are interpreted as extreme and abnormal conditions. Also, the study's driving assumption is that during housing bubbles, all speculative activities of market participants (i.e. individuals, investment firms, financial institutions, and builders) follow an approximate (positive) synchronisation. Consequently, the model would predict that an irrational, synchronised and periodic increase in a wide range of relevant variables must occur to anticipate a bubble component. Following the abovementioned issues, I would expect that during "known" housing bubble periods, the output of the model should be above the upper confidence interval of our BC_a rule in order to correctly reflect both the hypothesis and the presence of an actual UK housing bubble episode. In contrast, during historic non-bubble periods, I would expect the model output to be below its UCI of BC_a to correctly reflect the absence of a housing bubble.

8.2 The results

Our model calculates and applies the three-year moving average for each observation when dealing with bubble tests. Therefore, the model only identifies housing bubbles that are already three years mature. For instance, in 1986, the UK housing market experienced its first bubble year, but the model was only able to spot this at the end of 1988, that is, after the maturity period of three years. Considering this logic, the results in Table 23 show that the UK housing market was in a bubble in 1986-1989 and in 2001-2006, using the rule threshold of 0.85 (95% confidence). However, the last year of the most recent bubble, 2007, was very close to our threshold, having a distance of just 0.03. One reason for the inefficiency of the

model for detecting 2007 as a bubble year (at the 95% confidence threshold) is because at this stage the UK housing market (and the selected variables) had already moved into a slow disinflation regime (see Section 6.2 and Table 15). This makes it relatively difficult for our model to detect such bubble regimes. Nevertheless, after applying the 90% confidence rule (0.82), I found that this issue was eliminated. Our results also shed light on a controversy in the literature regarding which year constitutes the beginning of the 2000s bubble. For instance, the studies of Dolphin and Griffith (2011) and Phang (2013) argue that the 2000s UK housing bubble lasted from 2002 to 2007, whereas the studies of Rapp (2009) and Clark et al. (2010) support the idea that the 2000s UK housing bubble was the period between 2001 and 2007. Regarding this argument, our results are consistent with the studies of Rapp (2009) and Clark et al. (2010).

The application and the tests of the model between 1984 and 2011 reveal another interesting component. In most of these observations, the result fluctuated in line with the phases of the UK real estate cycle. For example, during the first three recessionary years of the early 1990s (i.e. the observation for 1992), the result was at its highest negative value, thus correctly indicating that there were the more extreme negative conditions in place. The same situation applies to the first recession phase after 2007, that is, the observation for the year of 2010. Also, as the tests of the model move from the early 1990s recession towards the earlier recovery period of 1996, the results accelerate in a positive upward trend until reaching the positive result of 0.05 for the first recovery year of 1996. Then, moving from the recovery (1996) to the later expansion phase, the results continue in the same trend until 2003, which indicates the first three bubble years of the later case (2000s bubble). Consequently, despite the fact the model was built to correctly detect the UK housing bubble component, it can be also used as an initial monitoring tool for the UK housing market as a whole.

Table 23. Tests of the model

Year	Output	Bubble Signature
<i>Rule 0.85</i> (95% Confidence)		
1986	0.79	
1987	0.63	
1988	0.93	Positive
1989	1.19	Positive
1990	0.80	
1991	-0.13	
1992	-0.67	
1993	-0.59	
1994	-0.28	
1995	-0.12	
1996	0.05	
1997	0.38	
1998	0.62	
1999	0.69	
2000	0.52	
2001	0.55	
2002	0.71	
2003	0.94	Positive
2004	1.38	Positive
2005	1.18	Positive
2006	1.10	Positive
2007	0.82	Positive at 90% confidence level (0.82)
2008	0.14	
2009	-0.59	
2010	-0.83	
2011	-0.27	

8.3 Results of past tests on UK housing bubbles

This section aims to provide a snapshot of the conclusions reached by previous studies that examined whether a housing bubble existed in the UK. Technically, the UK housing market was in a bubble during the periods of 1986-1989 and 2001-2007. Given the critical advantage that our research has in terms of time, being that it a later study, I can compare the results of previous work on UK housing bubble detection to observe whether those models manage to correctly identify the known UK bubble cases. This analysis will help us to better understand the effectiveness of the existing models for diagnosing bubbles in the UK housing market. Details of the methodology used by the studies presented below can be found in Chapter 4.

Cameron et al. (2006) addressed the question of whether there was a bubble in UK house prices in the 2000s. In their analysis, the authors defined a bubble as a systematic but temporary deviation of house prices from fundamentals. The model consists of a system of dynamic equilibrium-correction (inverted housing demand) equations, incorporating spatial interactions and lags and the relevant spatial parameter of heterogeneity. This model used data from the period of 1972-2003. The period between 1972-1996 was used to build the model's estimation, while the period between 1997 and 2003 was used for forecasting purposes. The results suggest that in 2003, house prices were not substantially overvalued. Thus, no bubble is detected in the UK in the early 2000s. Also, the study proposed "moderate nominal falls in house prices in 2006-2007 are a possibility, especially in London and the South but not in the country as a whole" (p.23). However, revisiting the study of Cameron et al. (2006), Muellbauer and Murphy (2008) suggest that by mid-2007, UK house prices looked "slightly overvalued" (cited in Kuenzel and Bjornbak 2008).

By examining the successfulness of Cameron et al.'s (2006) model for detecting UK housing bubbles, one can assert that it did not prove to be correct in practice. In particular, the model failed to identify the UK housing bubble that was forming in the early 2000s. Also, the second finding of Cameron et al. (2006, p.23) that "moderate nominal falls in house prices in 2006-2007 are a possibility, especially in London and the South but not in the country as a whole" also proved to be incorrect. As to the study of Muellbauer and Murphy (2008), their findings that UK house prices looked slightly overvalued by mid 2007 are not inconsistent with the true market condition at that time. This is because house prices by mid 2007 were in the final bubble year, indicating a peaking bubble year rather than a slight overvaluation.

Also, the period prior to 2007, that is, 2001 to 2006, was also bubbly, but Muellbauer and Murphy's (2008) model also failed to identify them as such.

Weeken (2004) applied a simple asset-pricing model (i.e. dividend discount model) to examine whether the observed rate of increase in house prices was unsustainable. Additionally, Weeken (2004) introduced a constant real rate growth model. The dividend values in Weeken's (2004) model are implied by the rental values. Such data is available from real estate agencies and research institutes like Investment Property Databank (IPD). It is important to note Weeken's (2004) finding that 'housing dividends' are difficult to estimate and that asset pricing models face several limitations. In relation to this, the study suggests that no clear results can be produced due to data and model limitations. However, by comparing the implied housing risk premium in 2004 (the study year) with that of the late 1980s, the author suggests that house prices were closer to sustainable levels in 2004 than was the case in the late 1980s. Thus, no bubble was detected for the early 2000s.

By critically analysing the accuracy Weeken's (2004) results for the selected UK housing bubble cases, it seems that they do not capture the real picture. This leads us to conclude that the asset pricing model, to the extent that it was used by Weeken (2004), is unable to explain and correctly diagnose the housing bubble component in the UK housing market. However, Weeken (2004) also employed the indicator of house prices to net rentals (a concept close to the price to earnings ratio used for equity markets) by linking it to the mean reversion theory. After accounting for this, Weeken (2004) showed that in the 2000s, this indicator was well above its long-term average, thus concluding that 2004 house prices might be unsustainable. This argument is in line with our findings, which show that the concept of affordability in conjunction with the mean reversion theory could be helpful in diagnosing housing bubbles in the UK, particularly if used along with other variables in an algorithmic model.

Another interesting study that focused on UK housing bubble detection was that of Black et al. (2006). They proposed an advanced procedure using a time-varying present value approach to assess whether house prices are deviating relative to fundamental house prices in the UK. An adaptation of the vector autoregressive (VAR) methodology was also used along with other tests such as the Ljung-Box test statistic and Wald test statistics to enhance the statistical dynamic of their results. Black et al.'s (2006) model made use of UK housing data from Q4 1973 to Q3 2004. It covered the variables of house prices, disposable income and retail price index. The house price data came from Nationwide while data for real disposable income and retail price index (RPI) come from the Office of National Statistics. The housing

data were deflated by the RPI in order to convert the prices to real terms. The results suggest that the time-varying present value model does not fit well with actual prices, displaying periods of over and under valuation of prices. In particular, the study found departures between actual and computed fundamental prices for the mid-to late 1980s. Regarding this time frame, the study failed to identify the first year of the 1980s bubble (i.e. 1986) since actual prices were close to the fundamental values in that year. As for the 2000s bubble, the model's results indicated that by the end of the sample time period (September 2004), there was a 25% gap between actual price and estimated fundamental price. Nevertheless, for the early formative years of the 2000s case (i.e. 2001, 2002, and 2003), their results showed that prices were "under"-valued, despite the current widespread view that 2001, 2002 and 2003 were bubbly years and thus that house prices over-valued. To the best of my knowledge, the results produced by Black et al.'s (2006) model were the most successful compared to the rest of the UK studies. Nevertheless, it must be highlighted that the model failed to identify the year 1986 as the first bubble year of the 1980s bubble, nor did it identify the early years of the 2000s bubble. This leads us to conclude that while this approach may be useful for raising some warning when the market is experiencing a bubble, it may not successfully produce bubble warnings during the development of the phenomenon.

The next model is that of Zhou and Sornette (2003), which also focused on identifying and testing whether the UK and US housing markets were experiencing an unsustainable speculative bubble using a pure econophysic approach. This approach was created for application to financial assets rather than housing, which is significantly different in nature (Geraskin and Fantazzini 2011). In particular, Zhou and Sornette (2003) used the Log-Periodic Power Law (LPPL) to identify signals of faster-than-usual performance. These signals had been found to be consistent predictors of previous crashes in financial markets. The housing data used in the study was based on the Halifax housing indices and covered the period between December 1992 and April 2003. The paper concluded the following:

- (1) The US real estate market was in a "rational expectation" regime, and thus was not in a housing bubble.
- (2) The UK real estate market was exhibiting an ultimately unsustainable speculative bubble in 2000-2003.
- (3) The analysis points to the end of the UK bubble around the end of 2003, with either a crash or a change of direction by moving into a deflation regime.

As for the validity of the results obtained via the LPPL approach, I argue the following. First, the study was partly correct regarding the second finding, since the UK housing market is now believed to have been in a bubble in 2001, 2002 and 2003, although the year 2000 is not considered in the literature or our model to be a bubble year. Secondly, their prediction that UK housing bubble of the 2000s would end in a crash in 2003 or change direction (into a deflation mode) has proven wrong. Specifically, in 2003, UK house prices did not crash, nor did they transition to a deflation regime. Instead, prices continued to rise, albeit less rapidly, and can therefore be seen to have transitioned to a disinflation regime rather than to deflation. Although it is beyond the scope of this section to discuss findings obtained for other markets, it is worth mentioning that Zhou and Sornette's (2003) model was also wrong in terms of its first finding. This is because it is currently well accepted that the US housing market was in a bubble in the 2000s. Despite this, the LPPL approach has gained popularity over the last years, as it has provided several successful bubble warnings in finance markets. However, the level of effectiveness of LPPL for the housing market remains ambiguous.

Chapter 9

9.0 Conclusion

This research has looked at the phenomenon of housing bubbles in the UK context with the aim of proposing an algorithmic model for identifying UK housing bubbles in the making. This chapter highlights the conclusion of the thesis. It begins with a description of the research objectives achieved. Subsequently, a synopsis of the main research findings is given, along with the contributions to the existing knowledge. Also, the advantages of the proposed model and the model's limitations are discussed. Finally, recommendations for further research and a summary conclusion are provided.

9.1 Research objectives achieved

This section discusses how the aim and objectives of the research have been achieved. The aim of this research was to develop a new algorithm-based model/method for the identification of UK housing bubbles. With this in mind, the overall aim of the model was to propose a new measure for studying the presence of (irrational) housing bubbles that uses data up to the point of analysis for on-going bubble assessment, with the view to provide an early bubble diagnostic. The leading question of this study was: How can property bubbles be better estimated in order to provide advanced warning to market participants? This aim has been achieved by addressing the research objectives as follows.

The first objective was to build a contextual knowledge of the cyclical development of the UK housing market and of the historical housing bubble episodes. The second objective was to explore the theoretical framework of housing cycles and housing bubbles. These two objectives were achieved by reviewing the relevant literature on housing cycles and housing bubbles. As for housing cycles in particular, the theory behind housing cycles was covered. Also, the study included a deep historic and empirical review of the UK housing market since World War II, with emphasis placed on the different phases of the UK housing market, including bubble events that occurred from 1945 onward. The study went further in outlining the relationship between housing affordability and house price cycles using empirical tools. While the literature on housing cycles is rich, no empirical evidence was available regarding whether and to what extent housing affordability indices are related to

house price cycles. The need to analyse this relationship derived from the widespread view that housing affordability is a significant parameter in the housing bubble phenomenon. In terms of housing bubbles in particular, the related objectives have been fulfilled via a literature review. The literature review explored the available bubble definitions, bubble descriptions, notable historical examples of bubbles occurring worldwide, and the different schools of economic thought on bubbles. The review also looked at the different types of bubbles, what creates housing bubbles, what causes housing bubbles to recur over time and why housing bubbles tend to last for so long.

The third objective was to review the literature on housing bubble detection methods/ approaches and to critically analyse their gaps and limitations. This objective has been met by critically analysing the main approaches available for the identification of bubbles, their gaps and their limitations. Also, in Chapter 4, the study explored the on-going debate on bubble detection methods as well as the challenges in looking at the phenomenon of housing bubbles.

The fourth objective was to identify and describe the last two UK housing bubbles from both a historical and empirical context. To meet this objective, the study first provided a historical description of the two most recent UK housing bubbles by relying on previous work. The study conducted an empirical analysis using descriptive tools, the triangular method, and extensive correlation analysis of several time frames, including housing bubble periods. The results of correlation analysis were also supported by theoretical work. To enhance our understanding of the selected UK housing bubble cases, the research also examined whether the statement of Barlevy (2007) (“Positive changes, even at unprecedented rates, are not in and of themselves sufficient to define a situation as a bubble”) holds for the UK housing bubble cases.

The fifth objective was to develop a new methodology/model for estimating irrational housing bubbles and to apply it to the UK housing market (i.e. testing). This was also the most crucial objective for answering the main question of the thesis. To achieve this objective, the study applied the steps of the proposed methodology. Initially, the variables were identified by relying on the previous literature. Subsequently, a verification process was applied by engaging several forms of analysis: mean analysis, normality tests, control charts and descriptive statistics using the bootstrapping method. Next, the study endeavoured to identify and explain the key constructs of the model. For this purpose, the study used theoretical reasoning derived from the literature review and from the knowledge gained from

the previous case study analysis. The research also applied an analytical hierarchy process using the trapezoid rule and the second law of motion, along with moving averages and descriptive statistics using the bootstrapping method. The study then attempted to establish the model's rule. To complete this methodological step, the thesis used part of the data in combination with a statistical procedure, as advised by the selected model validation technique (HDV). The statistical procedure chosen for the development of the model's rule was bias-corrected and accelerated bootstrapping. It is important to note that the special relationship between bubble identification and the technique of bias-corrected and accelerated bootstrapping was explained in detail. Finally, the study applied the final methodological step to meet our fifth objective. This step refers to the tests and the implementation of the model for the UK bubble case studies. To this extent, the study used the historic data validation (HDV) and event validity (EV) techniques. Data was gathered for the period of 1983-2011 to directly observe whether and how closely the model's simulation output resembled the output from the real system. In particular, I examined whether the model reproduced an out-of-rule state during "known" UK housing bubble periods and whether historical non-bubble input reproduced a state of rule control. The results found that the model acts as an effective tool for identifying and measuring housing bubbles in the UK.

The final objective was to draw conclusions. This objective has been met in Chapter 8 as well as in this chapter.

9.2 The main research findings

The detection of housing bubbles and optimal investment timing has long been a subject of interest. The purpose of this thesis has been to provide a decision support model by enabling the early diagnosis of housing bubbles in the UK. By doing so, several findings emerged.

- 1) The model successfully identifies the "known" historical UK bubble episodes over the period of 1983-2011.
- 2) The model results reveal that the 2000s UK housing bubble commenced in 2001.

- 3) The study has further determined that to uncover housing bubbles in the UK, house price changes have the same weight as the debt-burden ratio when their velocities are positive.
- 4) The research has provided a new and more technical definition of an irrational housing bubble. The phenomenon is described as “a situation in which all speculative activities of market participants (i.e. individuals, investment firms, financial institutions, and builders) achieve an approximate synchronisation.”
- 5) The model’s outputs fluctuate approximately in line with the phases of the UK real estate cycle.

9.3 Contribution to Knowledge

The existing conventional methods to detect bubbles have mostly been supported under the rational bubble theory by including the fundamental factor of house prices. The appropriateness, success and limitations of such approaches have been challenged critically throughout this thesis. Paradoxically, such approaches overlook the measurement of the bubble component in housing markets as a whole, as they pay attention only to measuring fundamental prices. Other popular approaches include the specific analysis of “market fever” variables such as house price to earnings ratio and the house price to rent ratio. Such approaches are unable to consider more than one variable at a time while also suffering from a lack of reliability. Through this thesis, I have shown that irrational bubble theory is gaining more acceptance every day, particularly after the novel research of Case and Shiller (2003), who found that housing markets often performed in a speculative, unhealthy and unbalanced manner, with unstable prices movements. In such situations, they appear to be near a state of disease, like a kind of a “social epidemic” (Shiller 2000, Case and Shiller 2003). The work of Case and Shiller (2003) can be considered as the “symbol” of irrational bubble theory applied to housing bubbles. Still, irrational bubble theory (in housing) is in its infancy, given the fact that it has only been applied on the premise of a survey method. Demand for more empirical quantitative evidence of irrational bubbles calls for the research to seek new techniques to identify the magnitude of such bubbles. With this in mind, Mayer (2011), Orrel and

McSharry (2009) and Agnello and Schuknecht (2011) are the only three studies that have pointed out the need for and significance of models to help diagnose housing bubbles, just as doctors identify cancers, rather than to predict the exact probability or the timing of the next crash or even to forecast an outcome like fundamental prices. They further argue that perhaps there is a need to change the kinds of questions we ask. Instead of trying to predict changes in prices and the future path of housing markets to explain bubbles, we should focus on developing models to better understand and identify the bubble system as a whole.

In academia, the proposed housing bubble model can potentially contribute to research by shedding light on irrational developments in the housing market via quantitative measures. Case and Shiller (2003) define an irrational speculative housing bubble as “buying for the future price increases rather than simply for the pleasure of occupying the home” or like a “peculiar kind of fad or social epidemic that is regularly seen in speculative markets; not a wild orgy of delusions but a natural consequence of the principles of social psychology coupled with imperfect news media and information channels.” (Shiller 2013, p.2) I provide a new and more technical definition of irrational housing bubbles by describing the phenomenon as “a situation in which all speculative activities of market participants (i.e. individuals, investment firms, financial institutions, and builders) achieve an approximate synchronisation.” I consider that during housing bubbles, an irrational and synchronous increase in a wide range of relevant variables must occur to anticipate the bubble component. Within this definition, the relevant variables are those that exhibit a periodic and irrational acceleration in rate of change, which is in turn approximately synchronised with other relevant variables (i.e. symptoms).

Our approach is not only of importance to academia because it provides an initial attempt to quantitatively measure irrational real estate bubbles or because it offers a more technical definition for describing irrational bubbles, but it is also valuable because it is the first quantitative model that does not treat as its epicentre of analysis the variable representing house prices or any other variable. Instead, it places emphasis on estimating the magnitude of the phenomenon as a whole. Therefore, it purely represents the bubble without commingling with any fundamental aspect of pricing. Hence, the output of our proposed model could be taken as proxy of housing bubbles. Success in estimating the bubble index could open a new path for academic research in the UK housing market. Having a “bubble index” as a new variable could help us learn about the interaction between such a variable and real economic output, for example, whether and to what extent this “new” bubble index

variable drives the UK's economic output and vice versa. The significance of such a topic can be better understood by taking into account the well-known fact that housing bubbles give rise to instability in an economy (Panagopoulos and Vlamis 2009, Reinhart and Rogoff 2009, Kaminsky and Reinhart 1999, IMF 2003). Also, according to Jowsey (2011), housing bubble-busts tend to last twice as long as stock bubbles with effects twice as large in terms of GDP loss, a statement consistent with the work of Brocker and Hanes (2014) and Hlaváček and Komárek (2009).

9.4 The advantages of the proposed bubble model

Our proposed bubble methodology/model excels over conventional techniques at assessing bubbles in housing markets. It is borne from the theoretical framework of irrational bubbles and rests on the belief that a housing bubble is a situation in which all the speculative activities of market participants (i.e. individuals, investment firms, financial institutions, and builders) undergo an approximate synchronisation, leading to an irrational and synchronous increase in a wide range of relevant variables. The advantage of our method can be summarised as follows.

First, it is apparent that the assessment of fundamental values (FV) in housing markets is rarely done, since existing FV conventional techniques are subject to several serious limitations, as discussed in the literature (Orrel and McSharry 2009, Glaeser and Gyourko 2007, Stiglitz 1990, Case and Shiller 1989, Shiller 1992, Smith and Smith 2006). As for the "housing market" specifically, Robert Shiller (1992) made clear that price determinants of housing are far more complicated and unknown than they are for other assets. This issue makes the process of calculating fundamental value in housing even more problematic, as expressed by Krainer and Wei (2004, p.1): "We see that housing bubbles are difficult to detect because fundamental value is fundamentally unobservable." Another profound gap in conventional techniques is that the existing housing bubble models lack a basic hierarchical structure for the selected variables. Neither has there been any attempt to assign a weight to each variable based on the housing bubble theory followed. Finally, fundamental value approaches lack a clear and objective interpretation procedure when assessing the presence of bubbles. This is because such models tend to accept the presence of a housing bubble if house prices are not reconciled with variations of macroeconomic variables, or if the price

change cannot be explained by both fundamentals and ‘reasonable’ shifts (Shen et al. 2005). This issue was made evident by Taipalus (2006, p.11) who questioned, “How can one say that the real estate prices are in a bubble?” He then stated that this question is the same as asking, “How can one say that prices are detached from their fundamentally justified level?” However, the notion of how much actual prices must deviate from the so-called fundamental value or for how long in order to detect a bubble is open to different interpretations and thus to a profound bias. Similarly, Meltzer (2002) explained that the reason that a bubble hypothesis is difficult, if not impossible, to test (using fundamental value methods) is that expectations are measured relative to the hypothesis associated with rational expectations (i.e. that investors exploit all the available information). Thus, the bubble phenomenon is what remains unexplained by the hypothesis and therefore by the model.

Unlike the existing fundamental value approaches, our proposed bubble methodology/model gives rise to a new approach for estimating bubbles that emphasises the bubble component itself (via modelling the symptoms of bubbles) rather than comparing actual and fundamental values. Hence, what differentiates our method from most conventional bubble techniques is that instead of using fundamental variables to explain prices that in turn will “somehow” explain bubbles, I use the inherent symptoms of bubbles to directly explain the bubble component in the UK housing market. Therefore, our approach extends the concept of housing bubbles to a new measure that could be described as a proxy of a bubble index. More specifically, this is achieved by employing an algorithm-based model, which in turn relies on a wide range of data coming from different sources and covering a long period of time. This approach is also in line with the statement of Milton Friedman (as quoted by Hamermesh 2000 p. 376): “I have long had relatively little faith in judging statistical results by formal tests of significance. I believe that it is much more important to base conclusions on a wide range of evidence coming from different sources over a long period of time.” Another benefit of our model is that it incorporates a basic hierarchical order for the selected variables. This process has been undertaken to determine variable best explains the presence of the phenomenon if its velocity is positive over an economic curve, thereby comprising a bubble force factor. This position is in line with the thesis’ general subject of analysis (i.e. the speed of growth). Another crucial advantage of our proposed method is based on the way in which results are interpreted. In contrast to fundamental value models, our method considers that a housing bubble exists if the output of the model is above a certain well-defined and well-documented empirical threshold (i.e. rule). This inherent feature in our model leaves less room for bias when assessing housing

bubbles, thus making it a more objective measure for interpretation purposes. Moreover, since this study already provides the variables' "weights" to potential users of the model, along with the level of the bubble rule/threshold, the remaining process for applying the model involves only two simple steps:

- 1) Simple data transformations of easily accessible data
- 2) Straightforward application of a simple algorithm

As such, it can be argued the model offers a feasible process for frequent future bubble testing. This can be considered an additional advantage of the model compared to existing models, which include time consuming tests and complicated procedures with several data adjustments in some cases (as reviewed in the literature), making frequent testing an infeasible process for "ordinary people."

Second, the existing fundamental value methods make use of several idealistic assumptions about market participants in assessing bubbles. For instance, by relying first on the efficient market hypothesis and subsequently on rational bubble theory, conventional methods consider that market participants make decisions according to an optimal use of "market" information and that they use rational rules in doing so (Diappi 2013). Also, in implementing such approaches, researchers also assume that market participants know that the market is overvalued but have no incentive to leave it because they expect the bubble component to grow and compensate them appropriately (i.e. the bubble premium) (Hardouvelis 1998, Harrison and Kreps 1978, Flood and Hodrick 1990). The idea that participants in housing markets are so optimizing, calculating and willing to update their views based on new investment information has been called into question by the influential work of Case and Shiller (2003, 1989, 1988). The authors found that the actual housing market paints a very different picture from what has been thought. They concluded that real estate markets are far from rational, as they are populated by amateurs who make infrequent transactions on the basis of limited information and with no serious experience in gauging the fundamental value of the houses they are trading. Case and Shiller (2003) also found that during housing bubbles, market participants are not aware that the market is overvalued or bubbly when they form their investment decisions. Keynes (1936) also explained that asset markets operate in an environment in which market participants may not be governed by an objective view of the fundamentals but by "what average opinion expects average opinion to be." This led Krugman (2009), in one of his most novel articles, to assert that the "widespread belief

that markets are efficient and rationally constructed had blinded many if not most economists to the emergence of the biggest financial bubble in history.” With this in mind Meltzer (2002) explained that the rational bubble hypothesis is empirically empty in terms of evidence and that rational price expectations cannot be empirically observed. The efficient market hypothesis and, to an extent, assumptions of rational bubbles, which were once at the forefront of economics, are now accepted as being outdated. Currently, the new area of research on housing bubbles offers a remarkable alternative to the EMH and to rational bubbles (Case and Shiller 2003). This alternative is irrational bubble theory, which uses more realistic assumptions when assessing bubbles.

Based on the above, it can be considered that our method utilizes more realistic assumptions about how market participants interact in housing markets. Principally, in contrast with the existing outdated theories and assumptions, our method touches upon the irrational bubble theory and additionally on the realistic and logical assumption that during housing bubbles, all speculative activities of the market participants (i.e. individuals, investment firms, financial institutions, and builders) achieve an approximate synchronisation. This assumption has been validated empirically by employing a correlation analysis in Section 7.1.5 (and Section 6.2.2). Furthermore, our method does not take into account any assumptions about rational price expectations from the market participants’ point of view, which is a key subject of contention in the existing bubble debate.

Third, in the existing bubble identification models, various assumptions about the bubble’s potential movement path or the probability of collapse have been applied (Cameron et al. 2006, Zhou and Sornette 2003, Himmelberg et. al 2005, McCarthy and Peach 2005). The general limitations associated with statistical and econometric forecasting have been well documented by Philips (2004), Chen and Wang (2004) and Vasigh et al. (2013). As was once said by an early statistician, Simpson (1952), “The only thing certain about the future is that it is uncertain.” Compared to the various existing bubble tests in the literature, our method’s advantage is that it does not require any forecasting or assumptions about the potential bubble movement path because it is a purely diagnostic model (it is only concerned with assessing the present bubble situation in the UK housing market).

9.5 Limitations of the proposed bubble model

Despite the many advantages of our proposed method, it is important to emphasise and critically assess the general limitations of this study. The limitations should be considered within three contexts. The first is related to the research philosophy and design. The second is related to the approach and to the concept of the model's output. The third is related to common data limitations associated with model inputs, as in all studies.

As discussed in Chapter 5.0, this study makes use of the positivist research philosophy. However, positivism comes with its own limitations. In particular, positivistic research is restricted to stimulus/response experimentation, which may not be adequate to describe the social setting within which the phenomenon of interest normally takes place (Rombach et al. 1993, Sheldon et al. 2011). This can be better explained by considering the survey method applied by Case and Shiller (1989, 2000, 2003). Our main research design utilises the case study approach by looking at the last two UK housing bubbles. This limited number of case studies (two) restricts the weight of our findings. Also, single-country studies have a limitation in the extrapolation of general rules to other markets.

Although the proposed model is adequate to describe the presence of housing bubbles in the UK and to observe the overall market movements in relation to the bubble component, it does not offer much in terms of explaining the causality between the inputs of the model. Moreover, despite the fact that moving averages are popular for filtering market trends and the effects of the market (Tse 1997), and that three-year moving averages in particular are useful for housing bubble detection (Bordo and Jeanne 2002), the employment of such a metric provides a confined time horizon of analysis that prevents our model from potential application on the basis of a two-year moving average or single-year average performance. In relation to this, since this study takes as a prime subject of analysis the “speed” of “change” of several variables, it can be argued that it is relatively limited to catching bubbles that are already in a slow-disinflation mode. To overcome this issue, I have proposed an additional bubble rule threshold (under 90% confidence). Nevertheless, the suitability of the selected subject of analysis (speed of change) is justified by previous work in Section 7.2.3.1.

The next problem is related to the potential for applying this model to different housing markets/countries (other than UK). The problem actually lies in the unavoidable use of long calculations in order to resolve the model's system of weights (i.e. variable weights) and its

subsequent application for developing the corresponding rule-threshold.

The third limitation is associated with the content of the “data” used. I acknowledge that the variable of housing completions in particular, which is viewed as the representative variable for housing supply, is subject to an inherent limitation. For instance, the development and completion of housing requires public approval, financing, research, construction and proper marketing, and as a result often takes an unreasonable amount of time. This means that changes in supply happen with delays and create a mismatch of “catching” the changing market demand prices (Barras 1983, 1994, 2005, 2009; Pugh and Dehesh 2001; Reed and Wu 2010; Mueller cited in Rosenthal 2006). As a result, the speed of change of the housing supply parameter in our model, which is in turn reflected by the bubble component, may come with a delay.

9.6 Recommendations

The bubble methodology/model developed in this thesis provides a new measure for identifying housing bubbles in the UK. This section presents recommendations to the property industry towards enhancing the quality of identifying and, therefore, potentially monitoring the bubble component in the UK housing market. In this work, there is definitely room for further research, with openings waiting to be filled in. Specifically, as this research strived to take some new challenges using extant as well as some new measures with quantifying housing bubbles, this provides a solid foundation for many research avenues and thus several recommendations are made for further research.

- **The proposed bubble methodology/model could be replicated in different developed countries as part of a wider comparative study (i.e. USA, Norway).**

From the contextual aspects of housing bubbles, this research envisaged a demanding context with theoretical and empirical assertions and validates all of the findings from the perspective of one developed country. Therefore, a research avenue is open for further validation in the context of different developed countries with well-established and long-term housing data; and developed countries that also experienced a housing bubble in 1980s and 2000s. An ideal example of such developed county is the USA. Replicating the model in

USA housing market might provide a more comprehensive research setting for generalising the present findings. On such scenario researchers might find helpful the recommendation of re-applying two parts of the methodology of the development process of the model, using the same or similar content of data sets. For this purpose, researchers could re-apply the process related to the hierarchical order of the variables (Section 7.2.1) in order to obtain new weights for the selected variables. These “new weights” will provide to researchers the opportunity to follow the process as exhibited in Section 7.3 and thus to build a “new rule” (ρ) for the identification of housing bubbles in their country-specific context (i.e. USA). Consequently, having the “new weights” for the selected variables and the “new rule”: researchers would find themselves able to apply the proposed algorithm over the long-term and thus be eligible to assess whether the algorithm provides reliable results and insights for their selected country.

- **The usage of the model from the perspective of UK housing policy makers**

The housing bust of 2008 and its severe effects on the real economy have increased calls for monetary and regulatory policy makers to take into account emerging housing price bubbles in their policy assessments and to develop early warning devices for bubble identification (Agnello and Schuknecht 2011, Ambrose et al. 2013). However, as it has been showed throughout this thesis, the proposed method acts like an index or a thermometer to gauge the “fever” of a housing bubble in the UK at any point in time. In this approach, the housing bubble is no longer invisible until the crash, and as such can be monitored over time. Hence, given the aforementioned need from the policy makers’ perspective, our approach could be used as a tool to enhance policy makers’ knowledge towards the identification of housing bubbles in the UK. This could considerably help policy makers in the process of discussing/examining and developing public housing policies.

- **Recommendation for UK individual investors**

Identifying a bubble is always a timely question for investors. Knowing or assessing the risk of whether the UK housing market is in a bubble would potentially help individual investors and households to reduce their exposure to unnecessary risks and would thus reduce the overall stress in UK housing market. However, bubbles have the stigma to develop when there is widespread risk unawareness towards the presence of bubbles (Case and Shiller 2003) and when there is a bulletproof confidence in the efficiency of markets and the health of housing market. Often, such confidence is supported by empty or bubbly stories that make the majority of investors to utterly being convinced that this time is different (Shiller 2000, 1989, 2013, 2005). As a result, during housing bubbles, those investors who are in a position to identify correctly the housing bubble component can drastically benefit in monetary terms. This demand highlights the need for a bubble warning system that can alert investors to danger signs.

The proposed algorithmic model has been exclusively build on the framework of irrational bubble theory and in extent on the herd behaviour, which is considered (particularly after the novel work of Case and Shiller 2003) as the primary cause for the development of the phenomenon itself, in the first place. The good news is that those who believe that markets are irrationally constructed are gaining more acceptance everyday and have a greater chance of influencing our future. The model in this thesis suggests that a housing bubble is a situation in which all speculative activities of market participants achieve an approximate synchronisation. With this model, successful assessment for bubbles is made relatively simple given the simplicity of applying this model in real-time (Section 9.9) and the predominant evidences of successful bubble warnings over the period of 1983-2011 (Section 8.2). While the model's bubble signals are not explanatory to predict a bust or the exact specific peak, they can provide advance information as to whether a housing bubble exist in the UK housing market in real time, and thus valuable investment information can arise.

- **The researcher recommends a further study on whether and how the output of the model (i.e. the bubble “index”) affects or is related to the real economic output in the UK and vice versa.**

A separate comparative analysis with large sample from these two groups (Bubble index-model’s output vs. GDP) may be a constructive study in future research framework. This is because such study could grasp these two groups and as a result could encapsulate the overall picture of the relationship/effects between UK’s economic output and UK’s bubble phenomenon and vice versa. Alternatively, researchers might perform a comparative study by focusing on the specific bubbly-period sample from these two groups rather than on the long-term sample. Likely, results from such studies could provide more robust understanding from both perspectives (Bubbles and GDP).

- **Further research should seek to establish specific guidance in terms of how property appraisers in the UK at least, could apply or combine to their valuations the results of the housing bubbles tests of this proposed model, with a view to positively affect the reliability of valuations.**

This work is also significant from the point of view of UK property appraisers, despite the fact that no serious link between housing bubbles and property valuations has yet been established in the actual valuation process. Generally, in the Mallinson (1994) report and the subsequent “Carsberg report” (RICS 2002), the Royal Institution of Chartered Surveyors (RICS 2002) have raised the concern that ways should be sought to establish an acceptable method for expressing uncertainty in valuations. In the time between these two reports, Mallinson and French (2000) suggested that “the solution must lie in the creation of some format description, accepted as a norm, which conveys the essence with simplicity, but is capable of expansion and interpretation.” Still, when these reports refer to uncertainty in valuations, they mainly refer to the difference between multiple valuations of the same property undertaken at the same time, which is related to the inherently uncertain nature of individual valuations. With this in mind, RICS (2012), in the “Red Book,” consider five issues that could materially affect the degree of certainty and confidence (types of uncertainty) in a valuation. These include the following:

- i. Status of Valuer
(Skills and Experience)
- ii. Inherent uncertainty
(Unusual or unique type of property and assumptions made)
- iii. Restrictions on enquiries or information provided
(Limited information/data)
- iv. Liquidity and market activity
(Inactive market, low level of liquidity or absence of empirical data)
- v. Market Instability
(Unforeseen financial, macro-economic, legal, political or even natural events)

The closest type of uncertainty to our research work is the fifth (v) type of uncertainty. RICS (2012) define market instability as “unforeseen financial, macro-economic, legal, political or even natural events. If the *valuation date* coincides with, or is in the immediate “aftermath” of, such an event there may be a reduced level of certainty that can be attached to a valuation, due to inconsistent or absent empirical data, or the valuer being faced with an unprecedented set of circumstances on which to base a judgment.”

Although this type of uncertainty is more relevant to our study than the rest of the types listed, the RICS definition does not include housing bubble events. The RICS description could be seen as more relevant for describing a housing crisis and not housing bubbles (housing crisis is the immediate aftermath of housing bubbles). However, in the literature on housing bubble, such phenomena (bubbles) are consistently seen as events describing market instability. In this sense, a bubble is an equally important event that could affect the reliability of a valuation figure. For instance, let us assume that there is a good amount of comparable evidence available for a valuation, but that these comparable sales coincide with a bubble period. Would this not mean that the data is bubbly and thus uncertain? This question shows that RICS (2012) neglected to include and properly clarify that housing bubbles are events that could also materially affect the degree of certainty and confidence in a valuation.

Bearing in mind the aforementioned issue (that bubbles affect the certainty in valuations), along with our successful bubble warning results, I can assert that the proposed model could

be used by appraisers as a decision support tool to enhance their judgments regarding housing bubbles – during the valuation process. By having a good proxy and knowledge about whether the housing market is experiencing a housing bubble, on or close to the date of valuation, appraisers could use model's findings as an additional data set³⁹ (like comparable sales) to form more reliable valuation conclusions. The validity of this argument can be better realized when one take into account French and Gabrielli's (2003) argument that the selection of property valuation data is a heuristic process involving the ability to discover new facts and connections between market facts. Moreover, since the application of our model involves a simple algorithm that utilises easily accessible UK data sources, with a clear and precise way of interpreting the findings (i.e. rule threshold), it can be argued that the model fulfils the requirements of "simplicity" and "interpretation" expressed by Mallinson (1994) and French (2000) above (p. 180).

- **The model demonstrated in this work is merely in a conceptual phase. The model can be improved by further enriching the model inputs (symptoms).**

Without a doubt, a model that embraces additional bubble symptoms can further improve the accuracy of the bubble estimation. However, in such a case, the re-application of the whole methodology is necessary.

- **Finally, from an information perspective, irrational bubbles are far more informative and "real" than rational bubbles. This feature is consistent with behavioural analysis in that it explains housing bubbles by psychological phenomena that are mainly within the irrational scope. Therefore, further research should place emphasis on combining results from both irrational bubble methods, i.e. the thesis quantitative approach and the survey method. This would greatly increase the validity of any conclusions associated with the bubble hypothesis.**

³⁹ In this sense, the model output can be used as a snapshot picture of the housing market's sustainability and its risk of the presence of a housing bubble.

9.7 Summary

The detection of housing bubbles and optimal investment timing has long been a subject of interest. Most of the existing efforts in the housing bubble research have been made with the goal of finally creating a comprehensive model to accurately predict or identify housing bubbles. Clearly, this goal cannot be achieved through only a partial advancement of the existing conventional techniques. Differing from the classical bubble techniques, my approach begins with the real-world phenomenon (bubbles) with the view to develop corresponding models to explain the presence of such happenings. As a contribution, my work moves forward the research agenda of identifying irrational housing bubbles, whilst unlike the work of Case and Shiller (2003), this study provides quantitative empirical evidence of irrational bubbles. This study proposes a new measure for housing bubbles. This measure is not simply an ex post detection technique but a dating algorithm that uses data up to the point of analysis for an on-going bubble assessment, providing an early warning diagnostic that can assist market participants, professionals and regulators in market monitoring.

However, like other studies, my work is just a beginning in terms of quantitatively measuring irrational bubbles, which as a field of research (irrational bubble theory), is still much closer to the beginning, in terms of its research agenda, than it is to the end (Thaler 2005, Shleifer, 2000). The good news is that those who believe that markets are irrational are gaining more acceptance everyday and have a greater chance of influencing our future. As a result, the proposed model could play major role in future research in terms of quantitatively measuring the presence of bubbles caused by the market's participants interaction of irrationality without imposing the necessity of drawing any future bubble paths or making predictions.

As a final comment, I would like to acknowledge that there is no silver bullet cure for the problems associated with housing bubble identification, just as there is no magic drug to cure cancer. However, the least one can do is to use the best available methods to develop new approaches based on real-world assumptions rather than continuing to apply methods based on antiquated and unrealistic theories and assumptions.

9.8 References

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9.9 Appendix A - How to apply the algorithm? (real data)

Recall that the thesis proposed method; utilises two models. The first (I) is used when the three-year moving average of income is positive, and the second (II) is employed when the three-year moving average of income is negative.

Model I

$$f(b) = \frac{\left[\left(\chi \left(w_\alpha + w_\beta + w_\gamma + w_\delta + \frac{1}{\varepsilon} \right) \right) \times \lambda \right]}{\omega} \geq \rho$$

Model II

$$f(b) = \frac{\left[\left(\chi \left(w_\alpha + w_\beta + w_\gamma + w_\delta + \sqrt{(\varepsilon)^2} \right) \right) \times \lambda \right]}{\omega} \geq \rho$$

Selected Data (2001,2002,2003)

Year	House Price	D/B Ratio	Gross Lending	Housing Completions	Income	H/P Income Ratio
	α	β	γ	δ	ε	λ
2001	10.5%	-1.5%	26.3%	0.5%	4.5%	3.40 Nominal Value
2002	19.8%	5.7%	18.8%	7.0%	4.0%	3.96 Nominal Value
2003	19.6%	14.1%	4.0%	4.9 %	1.6%	4.54 Nominal Value

Since the income variable (3-year moving average) is positive we use Model I.

Model I

$$f(b) = \frac{\left[\left(\chi \left(w_a + w_\beta + w_\gamma + w_\delta + \frac{1}{\varepsilon} \right) \right) \times \lambda \right]}{\omega} \geq \rho$$

Constants

$\omega = 100, \rho = 0.85, \chi = 2.$

Constants - Weights for the weighted-variables

- (α) House Prices = 0.35
- (β) D/B ratio = 0.35
- (γ) Gross Lending = 0.20
- (δ) Housing Completions = 0.10

Calculations

Selected Data (2001,2002,2003) Three-year moving average for 2003.

Year	House Price	D/B Ratio	Gross Lending	Housing Completions	Income	H/P Income Ratio
	α	β	γ	δ	ε	λ
2001	10.5%	-1.5%	26.3%	0.5%	4.5%	3.40 Nominal Value
2002	19.8%	5.7%	18.8%	7.0%	4.0%	3.96 Nominal Value
2003	19.6%	14.1%	4.0%	4.9 %	1.6%	4.54 Nominal Value

Step 1 – Calculation of the weighted moving averages

House Prices

$$w_a = \frac{(a_{t-2} + a_{t-1} + a_{t1})}{3y} \times 0.35$$

$$w_a = \frac{(\alpha_{\tau-2} + \alpha_{\tau-1} + \alpha_{\tau1})}{3years} \times 0.35 \Rightarrow \frac{(10.5 + 19.8 + 19.6)}{3} \times 0.35 \Rightarrow \left(\frac{49.9}{3}\right) \times 0.35 \Rightarrow 16.63 \times 0.35 = 5.82$$

D/B Ratio

$$w_\beta = \frac{(\beta_{t-2} + \beta_{t-1} + \beta_{t1})}{3y} \times 0.35$$

$$w_\beta = \frac{(\beta_{\tau-2} + \beta_{\tau-1} + \beta_{\tau1})}{3years} \times 0.35 \Rightarrow \frac{(-1.5 + 5.7 + 14.1)}{3} \times 0.35 \Rightarrow \left(\frac{18.3}{3}\right) \times 0.35 \Rightarrow 6.1 \times 0.35 = 2.13$$

Gross Lending

$$w_\gamma = \frac{(\gamma_{t-2} + \gamma_{t-1} + \gamma_{t1})}{3y} \times 0.20$$

$$w_\gamma = \frac{(\gamma_{\tau-2} + \gamma_{\tau-1} + \gamma_{\tau1})}{3years} \times 0.20 \Rightarrow \frac{(26.3 + 18.8 + 4.0)}{3} \times 0.20 \Rightarrow \left(\frac{49.1}{3}\right) \times 0.20 \Rightarrow 16.36 \times 0.20 = 3.27$$

Housing Completions

$$w_\delta = \frac{(\delta_{t-2} + \delta_{t-1} + \delta_{t1})}{3y} \times 0.10$$

$$w_\delta = \frac{(\delta_{\tau-2} + \delta_{\tau-1} + \delta_{\tau1})}{3years} \times 0.10 \Rightarrow \frac{(0.5 + 7.0 + 4.9)}{3} \times 0.10 \Rightarrow \left(\frac{12.4}{3}\right) \times 0.10 \Rightarrow 4.13 \times 0.10 = 0.41$$

Step 2 – Calculation of the three-year moving average of: Income and HP to Income Ratio

Income

$$\varepsilon = \frac{(Income\Delta\%_{t-2} + Income\Delta\%_{t-1} + Income\Delta\%_{t1})}{3y}$$

$$\varepsilon = \frac{(Income\Delta\%_{\tau-2} + Income\Delta\%_{\tau-1} + Income\Delta\%_{\tau1})}{3years} \Rightarrow \frac{(4.5 + 4.0 + 1.6)}{3} \Rightarrow \frac{10.1}{3} = 3.36$$

H/PI Ratio (nominal values)

$$\lambda = \frac{(HPI_{t-2} + HPI_{t-1} + HPI_{t1})}{3y}$$

$$\lambda = \frac{(HPI_{\tau-2} + HPI_{\tau-1} + HPI_{\tau1})}{3years} \Rightarrow \frac{(3.40 + 3.96 + 4.54)}{3} \Rightarrow \frac{11.9}{3} = 3.96$$

Step 3 – Application of the Algorithm

Model I

$$f(b) = \frac{\left[\chi \left(w_a + w_\beta + w_\gamma + w_\delta + \frac{1}{\varepsilon} \right) \times \lambda \right]}{\omega} \geq \rho$$

$$\Rightarrow f(b) = \frac{\left[\left(2 \left(5.82 + 2.13 + 3.27 + 0.41 + \frac{1}{3.36} \right) \right) \times 3.96 \right]}{100} \geq 0.85$$

$$\Rightarrow f(b) = \frac{[(2 \times 11.92) 3.96]}{100} \geq 0.85$$

$$\Rightarrow f(b) = \frac{(23.84 \times 3.96)}{100} \geq 0.85$$

$$\Rightarrow f(b) = \left(\frac{94.40}{100} \right) \geq 0.85$$

$$\Rightarrow f(b) = 0.944 \approx 0.94 > 0.85$$

$$\Rightarrow f(b) = 0.94 > 0.85 \rightarrow \text{Positive Bubble Signature}$$