Origins and Characteristics of Recent Residential Real Estate Bubbles

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Abstract

In this paper, I study various characteristics of five countries' bubbles, including those in Australia, Denmark, Ireland, the United Kingdom, and the United States, in order to better understand how these bubbles began and how they subsequently developed. I conclude that these bubble markets are often characterized by a rising home ownership rate, rapidly increasing housing starts, and quickly declining affordability. In addition, I discover that the size of a U.S. city's bubble can largely be explained by its median multiple, percentage of renters, and coastal location.

Keywords

real estate, bubble, residential, housing bubble

Cover Page Footnote

Introduction

A series of worldwide residential real estate bubbles peaked in a relatively short period between mid-2006 and mid-2007. While numerous countries were impacted, I focus on five countries whose data I found to be the most readily available, namely Australia, Denmark, Ireland, the United Kingdom, and the United States. The following chart shows real indexes for each country modified for comparability.
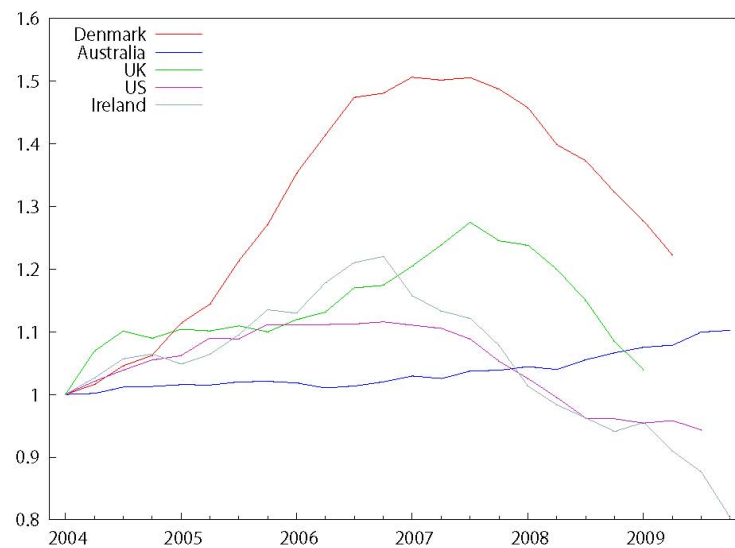
Notice that Australia is the only country whose home prices continue to rise. While it, thus, may not seem like a bubble at first glance, I will show that Australia's residential real estate market currently exhibits many of the characteristics displayed in the other four bubble countries before their bubbles burst.

The paper begins with a summary of some popular research and theories of real estate bubbles. The 'overview of housing bubbles studied' provides a summary of each of the residential real estate markets in the five counties I am studying, which includes a short synopsis and a timeline of events. Afterward, I analyze variables that may potential indicate that a housing

market is in a bubble, including housing starts, the construction PPI, the home ownership rate, and the mortgage interest rate, in the 'Analysis of various potential indicators in bubble markets'. I subsequently examine other interesting characteristics of residential real estate bubbles in the 'analysis of housing affordability in housing markets' and 'patterns in the rising and falling of home prices in bubble markets' sections. After that, I examine the application of a popular theory that relates peaks in the stock market with peaks in the housing market to the latest housing bubbles in the 'relationship between peaks in home prices and peaks in the stock market' section. That is followed by an 'analysis of bubble size discrepancies across United States cities', which attempts to model the size of bubbles that large U.S. cities experienced using various city characteristics. Then, I evaluate the potential independence between commercial and residential real estate markets and its implications for the cause of their respective bubbles in the 'analysis of the relationship between commercial real estate and residential real estate in the United States'. Next, I summarize my conclusions from the preceding sections and their application to evaluating whether a bubble is forming in a housing market in the 'summary of factors that might indicate that a bubble is forming and other notable conclusions'. Afterward, I use my conclusions to evaluate the likelihood that the housing markets in Australia and Canada, which have recently experienced remarkable real price growth, are in bubble states in the 'application to potential bubble markets'. The exhibits referred to throughout the paper are listed in the chronological order of their mention in the 'exhibits' section.

Literature review

The Definition of a Bubble

Robert Shiller, the famous asset bubble researcher and co-creator of the Case-Shiller home price index, defines a speculative bubble as "a situation in which news of price increases spurs investor enthusiasm, which spreads by psychological contagion from person to person, in the process amplifying stories that might justify the price increases and bringing in a larger and larger class of investors, who, despite doubts of the real value of an investment, are drawn to it partly through envy of others' successes and partly through a gambler's excitement." (Shiller 2) This definition lays out the course of the rise of a bubble and explains how simple expectations of price increases, founded on recent price increases, can lead to further future price increases, which continues to fuel what Alan Greenspan calls "Irrational Exuberance". (Shiller 2) Another widely used definition of an asset bubble is the condition where the market price of an asset rises above its fundamental value. Of course, it can be very difficult to estimate the fundamental value of an asset, even in the tangible real estate market. While the current replacement cost of the building portion of a piece of a real estate property can be easily calculated, the land plot is unique and thus does not have a replacement cost. Hence, the land plot is best valued by the forces of supply and demand, which consequently determines its market price. Still, in order to sort out the true fundamental value of real estate, one must tease out the portion of the market price that may be due to speculative hype. Thus, both definitions require the challenging task of identifying speculation in the real estate market to determine whether a bubble is forming.

Sudden increases in overall real estate prices have been justified by some on the basis that the increases are due not to speculation, but rather changes in supply and demand, which would lead to a fundamental appreciation. Despite unprecedented rises in home prices around the

world, the 2005 OECD Economic Outlook stated, "While concerns have been expressed in several quarters about high housing prices, the evidence examined here suggests that overvaluation may only apply to a relatively small number of countries." ("No Housing Bubble in US, Says OECD.") The OECD thought that houses might be overvalued in the United Kingdom, Ireland, the Netherlands, Spain, and Australia, but not in Denmark or the United States. The report bases its conclusion regarding the United States on the fact that rents generally kept up with rising home prices in the early 2000s. ("No Housing Bubble in US, Says OECD.") In October 2005, current U.S. Federal Reserve Chairman Ben Bernanke stated before Congress, "U.S. house prices have risen by nearly 25 percent over the past two years, but these increases largely reflect strong economic fundamentals, such as strong growth in jobs, incomes and the number of new households." (Henderson)

Robert Shiller cites three arguments for the simultaneous rise in fundamental real estate value during the 2000 real estate boom that occurred in several areas around the world. These arguments point to increases in population (rightward shift in the demand curve), increases in production costs (leftward shift in the supply curve), and lowered interest rates (rightward shift in the demand curve) to justify the increase in the fundamental value of real estate. Shiller disputes the two former claims on the basis that the changes in these variables have been gradual and in line with past trends when real property prices were constant. He concedes that low interest rates may lead to some degree of home price appreciation. Still, he argues that low interest rates in the past have not been enough to spark a boom like in the 2000s. (Shiller 11-12) Shiller's home price index indicates that population, building costs, and interest rates have no significant bearing on real home prices. (Figure 1)

Long-Run Real Home Prices Stability

With a lack of fundamental factors to explain the residential real estate booms in the 2000s, Shiller emphasizes the importance of looking at past trends in the real estate market. Unfortunately, only one real estate boom, during the period after World War II, has occurred in the past 100 years and Shiller says that bubble was fundamentally different than the recent U.S. bubble. (Figure 1) Shiller argues that, with the exception of a bust (1918) and boom (1945) cycle, U.S. real home prices appear to be relatively flat over a 100 year period. (Shiller 20, see Figure 1) He explains that the decline in U.S. home prices after WWI was a result of a severe influenza pandemic. (Shiller 14-15) This, of course, cannot explain the dramatic fall in home prices that began in 2007.

While the long-run trend cannot be compared to many other countries since very few real estate indices for other countries go back before the 1990s, Shiller examines one exception. After analyzing an index of the price of homes along a canal in Amsterdam, which was computed from 1628 to 1973, Shiller concluded that, though the index displayed substantial volatility, there was only a 0.2% average annual real price appreciation over the entire period. (Shiller 21) As further evidence of a lack of substantial real home price appreciation, Shiller points out that, since more and more children are moving out of their parents' homes before marriage, U.S. real home price growth must have been less than real per capita income growth, which was 2.0% a year from 1929 to 2003." (Shiller 22) If it is true that real home prices have historically hovered around a constant level, the residential real estate booms in the 2000s would seem to have no other explanation than speculation.

Notions of Appreciation

In order for speculation in the housing market to occur, homebuyers must somehow expect home price appreciation to continue long enough to create a buy-low/sell-high profit opportunity. Shiller argues that, while the past trend in home prices may be somewhat accurate in predicting future prices in the short-run, real estate is less susceptible to short-run speculation than the stock market since it is far less liquid. On the other hand, Shiller says that only "roughly half of the variability of home prices can be predicted one year ahead." (Shiller 14) Hence, when it comes to predicting home prices five to ten years out, which is more relevant to most home buyers, past trends become very poor predictors. (Shiller 14) If the exploitation of short-run trends in real estate is impossible and long-run real home prices are flat, it is perplexing that so many homebuyers were wrongly viewing their home as a high-return financial investment before the 2007 bursting of the housing bubble. Shiller argues that homebuyers probably founded their notion of perpetual home appreciation on the trend in *nominal* prices that they had paid for homes over many years. Compared to the stock market, where stock splits keep many stock prices steady in the long-run, housing might give the impression that it is a good investment in nominal terms, when, in reality, home prices are simply keeping up with inflation. The fact that many homebuyers do not deduct money spent on home improvements from their analysis of home price appreciation further explains their mistaken belief. (Shiller 20)

Karl Case and Robert Shiller attempt the daunting task of measuring homebuyer speculation by surveying households on their "expectations, understanding of the market situation, and behavior." (Case Shiller 319) Their 2003 survey of 700 households is conducted in high-bubble cities including Los Angeles, San Francisco, and Boston, as well as a low-bubble city, Milwaukee, as a control. (Case Shiller 320) The results show that, in Milwaukee and San

Francisco, "investment was a major consideration for a majority of buyers." (Case Shiller 321) They also point out that housing was viewed as carrying very little risk as an investment in the four cities studied. They argue that homebuyers' perception of housing as an investment, especially one of low-risk in nature, is a fundamental reason why bubbles form. The idea of investing in housing is identical to speculating that the home price will appreciate. (Shiller 319-321) Indeed, Case and Shiller's survey reveals that about 90% of respondents believe that housing prices in their city would increase over the next several years. Even more astounding is the degree of expected appreciation. Respondents in the cities studied predicted an average of 7 to 11 percent appreciation in the value of their homes over the next year. While Milwaukee, the control low-bubble city, did not differ substantially from high-bubble cities in many of the aforementioned respects, it does break away slightly when it comes to homeowners' ten year outlook on appreciation. While high-bubble cities' estimates hover around 14%, Milwaukee homeowners estimate a rise of 12%. Milwaukee homeowners were also less likely to agree with the claim that "Housing prices are booming. Unless I buy now I won't be able to afford a home later." (Case Shiller 223-324) This latter point is interesting in that some homebuyers were actually drawn to buy unaffordable housing out of the very fear of not being able to afford a home in the future. Milwaukee homeowners were less likely to discuss conditions in the housing markets frequently with friends and associates over the last few months as well. (Case Shiller 323-324) Thus, it seems that, while attitudes across all four cities were very optimistic in regards to the home appreciation, the bubble cities tended to be slightly more optimistic overall. Thus, bubble size appears to be positively related to speculation. Indeed, all four cities experienced entered some degree of a bubble state in the 2000s as a result of homebuyers' optimistic speculation.

With many seemingly relevant factors, such as population and production costs, failing to explain changes in home prices, the predictability of real estate bubbles is contested among economists. It can be difficult to distinguish between fundamental appreciation, pure speculation, and a working together of the two. Case and Shiller's method of surveying homeowners in booming areas seems a hopeful solution. Changes in more concrete variables, such as affordability measures, housing starts, and the home ownership rate may also indicate that speculation is occurring before the burst of the housing bubble.

Trying to Measure Speculation

Affordability measures are perhaps the best indicator of speculation in the housing market. Chris Martenson actually bases his definition of a bubble on affordability, stating that "a bubble exists when asset price inflation rises beyond what incomes can sustain." (Martenson) Indeed, affordability, or lack thereof, appears to have been an issue in the most recent real estate bubbles. Karl Case and Robert Shiller write, "Since 1995, U.S. housing prices have been rising faster than incomes and faster than other prices in virtually every metropolitan area." (Case Shiller 303). Even during the 2001 recession and period of concurrent rise in unemployment, housing starts and home prices continued to increase. (Case Shiller 304) Case and Shiller also remark that many of the respondents claimed to have dedicated an increasing portion of their net worth to homeownership in response to high volatility in the stock market since 2000. (Case Shiller 332) In the "analysis of various potential indicators in bubble markets" and "analysis of housing affordability in bubble markets", I examine housing affordability, housing starts, and the home ownership rate during the rise of the housing bubble in the five countries that I have chosen to study.

Lags in the stock market may also have some prediction power in some countries. While Shiller argues that no relationship exists between stock market booms and real estate booms in the United States, he writes that "a recent Bank of International Settlements study of house prices in thirteen industrialized countries concluded that peaks in the housing market tended to follow peaks in the stock market with an average lag of about two years." (Shiller 14-15) Thus, peaks in the stock market could potentially be used to predict how long home prices would continue to rise. I test this assertion for the recent residential real estate peaks in the five countries studied.

Characteristics of Bubbles

Even if real estate bubbles cannot be predicted beforehand, it is interesting to study and compare them after the fact to see if any common traits can be found. One characteristic that several economists claim exists across asset bubbles of all sorts is symmetry between the magnitude and time horizon of the boom and bust phases. In 2006, Charles Hugh Smith predicted that U.S. home prices would fall in symmetry to their ascent based on the pattern of the NASDAQ between 1997 and 2003. He also claimed that U.S. real estate prices would actually fall below the pre-bubble level, just as the Nasdaq did in late 2002. (Smith) Chris Martenson also supports the claim that asset bubbles are generally symmetrical. He states, "They (bubbles) are roughly symmetrical in both time *and* price. That is, however long it took to create the bubble is roughly the amount of time it will take to unwind the bubble, and prices usually get fully retraced, if not a bit more." (Martenson) Martenson cites the 1720 South Sea Company bubble, the Dow Jones around the stock market crash of 1929, GM stock between 1912 and 1922, and Intel between 1992 and 2002 as evidence of his claim. I will examine the extent that the symmetry phenomenon holds in the five countries I have chosen to study.

Bubbles in Cities

While I spend most of the paper examining bubbles at the national level, I also look into characteristics of some large U.S. city bubbles. Robert Shiller, whose home price index is published monthly for twenty United States cities, points out that regional bubbles frequently occurred close to new railroads, canals, and other large construction projects around the turn of the 19th Century. (Shiller 15) In these local cases, it would seem that the fundamental value actually does rise with the existence of better infrastructure and more employment opportunities. Still, as Shiller points out, these areas are subject to a great deal of land speculation at the announcement of such construction projects. (Shiller 15)

Robert Shiller argues that the biggest city bubbles occur in "big glamour cities", where there is an international real estate market. (Figure 2) In Shiller's short list of international cities where residential real estate booms occurred, he cites cities in all five countries that I am examining including London, Dublin, Sydney, Copenhagen, and several cities in the United States. (Shiller 18) Thus, the existence of international real estate speculation might explain the simultaneous real estate bubbles that occurred across many countries with 'international cities' in the 2000s. I will look at various city characteristics, including size, that might lead one city to have a larger bubble than another city using Case-Shiller home price indexes for twenty large U.S. cities.

The Relationship between Commercial and Residential Real Estate

There is a debate among economists regarding the independence and causes of the United States residential real estate bubble and the commercial real estate bubble. While University of Chicago economist Casey Mulligan argues that the commercial real estate bubble was a result of the bubble in the residential real estate market, economist Paul Krugman claims that, since the bubbles are so similar in shape and moved together, they must both be rooted in a common cause,

such as banks' increased tolerance of risk. (Mulligan) While this paper focuses on residential real estate bubbles, the relationship between the United States commercial and residential real estate bubbles may have repercussions on the plausibility of popular theories on the origin of the residential real estate bubble. For instance, if the bubbles are, in fact, independent (one did not cause the other), then it is very likely that these bubbles, which both occurred in roughly the same period and represent the largest bubble in their respective markets in the past one hundred years, had a common primary cause which cannot be associated with just one market. Thus, the housing bubble could not be blamed completely on Fannie Mae and Freddie Mac's actions to promote lending to subprime residential borrowers. (Mulligan) As Paul Krugman writes, "It gives the lie both to those who blame Fannie/Freddie/Community Reinvestment for the housing bubble, and those who blame predatory lending. This was a broad-based bubble." (Krugman-"CRE-ative Destruction") Thus, the relationship between the two markets' bubbles may have implications for policy.

Mulligan argues that the housing boom led to higher residential construction, which took resources, such as land, labor, and physical materials, away from commercial construction. (Mulligan) He points out that nonresidential construction spending only began to take off as residential construction spending was reaching its peak. (Figure 3) Thus, the residential and commercial real estate bubbles have very different cycles with regards to construction and are, therefore, probably not the result of a common cause. Furthermore, the consecutive pattern in residential and commercial construction spending may indicate that the commercial bubble formed as a result of higher residential construction driving up the price of construction inputs and, therefore, the price of commercial property as well since the fundamental property value should reflect the cost of construction. Mulligan mentions that conversions of commercial

buildings into residential buildings were common during the housing boom to illustrate that even commercial land could be driven up in value as a result of the housing boom. (Mulligan) Thus, this increase in fundamental value could have set off speculation in the commercial real estate market, which would increase commercial property values artificially and subsequently lead to more commercial construction as input prices fell with the fall in residential housing construction spending.

Krugman, in contrast to Mulligan, argues that the residential and commercial real estate bubbles had a similar cause, but that one did not cause the other. He points the finger at financial deregulation, which allowed investment banks to lever themselves too highly. This led to a large increase in the supply of lending to both residential and commercial real estate borrowers. Krugman also argues that demand for innovative ways of raising money was inflated along with supply because banks hid the risks of their complex financial innovations. In response to claims that the housing bubble was caused by the Community Reinvestment Act, Krugman states that the act had been around long before the bubble, that many subprime lenders weren't covered, and that Fannie Mae and Freddie Mac were actually cutting back lending during the bubble's most rapid appreciation. (Krugman-"Six Doctrines in Search of a Policy Regime")

Overview of housing bubbles studied

This paper studies bubbles in Australia, Denmark, Ireland, the United Kingdom, and the United States to examine common characteristics between the bubbles. Still, there are certain characteristics, such as government policies, that are unique to each country. This section includes a short summary and timeline of events for country's bubble to highlight their idiosyncratic traits.
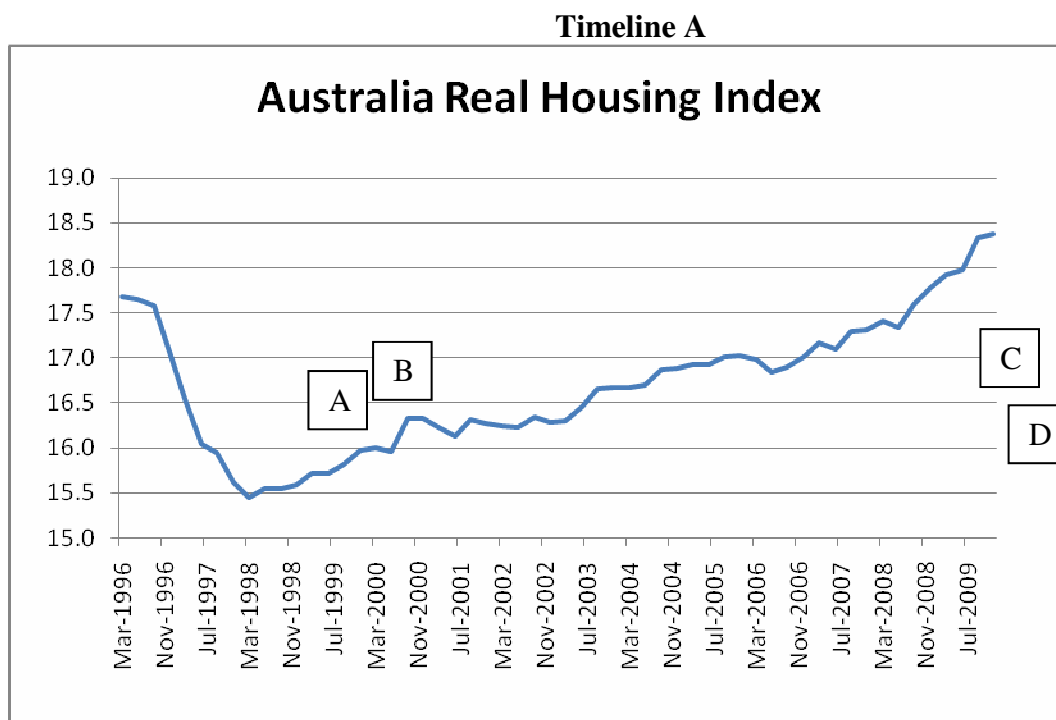
Australia

Australia has experienced real home price appreciation of 20% since 1998, compared to the United States' real appreciation of 45% between 1998 and the 2006 peak. The gain has probably been the result of government policy changes occurring around 2000 that propelled potential homebuyers to enter the market. It appears that Australian first time homebuyers who bought a home in response to a $14,000 government grant are now struggling to make mortgage payments as the central bank raises interest rates. A recent survey conducted by Fujitsu Consulting found that 45 percent of first-home owners who entered the market between July 2008 and January 2010 are experiencing "mortgage stress" or "severe mortgage stress". University of NSW economist Steve Keen stated, "The grant panicked first-home buyers to rush into the market, which pushed prices up by far more than the grant itself." (Shedlock)

Notice the steep decline occurring between 1996 and 1998 in the chart below. Australia's home prices boomed in the late 1980s and then fell 22% throughout the 1990s. Hence, it might seem that Australia's home prices are merely catching up to their pre-1990s crash prices. Still, while the 1980s boom did not coincide with a lack of housing affordability (median multiple = 3.0), today's home price appreciation is causing a severe decline in affordability. (Shedlock)

The 2009 6th Annual Demographia International Housing Affordability Survey ranked 12 Australian cities among the top 20 severely unaffordable housing markets, which places Sydney at number 2 on the list. In fact, Australia was assigned a national median multiple (median home price/median household income) of 6.8 compared to 5.1 in the United Kingdom, 3.7 in Ireland, and 2.9 in the United States. The larger the median multiple, the less affordable homes are and the less sustainable the appreciation is. A ratio of 3.0 or lower is considered affordable. This strongly suggests that Australia's housing boom is probably unsustainable. It

seems that the price of housing has been driven up by government subsidies, which have encouraged homebuyers to buy homes that they cannot afford. Westpac, a large Australian bank, recently cut its maximum loan-to-value ratio for new customers to 87 percent, which is lower than its previous maximum of 92 percent. This seemingly small change substantially reduces the amount a homebuyer can borrow with a given down payment. Thus, if other banks begin to tighten their lending standards, demand for housing may fall, ending the Australian housing boom. (Shedlock)

Timeline A

A: 1999- the capital gains tax on housing is discounted from 100 to 50 percent for property held at least one year. ("Australian Property Bubble.")
B: 2000-The burst of the dot com bubble leads many investors to switch to real estate. The RBA begins to lower interest rates until 2002 The First Home Buyers Grant is established and was set at $7,000 for established homes, $14,000 for newly built homes. ("Australian Property Bubble.")
C: October 2009- the First Home Buyers Grant begins to be rolled back. A UNSW City Futures Research Centre director says "the boost has resulted in inflated prices" and had created "a bit of a mini-bubble". Unemployment surprisingly drops to 5.7%. The RBA increases interest rates by 0.25%, and indicates further rises in the future. ("Australian Property Bubble.")
D: January 2010- The First Home Buyers Grant expires. Mortgage applications fall by 21.2%. The economist says the Australia housing market is overvalued by 50%. ("Australian Property Bubble.")

Denmark

Denmark's property bubble began in 2004 and peaked between 2006 and 2007. Over this period, the average real price of single-family and terrace houses increased by 47%, compared to the United States' real appreciation of 27% during the same time period. The boom may be partially attributable to low interest rates, new mortgage products, and high economic growth. While the price of owner-occupied flats peaked in the third quarter of 2006, the price of single-family and terrace homes peaked exactly one year later. Since the peak in single-family homes, real prices have fallen by 15.7%. ("Denmark Price History-Resilient Mortgage Market Cushions House Price Falls.")

The global Property Guide claims that, in Denmark, rent controls have been influential in discouraging renting from a supply perspective while mortgage tax relief and a standard deduction for home maintenance encourage citizens to own their home. As a result, 51% of Denmark's housing is owner-occupied. Still, the Denmark rate is low compared to the 68% owner-occupancy rate in both the United States and the United Kingdom, ("Percent of Occupied Housing Units That Are Owner-occupied (most Recent) by State.", "68% of UK Houses Now Owner-occupied.") The Global Property Guide claims that Denmark has a very strict and structured process of issuing mortgages, which allows it to reduce the overall riskiness of the mortgage and maintain a functional mortgage market during recessions. As a result, the growth in the Danish mortgage market has outpaced Denmark's economic growth. Outstanding lending grew 11.7% in 2005, 10.2% in 2006, 9.8% in 2007, and 7.6% in 2008. When Denmark went into a recession in 2008, homebuyers either saved more or consumed in areas other than housing. ("Denmark Price History-Resilient Mortgage Market Cushions House Price Falls.")

Timeline B
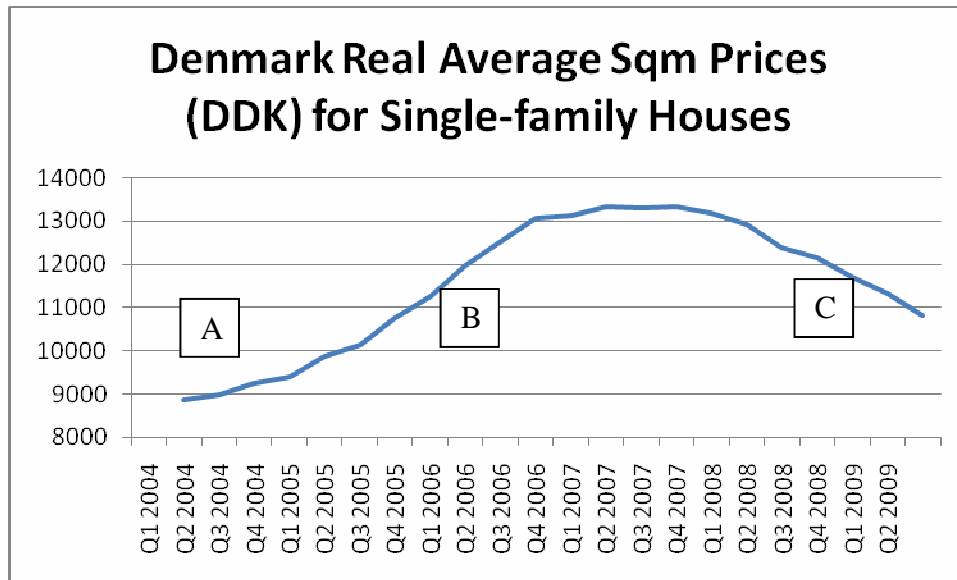
A: June 2004-The Economist adds Denmark to its list of countries experiencing the highest rises in real estate. (Gibson Perrot)

B: February 2006-The Danish Financial Supervisory Authority sends a letter to all Danish credit institutions, warning that a potential price bubble may be forming and that, in conjunction with the significant growth in mortgage loans in recent years, it could lead to significant losses if the bubble were to burst. ("DFSA Warns Credit Institutions About Potential Price Bubble.")

C: October 2008- A period of rising bankruptcy begins; Bankruptcies increase 77% over the next year. Wholesalers, retailers, construction, real estate development, and financial services companies were particularly vulnerable. ("Denmark.")

Ireland

Between 1998 and 2006, real prices of new homes rose by 150%, compared to an increase of 45% in the United States, even while the number of houses in the economy grew by 150%. The real prices of existing homes, which tend to be closer to employment centers, rose by about 350%. Over this same period, annual housing completions grew from about 23,000 to 93,000. (Malzubris) Jānis Malzubris, the European Commission on Economic and Financial Affairs' Country Focus Directorate for the Economies of Member States, attributes the appreciation to "particularly strong housing demand fuelled by a relatively young and growing population, rapid growth in real disposable income, low (and at times negative) real interest rates, favourable tax treatment of residential property and house purchase for investment purposes." (Malzubris) Overvaluation of homes at the peak of the bubble is estimated to be between 20 and 40 percent. With 10% of the country's output composed of residential construction, the bursting of the bubble has peeled back the Ireland's GDP growth. (Malzubris)

Timeline C

Ireland Real ESRI National Home Price Index
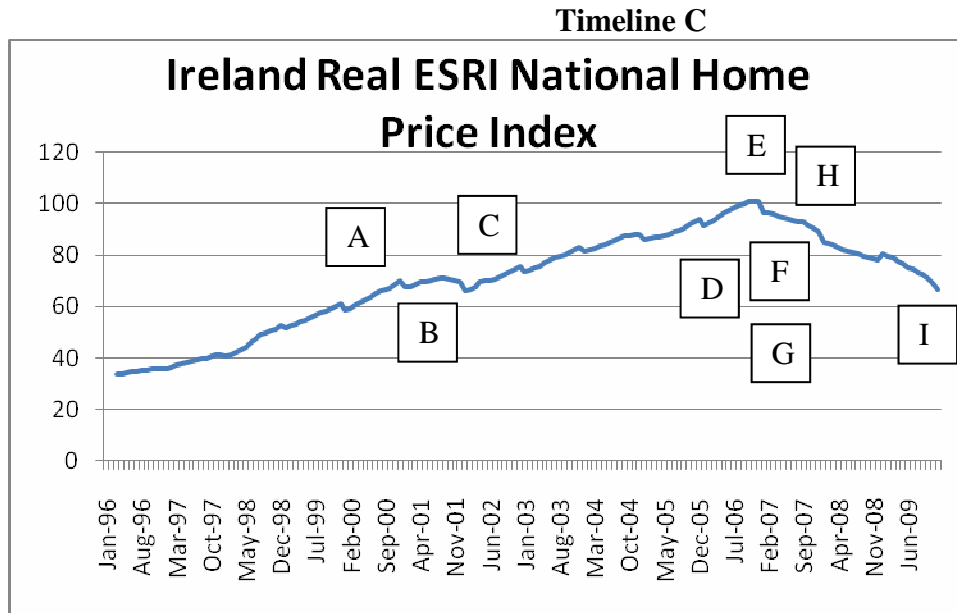
A: 2000-IMF reports Irish property prices are unlikely to grow strongly for long, judging by appreciation patterns in other countries. ("Irish Property Bubble.")

B: 2001-the Financial Regulator is created. ("Irish Property Bubble.")

C: 2002-Ireland switches to Euro, whose interest rates were lower than those in Ireland. ("Irish Property Bubble.")

D: November 2005-The OECD and officials at the Central Bank and Financial Services Authority of Ireland agree that Irish property is overvalued by 15%. ("Irish Property Bubble.")

E: April 2006-Central Bank says the housing boom may be unsustainable and poses a significant risk to the economy. ("Irish Property Bubble.")

F: November 2006-Central Bank estimates Irish residential property market is overvalued by 0-60%. ("Irish Property Bubble.")

G: December 2006-Public broadcasting organization, RTE, broadcasts an investigation revealing evidence that financial details of prospective customers were being sold by mortgage brokers to auctioneers, allowing auctioneers to charge prospective buyers the maximum price they are willing to pay. ("Irish Property Bubble.")

H: July 2007-Dublin agents reported to offer no mortgage payments for six months to avoid lowering the recorded sales price. ("Irish Property Bubble.")

I: May 2009-unemployment rate reaches 11.4% ("Irish Property Bubble.")

United Kingdom

The United Kingdom experienced a dramatic housing boom followed by an almost equally dramatic burst in mid-2007. Peter Woodifield writes that, "U.K. residential real estate had almost tripled in value during the decade before the credit crunch. The gains encouraged more Britons to pour borrowed money into homes and more "buy- to-let" investors to acquire property for rental income." (Woodifield) During the boom, the average house price to earnings ratio, which has a long-time average of 3.7, had increased to 6.2. This decline in affordability was partially due to banks' willingness to loan as much as five times a borrower's salary. In fact, the typical down payment required of homebuyers, which is now a high 25 percent, was only 5 percent during the peak of the housing boom. According to a Bloomberg survey, U.K. home prices, which fell by 23 percent from September 2007 to November 2009, may not return to their 2007 peak prices until 2014. Capital Economics housing economist Seema Shah still believes that the market is overvalued and that prices need to fall between 20 and 25 percent to get back to the long-term trend. (Woodifield)

Timeline D

United Kingdom Real Housing Index
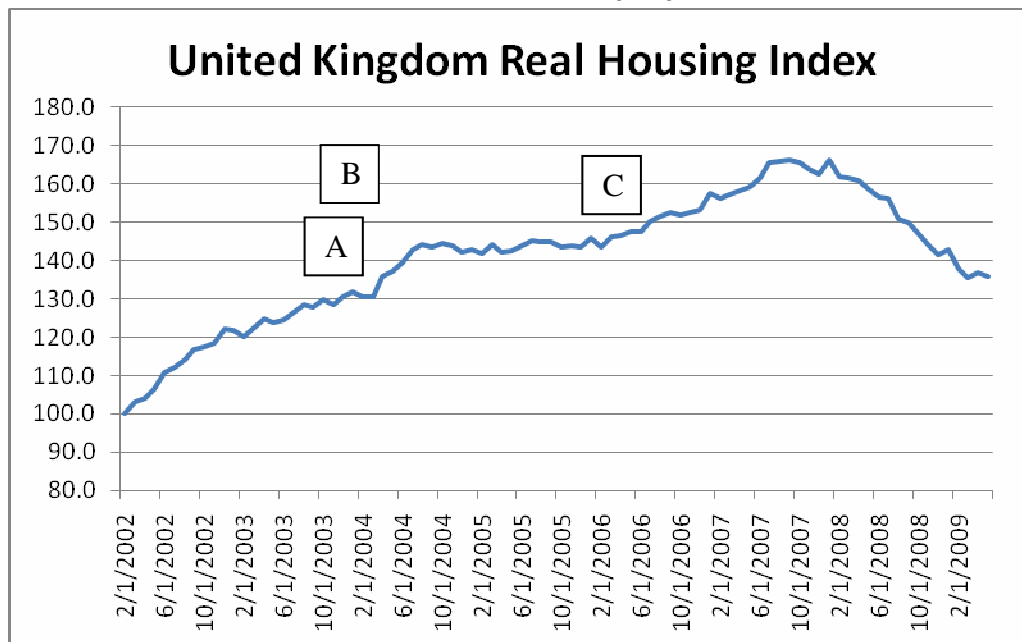
A: November 2003- the Bank of England begins its ten month quest to burst the housing bubble by taming property prices, increasing interest rates five times over the period. (Kennedy)
B: December 2003 - The British Government commissions Kate Barker to issue a report on the lack of supply in the housing market. It concludes that building an additional 70,000 houses would need to be built each year to reduce the real home price rise to 1.8% annually and that 120,000 additional houses would have to be built each year to reduce long term house price inflation to the European Union average of 1.1%. ("Affordability of Housing in the United Kingdom.")
C: 2006- The ratio of lower-quartile house prices to lower-quartile earnings, an affordability measure, reached a level of 7.1 in from 4 in 2000. ("Affordability of Housing in the United Kingdom.")

United States

Real residential real estate prices in the United States grew by 45% between 1998 and 2006. The initial appreciation may have been caused by low interest rates, lower lending standards, and higher incomes, all of which would tend to increase demand for housing. According to Ahorre.com, "In 2005, 1,283,000 new single-family houses were sold, compared with an average of 609,000 per year during 1990–1995." ("U.S. Housing Bubble 1997 2005.") While citizens were buying more homes, they were also borrowing more on the basis of home equity. The Federal Reserve estimates that homeowners borrowed $750 billion of equity from their homes in 2005 compared to $106 billion in 1996. ("U.S. Housing Bubble 1997 2005.") When prices began to fall, the "cities and regions that had experienced the fastest growth during 2000–2005 began to experience high foreclosure rates." ("U.S. Housing Bubble 1997 2005.")

Timeline E
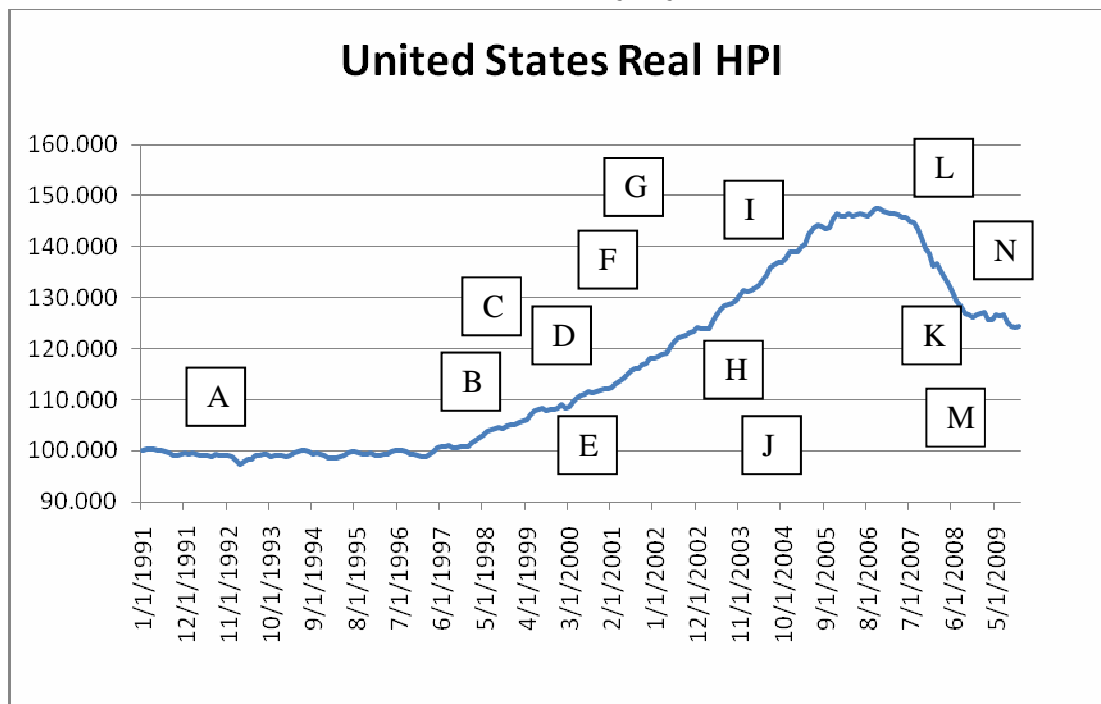
A: 1992- the Federal Housing Enterprises Financial Safety and Soundness Act of 1992 requires Fannie Mae and Freddie Mac to devote a percentage of its lending to support affordable housing

by increasing its pooling and selling loans as securities. (Swinney)

B: July 1997- The Taxpayer Relief Act of 1997 repeals the Section 121 exclusion and section 1034 rollover rules, and replaces them with a $500,000 married/$250,000 single exclusion of gain on the sale of a home, available once every two years. (Swinney)

C: November 1997- First Union Capital Markets and Bear, Stearns & Co launch the first publicly available securitization of Community Reinvestment Act (CRA) loans, issuing $384.6 million of such securities, All guaranteed with regard to timely interest and principle by Fannie Mae. (Swinney)

D: September 1999- Fannie Mae eases credit requirements to encourage banks to extend home mortgages to individuals whose credit is not good enough to qualify for conventional loans. (Swinney)

E: March 2000- the NASDAQ peaks and, thus, the burst of the dot-com bubble begins. (Swinney)

F: November 2000- Fannie Mae announces that the Department of Housing and Urban Development would soon require it to dedicate 50% of its business to low- and moderate-income families. (Swinney)

G: 2001-US Federal Reserve lowers Federal funds rate 11 times, from 6.5% to 1.75%. (Swinney)

H: 2003-Fannie Mae and Freddie Mac buys $81 billion in subprime securities. (Swinney)

I: June 2003- Federal Reserve Chair Alan Greenspan lowers federal reserve's key interest rate to 1%, the lowest in 45 years. (Swinney)

J: December 2003- President Bush signs the American Dream Downpayment Act, which provides a down payment assistance grant. In addition, the Bush Administration commits to reforming the home buying process in order to lower closing costs by approximately $700 per loan. (Swinney)

K: April 2007-New Century Financial, largest U.S. subprime lender, files for chapter 11 bankruptcy. (Swinney)

L: September 2007-Television finance personality Jim Cramer warns Americans on The Today Show, "don't you dare buy a home—you'll lose money…" (Swinney)

M: October 2007- A consortium of U.S. banks backed by the U.S. government announces a "superfund" or "super-SIV" of $100 billion to purchase mortgage-backed securities whose mark-to-market value plummeted in the subprime collapse. The fund is officially abandoned one month later due to a lack of demand for risky mortgage products. (Swinney)

N: July 2008- Housing and Economic Recovery Act of 2008 changes the $250,000/$500,000 capital gains exclusion so that it only applies to primary residencies and no longer to second homes and rental properties. (Swinney) ("Summary of Key Provisions of H.R. 3221 - The Housing Stimulus Bill.")

Analysis of various potential indicators in bubble markets

Housing starts

I find, just as Case and Shiller did, that housing starts rose quickly during the United States real estate bubble. (Figure 4) Housing starts in England, used as a proxy for unavailable United Kingdom housing starts, also rose quickly during the U.K.'s bubble. (Figure 5) In addition, Ireland housing starts, using completed housing in the year forward as a proxy, rose very quickly during its bubble. (Figure 6) On the other hand, housing starts in Australia appear to be quite random during its most recent period of rapid home appreciation. (Figure 7) This may indicate that Australia's home price appreciation is due more to a lack of supply. Perhaps there is a constraint that is keeping houses from being built, such as a limited land supply in big cities. If this is the case, then Australia's home appreciation may actually reflect fundamental appreciation rather than bubble-like speculation.

As with growth in debt service to disposable income per capita, variation in housing starts can have several interpretations. Housing starts may increase gradually over time due to changes in culture. For instance, children that used to live with their parents until marriage may begin to move out ahead of time. Note that this particular cultural change would probably lead to an increase in debt service to disposable income per capita as well since more money would be spent on building new apartments and houses. Another explanation for an increase in housing starts might be a growing preference toward building a custom new home rather than a preoccupied dwelling. These cultural changes would likely manifest themselves as a gradual increase in housing starts and it is, therefore, doubtful that they would account for suddenly rapid expansion. Population growth may also account for gradual growth in housing starts.

One explanation for faster growth in housing starts could be lower costs of inputs to housing production, which would lead to a lower cost to consumers to construct a house. This explanation, of course, does not consider the land value of real estate. In addition, it does not hold in the most recent United States bubble, where the construction PPI is generally increasing during housing start growth, albeit at a slower rate. (Figure 4) The fact that the two variables are in reality positively correlated might indicate that the rapid growth in the construction PPI between 2004 and 2006 was actually caused by a continued spike in housing starts, which continued to increase demand for housing construction inputs. A sharp increase in housing starts could also be the result of legislation that encouraged homebuyers to build a home, or more generally buy a home, such as the popular first-time homebuyer credit. The first-time homebuyer credit in the United States was probably partially responsible for stopping the sharp decline in housing starts between 2006 and 2009. (Figure 4) In Australia, when the First Home Buyers Grant was passed in July of 2000, housing starts soon stopped declining and quickly returned to the historic average. (First Home Owner Grant General Information) (Figure 7) (Timeline A-p.17)

Of course, the most likely explanation for the large sustained growth in housing starts in the United States, United Kingdom, and Ireland is the same explanation for the explosive growth in debt service to disposable income per capita: as Case and Shiller's 2003 survey indicates for homeowners in the United States, more and more people saw housing as an investment. This belief seems to have led potential homeowners to buy a home before they normally would to avoid missing out on the seemingly high rate of return. Still, while housing starts were generally increasing from 1990 to 2006 in the United States, debt service to disposable income per capita did not begin to rise substantially until the late 1990s. (Figure 4) This discrepancy in the patterns of the two variables is probably due to large increases in income during the 1990s. Thus, even

while housing starts were rapidly growing in the 1990s, the share of income dedicated to housing was not changing all that much because incomes were keeping up with increases in mortgage payments. Perhaps this initial period of quickly rising income is what led to the initial steady rise in home prices which seems to have set off the large speculation of the 2000s. After all, real growth in home prices began just as the technology boom of the 1990s was beginning. (Figure 1) Furthermore, the only other period of rapidly increasing home prices, during and immediately after WWII, coincided with a period of great economic prosperity as well. Still, during the roaring 1920s, there was only a very small increase in home prices.

Speculation is what caused the most recent home price growth to be so extravagant. The question is why speculation was so widespread in the late 1990s and early 2000s, but largely nonexistent during other periods of rising incomes and home prices, such as WWII and the roaring 20s. While a rise in housing starts provides some good insight into how initial home price growth began in the U.S., it cannot explain why homebuyers expected home prices to continue to rise and, additionally, why they would put so much faith in this fallacy.

Construction PPI

Robert Shiller claims that building costs cannot explain real estate bubbles. Based on the trends in home prices and construction costs between 1890 and 1997, the two variables appear to be fairly positively correlated. (Figure 1) However, once the United States housing market begins to exhibit bubble-like appreciation in 1997, the correlation disappears as construction costs remain relatively flat. Interestingly, the construction PPI calculated by the U.S. Bureau of Labor Statistics is correlated with nominal home prices even during the real estate bubble. (Figure 8) Still, a closer look reveals that the higher construction PPI values appears to be more of a reflection of U.S. home prices rather than a determining factor since home price appreciation

tends to lead PPI growth starting in mid-2001. During this period, growth in housing starts, which resulted from higher demand for housing, increased the demand for housing inputs. (Figure 4)

Unfortunately, construction producer price indexes are rare outside of the United States and it is, therefore, hard to confirm the United States trend as a general trend. The construction PPI is, however, available in Australia. As it turns out, the Australian construction PPI and nominal home prices have been growing at a remarkably similar rate since 1972. (Figure 9) In addition, neither variable appears to lead the other. Remember that housing starts in Australia over this period are extremely random; thus, the rising construction costs do not appear to be the result of a sharp increase in demand as is probably the case in the United States. As a result, the growth in the Australian construction PPI may join the lack of rising housing starts as a signal that rapid home price growth in Australia is actually a reflection of an increase in Australian homes' fundamental replacement value rather than speculation in the housing market.

Home ownership rate

The sustained growth in the United States home ownership rate that began in 1995 may provide an important insight into the origins of the United States residential real estate bubble. Notice that, while the start of growth in housing starts preceded the start of growth in the home ownership rate, real home prices did not begin to rise until after both variables had already begun growing. (Figure 10) Thus, perhaps the apparent real appreciation is not what initially led new homeowners into the market. In fact, it may be that the real appreciation in homes was actually partly the result of new homeowners suddenly entering the market for residential real estate, creating an increase in demand for property. Where did these new homeowners come from?

Either young U.S. citizens began buying homes at an earlier age or mortgage lenders discovered an untapped subprime market.

In fact, it is reasonable to believe that both factors contributed in this period. With regard to the first factor, the higher incomes as well as the stock-market gains of the 1990s would enable young people to afford to buy their own home sooner. At the same time, the 1992 Federal Housing Enterprises Financial Safety and Soundness Act, which required Fannie Mae and Freddie Mac to devote a larger percentage of its lending to support affordable housing through securitization, made it possible for banks to lend to subprime borrowers who had previously rented apartments. (Swinney) Of course, this initial increase in demand for housing helped cause a persistent increase in home prices that eventually sparked speculation that home prices would continue to rise. Speculation in the residential real estate market led even more new homeowners, both young prospective and subprime potentials, into the market. For young people contemplating buying a house, the upward trend in housing made them feel like they were missing out on a great investment if they rented instead. For subprime candidates, mortgage lenders were suddenly more willing to take advantage of these high-return, riskier borrowers because the collateral (the home) was expected to always be worth more than the outstanding principal. Of course, the expectations of home price growth became a self-fulfilling prophecy for awhile. Still, as the cycle continued, home appreciation became unsustainable because it required more and more new homeowners in order to continue. Thus, perhaps the United States real estate market crashed in 2007 because it ran out of new borrowers in 2004.

Mortgage interest rate

Robert Shiller points out that, although low interest rates may very well have some positive effect on home prices, they cannot fully explain the most recent United States bubble since periods of low interest rates in the past have not led to home appreciation of the recent bubble's magnitude. (Figure 1) On the other hand, the gradual appreciating effect of slowly diminishing mortgage interest rates on home prices may help account for the initial sustained home price growth that created the speculative idea that homes always appreciate. Low interest rates typically have a positive effect on home prices by making the total cost of holding a mortgage lower, which stimulates demand for housing. Interestingly, the United States is the only market where reduced interest rates might have played a major role in the real estate boom. (Figure 11) In the other countries studied, the housing bubble included at least one period of increasing interest rates. In fact, rises in interest rates during home appreciation in Ireland, Denmark, and the United Kingdom might be intentional efforts by the countries' central banks to 'pop' the bubble before it got any larger. In the United Kingdom, for instance, the central bank purposefully cuts rates for ten months straight beginning in November 2003 in order to tame appreciation. (Timeline D-p.23) In all three countries, the central bank's efforts (if indeed they were such) pay off after about two years when home prices eventually level off and begin a sharp decline. Still, the very beginning of the home price appreciation in Denmark, Ireland, the United States, and, to some extent, Australia and the United Kingdom coincides with falling interest rates. In Ireland, the fall in the mortgage interest rate between 2002 and 2006 resulted from the country's transition to the Euro. (Timeline C-p.21) Together, the diminishing effect of increasing interest rates and the enlarging effect of lower interest rates may play some role in creating and

bursting bubbles. Nevertheless, the graphs show that the correlation is very weak. Another factor, such as speculation, must be driving home appreciation.

Analysis of housing affordability in bubble markets

Many economists have examined the pattern of various affordability measures during the rise of real estate asset bubbles. The ideas is that, when affordability continues to decline amid prolonged rising prices, a bubble is likely to be forming because home prices are not supported by rising income and are, therefore, unsustainable. Martenson, Case, and Shiller all point out that rises in home prices did indeed far outpace rises in incomes before the burst of the housing bubble.

One often used affordability measure, which I have chosen to test, is nominal housing debt service to disposable income per capita. This variable represents the share of disposable income that the average household has devoted to spending on housing. As a share of income, this number cannot continue to rise forever since it is limited to 100% of income. Really any substantial rise in this variable would seem unusual since households must also dedicate shares of their spending to other necessities such as food, utilities, and transportation. A sustained increase in this variable would seem to indicate that households, on average, have decided to spend more on housing and either consume less in other spending categories or save less.

Although there may be many reasons for this trend, I assume that there are three main reasons why households might generally choose to dedicate more disposable income to housing. First, since some amount of spending on housing is a necessity, a rise may signal that the cost of housing is escalating. The higher cost of housing may be a result of higher mortgage interest

rates, higher costs of production, or increased demand due to high population growth in an area. Second, it might be a legitimate change in preference toward housing where households genuinely wish to spend more excess income on a living in a nicer house and, as a result, less on driving a nice car or buying other luxuries. As Elliott Wave International, a financial news website, puts it, "Maybe that's what consumers spend money on now – houses and condos instead of clothes and shoes?" ("Listen To The Market") Finally, households may increase their share of spending toward housing as a result of speculation in the price of housing. If the real price of housing is expected to increase persistently, which seems to be the attitude of 1990 and 2000 buyers and realtors, then people may decide to spend more on housing as a result of its dual function as living quarters and an investment.

As Case and Shiller's 2003 homeowner survey points out, many homeowners did in fact view housing as a safe high-return investment in the midst of the housing boom. When households start to think this way and, as a result, spend more money on housing, the price of housing does in fact rise due to an increase in demand. This creates a high return on housing in the short-run, which serves as a kind of deceiving proof for the claim that housing prices constantly outpace inflation. Hence, as the idea of housing as a high return investment is fueled, a larger and larger share of disposable income is dedicated to housing and, thus, housing prices appreciate more and more due to higher and higher demand. Consequently, just the belief that home price growth will perpetually outpace inflation can prove the claim true and actually exacerbate the returns on housing in the short-run. Hence, a bubble in the residential real estate market is particularly likely to form when a larger share of disposable income being spent on housing is being caused by the third speculative explanation.

To test my claim, I must use a proxy for housing debt service since, in most cases, it is unavailable. For all five of the five asset bubble cases studied, I use some form of total mortgage lending outstanding multiplied by some sort of average fixed mortgage rate. This number does not have a real economic interpretation, but its changes ought to represent corresponding changes in the proportion of disposable income that the average person spends on housing. In Denmark, the Danish Financial Supervisory Authority associated increasing outstanding mortgages with the existence of a bubble. (Timeline B-p.19) Indeed, quickly growing mortgages are typically the primary driver for increases in debt service to disposable income per capita. The actual variables used for outstanding mortgage lending and the mortgage interest rate differ somewhat across countries. For instance, the fixed mortgage rates are for loans of different durations. These differences might hinder the comparability of the magnitude of the change in debt service, since the yield curve will diminish the effect of a change in interest rate in countries for which I used a shorter duration mortgage rate; still, the overall direction of debt service will not be affected.

Finally, since many homes in any period are financed at prior-period fixed-rates, I use an adjusted interest rate to make the debt service calculation. This adjusted interest rate tries to proxy the average mortgage interest rate paid on outstanding mortgages in that period. It does so by taking a weighted average of the floating rate, using the current fixed rate as a proxy, and the average fixed interest rate over the past seven years, which is a proxy for the average rate that fixed-rate borrowers pay in the current period. I take the average over the past seven years primarily because most country's mortgage interest rate time series start seven years prior the start of the country's home index time series. Still, a seven year trailing average is reasonable based on the assumption that the average person lives in their home for about fourteen years across all countries surveyed and that homes are, on average, refinanced once. I assume that

homes are refinanced once in accordance with a homebuyer advice article that seems to imply

that most homes are refinanced once, while a few are refinanced twice. ("How Many Times Can

You Refinance A Mortgage") Finally, I use a 1:5 ratio of adjustable rate mortgages (ARM) to

total outstanding mortgages ratio to compute the current weighted average interest rate. John

Krainer, the senior economist at the Federal Reserve Bank of San Francisco, states that,

according to Freddie Mac, the average ARM share of mortgages in the United States between

1995 and 2009 was 20%. (Krainer) The final equation used to calculate the weighted average

interest rate is as follows:

Weighted average interest rate = 0.2*(current fixed interest rate) + 0.8*(average interest rate over the past seven years)

While the adjusted weighted average current interest rate approach cannot claim a high degree

of precision, it is necessary to tame the overstated decrease in affordability during periods of

quickly increasing interest rates, such as Paul Volker's 1971-1981 attack on inflation. If I were to

use the current unadjusted fixed interest rate, then debt service would automatically fall 25% if

the mortgage interest rate fell from 8% to 6%. In reality, the drop in the mortgage rate mainly

affects adjustable rate mortgage homeowners and fixed rate homeowners who have recently

purchased a home since other fixed rate homeowners are locked into fixed rates of the past. The

only case where the adjusted weighted average interest rate is not used in the calculation of debt

service is Ireland because mortgage interest rate data only dates back to 2003. In this case, the

fixed interest rate for the current period is used to represent the average interest rate that

homebuyers are paying in each period.

In all five countries studied, the rise of the residential real estate bubble was accompanied by a substantial rise in housing debt service to disposable income per capita. (Figure 12) Interestingly, the first boom tends to be in home prices as opposed to debt service to disposable income per capita. This implies that perhaps growth in the debt service to disposable income per capita ratio is a result of growth in home prices. This tendency can be intuitively explained by the third speculative explanation I gave for households increasing the portion of disposable income that they spend on housing. Before households start viewing their home as an investment, they must first see some evidence of rising home prices. Then speculative demand takes off and continues to fuel the initial growth in home prices.

To test whether a rise in housing debt service to disposable income per capita always signals a bubble, I wanted to look the relationship between past changes in this variable and the housing price index in each country. Unfortunately, the beginning date of the debt service data for most of the countries studied is limited to the near start of the real estate bubble in that country. Still, debt service for the United States is available beginning in 1971, when the recently created Freddie Mac began collecting conventional, conforming 30-year mortgage fixed interest rate data. (Figure 13) Thus, my debt service calculation began in 1978 since it requires seven years of prior interest rates.

I wanted to see if there were any substantial shocks to the housing debt service to disposable income per capita ratio and, if so, whether there were any simultaneous shocks to home prices. Fortunately, between 1978 and 1988, debt service to disposable income per capita in the United States actually doubled. Still, a real home price index that Robert Shiller uses in his book "Irrational Exuberance", which is used in this case for its longevity of measurement, rose only by about ten percent in the same period. Hence, the share of disposable income that

households spend on housing seems to have increased for some other reason. The second graph in Figure 13 sheds light on the increase; it seems to be due to the near tripling of the mortgage interest rate over the ten year period from 1971 to 1981. Remember that 80% of the interest rate aspect of debt service to disposable income per capita is based on the seven year tailing average. Thus, the increase in interest rate over 1971 to 1981 really showed up in the debt service calculation from 1978 to 1988. Thus, 1978-1988 is an example of an increase in the housing debt service to disposable income per capita ratio that was caused by an increase in the cost of housing and, in particular, high mortgage interest rates, rather than speculation. The fact that the growth in debt service to disposable income actually leads small growth in the home index during this period, in contrast to the recent bubble cases, is further evidence that the growth in debt service to disposable income was not caused by speculation since there was no substantial growth in home prices initially to start the speculation craze.

Patterns in the Rising and Falling of Real Home Prices in Bubble Markets

Charles Hugh Smith and Chris Martenson argue that asset bubbles, including residential real estate bubbles, are often characterized by a peculiar symmetry in the rise and fall of the asset price around the peak price. They argue that this symmetry exists for both the magnitude and time period of the bubble. Thus, a bubble that takes a long time to form will take a long time to burst and a bubble with a large ascent will subsequently have a large descent in magnitude. In fact, both economists mention that asset prices often retract beyond the pre-bubble price. To see if this pattern is present in the most recent residential real estate bubble, I compare the magnitude of the fall in home prices over the period between the bubble peak and the latest published home

price data to the magnitude of the rise in home prices over a period of the same length that directly precedes the bubble peak. (Figure 14)

Notice that Denmark follows Smith and Martenson's predictions very closely. The magnitude of the rise over the two years preceding the price peak is very close to the magnitude of the fall over the two years following the peak. In addition, the similarity in the concave shapes of the ascent and descent in home prices is remarkable.

Also notice that, in Ireland, the United Kingdom, and the United States, while the concavity of the ascents and descents are very similar, the ascent of home prices in the period directly preceding the bubble peak tends to be slower than the fall in prices after the peak. This trend is indicated by the fact that the horizontal line, which represents periods equally distant from the bubble peak, tends to fall below the home index on the peak-preceding side (left of peak).

If Smith and Martenson are correct in their conclusion that asset bubbles are generally symmetrical, then the four countries whose bubble market have peaked have a good three to seven more years of descent ahead of them. In addition, if home prices are to revert to pre-bubble levels, home depreciation is only halfway complete in most bubble markets. In Ireland and Denmark, the home index values published in the most recent months do not indicate that the descent will end anytime soon. On the other hand, the most recent United States and United Kingdom home index values provide hope that home depreciation may be leveling off.

Interestingly, if homeowners and real estate investors believe that bubbles are roughly symmetrical and fully retract to pre-bubble levels, it would likely become a self-fulfilling prophecy as real estate investors would try to liquidate their property before it declines even further, which would only increase the supply of housing and drive down the price even further.

Of course, it is much harder to liquidate real estate, especially in a bubble setting, than it is an equity security. Still, if these expectations of symmetry do exist in a real estate bubble market, it would make sense that the descent would be much faster than the ascent of home prices since investors have an idea of how much home prices will eventually fall (based on the magnitude of ascent) and will, therefore, liquidate their property holdings until the pre-bubble price level is reached. Thus, the trend of faster home price depreciation than appreciation directly surrounding the bubble peak may support the claim that people believe that bubbles are symmetrical and asset bubble prices are fully retractable.

If bubble symmetry exists, then Australia will experience sustained home price descent. Figure 14 shows the beginning of the descent *if Australia's residential real estate market is currently at its peak*. If Australian home prices continue to appreciate, the home prices descent following the peak might last for more than 12 years based on the long period of real appreciation.

I also look at bubble symmetry in individual U.S. cities using Case Shiller Indexes for 19 United States cities. I use June 2006 as the month of the burst of the bubble and April 2009 as the end of the subsequent decline since it is a local minimum of the composite 10-city CSXR index. Thus, I call the difference between each city's June 2006 Case-Shiller index value and its April 2009 value the 'size of the crash'. The actual beginning of the bubble phase, that is when home price start to rise above their fundamental value as a result of sheer speculation that prices will continue to increase, is hard to measure. Thus, since the period of peak to trough in the crash stage of the bubble is 32 months (from June 2006 to April 2009), I use August 2003 (32 months before June 2006) as the start of the bubble and, therefore, the difference between each city's June 2006 Case-Schiller value and its August 2003 value as the 'size of the rise'. Indeed, most of

the extreme growth in the Case-Shiller indexes came in the few years before the burst of the bubble for most cities. In order to measure symmetry, I look at the correlation between the size of the rise and the size of the decline. These numbers should be roughly equal if the city bubbles are symmetric since the rise and decline that I use are over equal time periods. The correlation is 0.8751. Thus, the bubbles are roughly symmetrical.

In order to see if the U.S. cities' depreciation was faster than their appreciation, as was the case with Ireland, the United States, and Ireland, I compare the cities' average size of the crash with their average size of the rise. The average size of the crash, 65.849, was indeed larger than the average size of the rise, 57.513, over the equal 32-months periods. Thirteen out of nineteen cities had larger declines in the 32 months following the bubble peak than rises in the 32 months before the bubble peak.

Overall, bubble symmetry tends to hold for the period immediately surrounding the peak in housing prices. Time will tell if prices will continue to retract to their long-term trend. I can also conclude that bubbles tend to depreciate slightly faster, in general, than they appreciate.

Relationship between peaks in home prices and peaks in the stock market

As I mentioned earlier, a Bank of International Settlements study found evidence that, in industrialized countries, peaks in the housing market generally tend to follow peaks in the stock market by two years. One potential explanation for this pattern is that a decline in the stock market might lead some investors to switch to investments in real estate, which might eventually cause a mini-bubble to burst in the real estate market a couple years later. The idea of switching between investments in equities and real estate after crashes is indeed popular with some students of bubbles. Nevertheless, before putting too much stock in the supposed two year peak

phenomenon, it is important to remember that Robert Shiller stated that there is no relationship between the housing booms and stock market booms in the United States.

To see if either of these arguments holds up in the most recent wave of housing and stock market booms, I look at graphs of both housing prices and the stock market over time for each of the countries that I study. I would not be surprised to see that the current cases contradict the Bank of International Settlements' conclusion since the current peaks in housing were particularly sharp and, thus, seem to denote an extraordinary case. Indeed, I expect the peak in housing to be more likely to coincide with peaks in the stock market during the most recent housing peak because it was so severe in many countries that some consumers seem to have cut back spending as a result of their lost equity in their homes.

In relation to the Keynesian IS-LM Model, many economists believe that the 'autonomous' component of consumption falls when consumers' overall wealth declines significantly. This cutback in consumption would negatively impact current sales and short-term forecasts of sales, which would, in turn, lead many stocks to fall in value immediately. On the other hand, a correlation might simply be a coincidence between concurrent worldwide real recessions, real estate bubbles, and stock market crashes. It may be the case that the falls in the stock market and housing market were drivers in creating the worldwide recession. The Economist points out that U.S. household wealth has shrunk by 18%, or $12 trillion, since 2007 due to contraction in both home and stock prices. It concludes, "…If consumers feel less rich, they are less inclined to spend." ("Time to Rebalance: A Special Report on America's Economy") Still, it is hard to be certain about a cause-and-effect relationship between the macroeconomic events; the only clear conclusion is that counties' economies, real estate markets, and equity markets are very much dependent on one another.

Indeed, the relationships between the most recent booms in real estate and the stock market in most of the countries studied appear to be fundamentally different than the booms studied by the Bank of International Settlements. (Figure 15) The only exception is Australia's home prices, which might actually follow the two year lag prediction fairly closely. If Australia is currently at its peak, then it would lag the late 2007 stock market peak by about three years. Australia's home prices do indeed appear to be leveling off slightly, but only time will tell if this trend represents the final time of reckoning for the bubble or merely a brief dip in housing prices.

In the other four countries, the stock market is highly correlated with real home prices *around the time of housing booms*. Notice that, in Ireland and the United Kingdom, local minima in house prices actually slightly lead local minima in the stock market. Notice also that, in Ireland and the United States, local maximums in housing prices slightly lead local maximums in the stock market. This observation is in line with the wealth affect on consumption that occurs when homeowners gain (or lose) a substantial amount of equity in their homes. When homes appreciate quickly, homeowners are willing and able to borrow against their equity. When homes depreciate in value, homeowners respond by saving more. Notice that, in all of the countries, there is at least one stock market peak that does not appear to impact the housing market at all. The most common trend seems to be that, when there is a housing peak, there is also a stock market peak. This is true for all four of the countries whose housing market has peaked. Thus, home appreciation does not appear to have as much of a positive impact on the stock market as home deprecation has a negative impact.

Analysis of Bubble Size Discrepancies across United States Cities

While an entire country may be infected with a residential real estate bubble, the size of its impact may vary greatly across cities. In order to study this phenomenon, I decided to transform the Case-Shiller indexes for the twenty United States cities that it measures into a measurement of the 'size of the bubble' in each city. I chose to use February 1994 as the bubble's starting point since it corresponded to a local minimum in the Case-Shiller Composite-10 (CSXR) Index, an index measuring home prices across ten cities. (Figure 16). As a result, I had to take Dallas out of the data set because its Case-Schiller Index began in January 2000. I used June 2006 as the burst of the bubble since it corresponded to the maximum value of the CSXR Index. Thus, the difference between each city's June 2006 Case-Shiller index value and its February 2009 value is the 'size of the bubble'.

It is clear that the size of the bubble, measured as described, varied substantially across cities. For instance, while the Los Angeles index rose by an extraordinary 196.36 from February 1994 to June 2006, the Cleveland index rose only by 44.76. (Figure 17) To understand the magnitude of these changes, consider the fact that the index values of Los Angeles and Cleveland were 76.86 and 78.17 respectively in February 1994. How can the index growth in one city be three times that of a city in the same country? I compare a number of city characteristics, including population, percentage of renters, number of houses, median rent, median house/condo value, median year home built, geographic annexed size, population density, median income, poverty rate, region, and median multiple, to each city's calculated 'size of the bubble' to try to gain an understanding of the bubble size discrepancy across cities. I use July 2008 statistics for cities because this data is readily available at city-data.com.

A city's affordability is probably the best indicator of the size of the city's bubble. I measure affordability using a common metric called the median multiple, which is defined as the city's median home price divided by its median income. Cities with higher median multiples, representing lower affordability, tend to have larger bubbles. This variable is an extremely significant variable and can explain about 52% of bubble size variation across cities. Figure 18 shows a scatter plot of bubble size and the median multiple for the cities studied. To make sure that the affordability measure was not simply measuring the median price, I compare the median multiple regression to the median price regression. I find that the median multiple explains an additional 17% of the variance in bubble size.

The 2009 6th Annual Demographia International Housing Affordability Survey ranks numerous Midwestern United States cities among its list of most affordable cities, calculated by the median house price/median household income. In fact, Detroit, Michigan tops the list. (Shedlock) Using the Midwest region as a dummy variable, I find that there is a significant negative relationship (P-value=0.02) between being in the region and the size of the bubble.

Since the Midwest region and the median multiple are highly correlated, I use the median multiple, the better predictor, in my final model and leave out the Midwest region to avoid multicollinearity. Still, it is important to realize that Midwestern city bubbles were much smaller than their coastal counterparts partly because housing was more affordable. In other words, people were not leveraging their income as much to buy housing. Recall that the Midwestern city (Milwaukee) in Case and Shiller's 2003 housing survey, while certainly speculative, had slightly less speculative views than the other non-Midwestern cities surveyed.

Coastal location is highly correlated with having larger bubbles. As a single dummy variable, the coastal region can explain about 48% of the variation in the size of city's bubbles.

One explanation might be that coastal cities are more likely to be 'international'. As Robert

Shiller points out, coastal cities are subject to higher international speculation, probably because,

having a larger potential market, they are more liquid.

Homes per person alone can explain only 9% of variation in the size of cities' bubbles.

Cities with more homes per person tend to experience smaller bubbles. This variable is not all

that significant with a p-value of slightly less than 0.20. Still, the trend is in line with intuition

since an abundant supply of housing should make it harder to bid up the price of residential real

estate.

Most other variables examined are even less significant. Still, a city's percentage of

people renting was negatively related to the size of the city's bubble when controlling for

affordability. In fact, when the percentage of people renting is added, the model can explain

about 18% more variation for a total explanatory power of 70% of variation in the size of the

bubble. It makes sense that cities with more renters will be subject to less of a bubble since

citizens who rent a home or apartment probably aren't speculating in real estate.

The optimal model is simple and manages to explain about 76% of the variation in the

size of cities' bubbles. It uses the median multiple, a city's percentage of renters, and whether the

city is coastal to explain variation. The model's equation, based on a sample of 19 United States

cities, is described as follows:

Size_o_Bubble = 182.992 + 17.19*Median_Multiple (4.44886) + -372.85*percnt_renters
(105.714) + 38.18*Coastal (19.9101)

The model output and a scatter plot of the actual and predicted values for each of the cities are

provided in Figure 19.

Analysis of the Relationship between Commercial Real Estate and Residential Real Estate in the United States

While real U.S. residential real estate appreciation began in 1998 and progressed steadily over the next nine years, commercial property values took off in 2005 and came crashing down only three years later. (Figure 20) Thus, the length of the bubbles in residential real estate and commercial real estate are very different. Even the magnitude of the bubbles appears to be a little larger in the commercial property market. It is tough to say what would cause the real estate bubbles to look so different. Casey Mulligan would cite the differences as evidence that the bubbles did not result from a common cause. Furthermore, the fact that the commercial bubble lags the residential bubble supports his claim that the commercial bubble was primarily caused by the residential real estate bubble. On the other hand, the coexistence of bubbles in both residential and commercial real estate that peaked within about six months of each other might support Paul Krugman's claim that the bubbles have a similar source.

The coincidence of the largest bubble in both real estate markets during the same time begs the question of whether and how these markets are related. The most obvious answer is that both require land. The opportunity cost of building a commercial establishment may be one home or several homes. Thus, when one market's prices increase quickly, some developers might look to buy land that would typically be dedicated to the other market, which would drive up the value of the value of the other market's property. Mulligan claims that the conversion of commercial property into residential property did indeed occur during the residential boom. (Mulligan) As far as construction materials go, it is interesting that the construction PPI takes off around the same time as commercial real estate prices. (Figure 20) Before 2004, the construction PPI had been roughly flat, even in the midst of increasing housing starts. (Figure 4) Thus,

Mulligan appears to be mistaken in his claim that commercial real estate was driven up by higher construction costs that resulted from additional housing starts. Instead, it appears that commercial building helped drive up the cost of construction inputs.

If it is not the case that the commercial real estate boom is a direct consequence of the residential real estate boom, then Paul Krugman may be correct in stating that both real estate bubbles resulted from a common cause. In this case, the shared cause of the bubbles is unlikely to be subprime lending made possible by Fannie Mae and Freddie Mac's lower mortgage lending standards since this would have no impact on commercial real estate. (Cottrell) Still, the rampant securitization and the use of liens that occurred in both markets may have led to depreciated credit standards for both businesses and homebuyers, made possible by the liquidity that these financial innovations provided. When originators do not intend to hold mortgage loans until maturity, they have a much lower incentive to thoroughly examine the creditworthiness of the borrower. Thus, lower borrowing standards that resulted from securitization, rather than from lower GSE credit standards, may have powered the bubbles in residential and commercial real estate.

Rampant securitization in the United States residential real estate began in November of 1997 when First Union Capital Markets and Bear, Stearns & Co issued $384.6 million securities of Community Reinvestment Act (CRA) mortgage loans. (Swinney) (Timeline E-p.24-25) Still, securitization in both residential and commercial real estate was promoted two years later with the passing of the Gramm-Leach-Bliley Act in November of 1999, which repealed the Glass-Steagall Act that barred the union of investment banking and commercial banking activities. (Heakal) With commercial banks able to do their own investment banking activities, such as securitization, it became both easier and more profitable to issue real estate loans to less credit

worthy homebuyers or businesses (on the commercial banking side) and subsequently, on the investment banking side, securitize these loans and sell them as mortgage-backed securities (MBS) and commercial mortgage-backed securities (CMBS).

In addition to Gramm-Leach-Bliley, the 2000 Commodity Futures Modernization Act exempted the naked use of credit default swaps (CDS) from state gaming laws. A naked position means that the purchaser of a credit default swap does not own the underlying security being insured. (Jones) Thus, a naked purchaser is not using the CDS to hedge default risk, but is rather speculating that the borrowers will default. The deregulation propelled the CDS market from $900 billion in 2000 to an estimated $58 Trillion in 2008 as CDS issuers like AIG were able to sell their products to a new speculative market. As they entered into many more CDS contracts, AIG could spread the default risk of individual underlying mortgages across thousands of contracts, pending a systemic default like the one that would be seen in 2007. ("Congress Exempted Credit Default Swaps From State Gaming Laws in 2000") The higher liquidity and availability of CDSs, which are essentially insurance contracts on mortgages, encouraged the issuance of more CMBSs and MBSs since the risk of these securities could be dramatically reduced when packaged with a CDS guarantee, provided the CDS issuer would not default on its obligations. Thus, the increasing use of MBSs, CMBSs, and CDSs, encouraged by deregulatory congressional acts of the late 1990s and early 2000s, may have led to lower lending standards for both homebuyers and businesses, which increased artificial demand for residential and commercial real estate and, thus, increased property values.

I refer to the new demand as artificial because, in reality, many of these homebuyers and business did not have the 'ability to pay' (only the willingness) for their purchased property for the entire length of the loan, evident by the widespread default once these property owners could

no longer refinance. Thus, it is again evident that property buyers, particularly subprime property buyers, were speculating that real home price appreciation would continue indefinitely in order to validate the belief that they could fall back on refinancing in the likely case that they would not be able to pay their high mortgage payments. Of course, as market values fell to their fundamental values starting in 2007, property owners who found themselves unable to meet their mortgage obligations could not refinance on property/collateral that was worth less than the outstanding balance of the loan.

The low sales and high unemployment that came with 2008-2009 recession only worsened the number of businesses and homeowners who could not afford to make their mortgage payments. The subsequent defaults only increased the supply of bank-liquidated residential and commercial real estate on the market, further depressing property values. The lower property values allowed fewer struggling borrowers to refinance and led to a downward cycle very similar to the pre-bubble burst upward cycle, which was based on speculation and subsequent validated beliefs of perpetual property appreciation feeding off one another. The Economist points out that, in the residential real estate market, only first-time homebuyers with federally guaranteed loans could get credit in the aftermath of the housing bubble. ("Time to Rebalance: A Special Report on America's Economy") Perhaps the absence of a large federal program to guarantee commercial credit after the bubble burst explains why commercial real estate prices fell more than residential prices.

Summary of factors that might indicate that a bubble is forming and other notable conclusions

While it can be hard distinguish the fundamental value of a property from its market value, there are a few housing market characteristics that seem to be correlated with bubble

formation. While changes in housing statistics may have alternative explanations, if several variables are particularly severe, there is a good chance that the market is in a bubble. This paper has evaluated several potential signals, but does not contemplate the subject of remedying bubbles.

Rapid increases in housing starts, such as those in the United States, the United Kingdom, and Ireland, indicate that homebuyers are suddenly encouraged to enter the market or that current homebuyers are investing in additional properties. The most likely explanation for recent bubbles is the new mindset of housing as an investment. If a rapid rise in income accompanies the rise in housing starts, there may not necessarily be a bubble. Still, even in this scenario, a bubble could easily begin to form if the notion of perpetual home appreciation catches on.

There is not enough data to make a conclusion on the effect spikes in the cost of inputs to housing production, as measured by a housing PPI, have on bubble formation. Still, the historical correlation between the two variables in the United States seems fairly strong until the most recent bubble. In most cases, it is logical to expect that initial home appreciation in the absence of a corresponding increase in the price of construction inputs signals a bubble. On the other hand, even fundamental home appreciation will eventually lead to construction inputs becoming more expensive.

An increase in a market's home ownership rate is a likely sign that a bubble is forming. Similar to a surge in housing starts, it indicates that new homebuyers are attracted to the market for some reason. While a gradual increase might represent a change in culture, there are few explanations for a sudden spike other than easy access to credit or speculation. Either event could lead subprime buyers or young homebuyers to prematurely enter the housing market. It may be that government policy, such as a first-time homebuyer credit is responsible for the surge.

Low mortgage interest rates should not lead an observer to expect a bubble to form. Still, rates tend to fall in the countries studied at the beginning of the bubbles. The rate drops may be responsible for the initial home appreciation that sets off speculation. Still, homes will likely appreciate whether or not a bubble is forming.

A rapid, substantial fall in home affordability is the surest indicator that a market is in a bubble state. In all five countries studied, debt service to disposable income grew rapidly with the home price appreciation, indicating that homebuyers were spending larger portions of their income on housing. In addition, a higher median multiple, which also measures housing affordability, was highly correlated with larger bubbles in U.S. cities. Hence, it is very likely that home appreciation is unsustainable when affordability falls substantially. Still, one must be careful to make sure that the large increase in debt service is not due to a large spike in the mortgage interest rate or construction costs. If it is not due to one of these factors, a large drop in affordability probably represent speculation in the housing market. In a case like the United States, where debt service was rising rapidly even while interest rates were falling during the early 2000s, it is quite clear that home appreciation was unsustainable.

The following table summarizes the direction and general strength of the correlation between the existence of a housing bubble and the variables examined:

Variable	Correlation	Strength
Housing Starts	Positive	Weak-Medium
Construction PPI	No Correlation	No Correlation
Home Ownership Rate	Positive	Medium-Strong
Mortgage Interest Rate	No Correlation	No Correlation
Debt Service to Disposable Income per Capita (Affordability)	Positive	Strong

It is clear that the property bubbles studied are much different from smaller bubbles in the past. I find that the Bank of International Settlements claim that peaks in the housing market generally lag peaks in the stock market by two years does not hold for the latest bubbles with the potential exception of Australia since its housing market continues to see home appreciation. However, it is interesting to note that, with the exception of Australia, every county's real estate decline coincided with the country's stock market decline. This trend may simply represent a coincidence in a global property crash and a global real estate clash, but it is possible that the fall in home prices may have led homeowners to spend less as a result of the Keynesian wealth effect on 'autonomous' consumption.

I find that Charles Hugh Smith and Chris Martenson's claims that bubbles are symmetric in nature holds somewhat for the bubbles studied. Many of the home markets studied are still experiencing declines; so it remains to be seen whether real home prices will actually fall all the way to their pre-bubble levels. Still, the magnitude of the appreciation and depreciation in home prices immediately surrounding the bubble peak tend to be fairly similar. In general, the decline tends to be slightly steeper in the country bubbles studied. In addition, bubble symmetry in U.S. cities generally tends to hold with a slightly sharper decline than rise as in the case of the countries. Thus, a housing bubble market that experiences rapid appreciation before the market peaks will probably experience only slightly more rapid depreciation after the peak.

My examination of Case-Shiller Home Price Indexes for 19 U.S. Cities reveals that 76% of the variation in the size of the cities' bubbles can be explained by the city's median multiple, percentage of renters, and coastal or non-coastal location. A city's median multiple, which is measure of affordability in the economy, is by far the best indicator of the size of the city's bubble. Cities with a larger median multiple, representing lower affordability, will generally

experience larger bubbles. Midwestern cities, in particular, experienced smaller bubbles because their housing markets were by and large more affordable. When controlling for the city's median multiple, cities with a larger percentage of renters generally experience small bubbles. Finally, coastal cities generally experienced larger bubbles.

My comparison of the U.S. residential and commercial real estate markets indicates that the U.S. housing bubble may have less to do with Fannie Mae and Freddie Mac's focus on providing affordable housing and more to do with systematic banking deregulation. Bubbles occurred in both markets because the increased volume of securitization, which was encouraged by deregulatory legislation, led banks to lend to both commercial and residential real estate buyers whose ability to make mortgage payments relied heavily on perpetual real estate appreciation and a booming economy.

Application to potential bubble markets

In light of the characteristics displayed in the appreciating housing markets of Denmark, Ireland, the United Kingdom, and the United States before home prices crashed, it is uncertain whether Australia's housing market is experiencing a bubble. On the other hand it is very likely that Canada's housing market is currently in a bubble state. Both countries have experienced significant real appreciation during the 2000s, but have yet to fall substantially. In order to determine whether the home appreciation is a result of fundamental appreciation or speculation, I compare the trends in housing starts, the construction PPI, and debt service to disposable income per capita to those of the bubble countries studied.

Looking at Australia's real home price index from 1972 to present, rapidly rising real home price appear to be simply catching up to long-term levels after persistent depreciation during the 1990s. (Figure 21) While housing starts are completely random over the appreciating

period, the construction PPI has steadily appreciated with home prices. Since a large increase in housing starts is not responsible for the increase in the construction PPI, the growing construction PPI may represent fundamental home appreciation On the other hand, debt service to disposable income per capita has been growing exponentially since 2002. In fact, citizens are actually dedicating twice as much of their income to mortgage payments today as they were in 2002. (Figure 21) A spike in debt service to disposable income typically indicates some kind of speculation. In this case, it cannot be explained by higher interest rates since interest rates have been random over the period. In addition, the 1999 pro-investment capital gains deduction and 2000 first-time homebuyer grant may have led to higher speculation in the housing market. (Timeline A-p.17) With the PPI and housing starts implying fundamental appreciation and debt service to disposable income indicating speculation, it is uncertain whether Australia's housing market is actually in a bubble.

Canada's residential real estate market is more consistent. Real home prices have risen by 60% since 2000. (Figure 22) Like Australia, the construction PPI has risen with real home prices. On the other hand, Canada's construction PPI coincides with rising housing starts. Thus, in this case, the rise in housing starts has increased the demand for construction inputs and, thus, raised their prices; so it is likely that the rise in the price of construction inputs is actually an effect and not a cause of higher home prices. Debt service to disposable income has increased substantially over the period, which typically indicates speculation. (Figure 22) Vancouver, Canada actually tops the 2009 6th Annual Demographia International Housing Affordability Survey's list of severely unaffordable housing markets. (Shedlock) Since increasing housing starts and decreasing affordability are simultaneously present, it is likely that Canada's housing market cannot continue to sustain its rapid real price appreciation and will, eventually, crash.

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Web Address:
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Range: Q3 1972 – Q4 2009

Canada
Name: Teranet-National Bank National Composite House Price Index: Composite 6
Source: Teranet and the National Bank of Canada
Web Address: http://www.housepriceindex.ca/Default.aspx
Range: February 1999 – January 2010

Denmark
Name: Average Square Meter Price of Owner Occupied Dwellings in Denmark
Source: Realkreditradet (Association of Danish Mortgage Banks)
Web Address:
http://www.realkreditraadet.dk/Statistics.aspx?M=News&PID=993&NewsID=302
Range: Q1 2004 – Q2 2009

Ireland
Name: Permanent TSB / ESRI House Price Index (NAT)
Source: The Economic and Social Research Institute
Web Address: http://www.esri.ie/irish_economy/permanent_tsbesri_house_p/
Range: March 1996 – December 2009

United Kingdom
Name: House Price Index
Source: Communities and Local Government
Web Address: http://www.communities.gov.uk/publications/corporate/statistics/hpi052009
Range: February 2002 – May 2009

United States
Name: Monthly House Price Indexes for Census Divisions and U.S. (Purchase-Only Index)
(NSA)
Source: Federal Housing Finance Agency
Web Address: http://www.fhfa.gov/Default.aspx?Page=87
Range: January 1991 – November 2009

Mortgage Rate

Australia
Name: 3-year fixed indicator lending rate for housing loans
Source: Reserve Bank of Australia
Web Address: http://www.rba.gov.au/statistics/tables/index.html#interest_rates
Range: Q4 1983 – Q4 2009

Canada
Name: Conventional Mortgage 5-year Chartered Bank Administered Interest Rate
Source: Bank of Canada
Web Address: http://www.bankofcanada.ca/en/rates/sel_hist.html
Range: March 1992 – December 2009

Denmark
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Source: Realkreditradet (Association of Danish Mortgage Banks)
Web Address: http://www.realkreditraadet.dk/Statistics.aspx?M=News&PID=993&NewsID=78
Range: Q4 1997 – Q2 2008

Ireland
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Source: Central Bank and Financial Services Authority of Ireland
Web Address: http://www.centralbank.ie/frame_main.asp?pg=sta_keur.asp&nv=sta_nav.asp
Range: January 2003 to December 2008

United Kingdom
Name: Monthly interest rate of UK resident banks (excluding Central Bank) and building societies' sterling 10 year (75% LTV) fixed rate mortgage to households
Source: Bank of England
Web Address:
http://www.bankofengland.co.uk/mfsd/iadb/index.asp?Travel=NIxIRx&levels=1&G0Xtop.x=48&G0Xtop.y=2&C=EP3&FullPage=X40727&FullPageHistory=X40727&Nodes=X41513X41514X41515X41516X41517X40727X40728X40729X40749&SectionRequired=I&HideNums=-1&ExtraInfo=true#BM
Range: January 1995 to August 2009

United States
Name: Conventional, Conforming 30-Year Fixed-Rate Mortgage Rate
Source: Freddie Mac
Web Address: http://www.freddiemac.com/pmms/pmms30.htm
Range: January 1984 – January 2010

Outstanding Mortgage Lending

Australia
Name: Bank lending to persons for owner-occupied housing, excluding securitizations in billions
Source: Reserve Bank of Australia
Web Address: http://www.rba.gov.au/statistics/tables/index.html#interest_rates
Range: Q3 1990 – Q4 2009

Canada
Name: Outstanding mortgage lending
Source: Statistics Canada
Web Address: http://www.statcan.gc.ca/cgi-bin/af-fdr.cgi?l=eng&keng=2&kfra=2&teng=Download%20file%20from%20CANSIM&tfra=Fichier%20extrait%20de%20CANSIM&loc=http://cansim2.statcan.gc.ca/results/2010041013205210325.CSV
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Web Address:
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Source: Central Bank and Financial Services Authority of Ireland
Web Address: http://www.centralbank.ie/frame_main.asp?pg=sta_late.asp&nv=sta_nav.asp
Range: October 2003 to December 2009

United Kingdom
Name: Monthly amounts outstanding of building societies' sterling net secured lending to individuals and housing associations (in sterling millions)
Source: Bank of England
Web Address:
http://www.bankofengland.co.uk/mfsd/iadb/fromshowcolumns.asp?Travel=NIxASxSCx&ShadowPage=1&Cat2=L&Frequency=M&SearchText=housing+loans&SearchExclude=&SearchTextFields=TC&Thes=Y&SearchType=Advanced&Cats=1X8X2&ActualResNumPerPage=21X&TotalNumResults=21&ShowData.x=32&ShowData.y=9&C=TT
Range: February 2002 to December 2009

United States
Name: Real Estate Loans at All Commercial Banks, billions of dollars
Source: Federal Reserve Bank of St. Louis
Web Address: http://research.stlouisfed.org/fred2/series/REALLN/downloaddata?cid=100
Range: January 1991 – January 2010

Housing PPI
Australia
Name: Produce price index for materials used in house construction
Source: Reserve Bank of Australia
Web Address: http://www.rba.gov.au/statistics/tables/index.html#interest_rates
Range: Q3 1972 – Q4 2009

Canada
Name: Price indexes of apartment/non-residential construction, seven census metropolitan area composite
Source: Statistics Canada
Web Address: http://www.statcan.gc.ca/cgi-bin/af-fdr.cgi?l=eng&keng=1&kfra=1&teng=Download%20file%20from%20CANSIM&tfra=Fichier%20extrait%20de%20CANSIM&loc=http://cansim2.statcan.gc.ca/results/2010041016100217226.CSV
Range: Q1 1999 – Q4 2009

United States
Name: PPI: stage of processing – materials and components for construction, seasonally adjusted
Source: Freelunch.com, U.S. Bureau of Labor Statistics
Web Address: http://www.economy.com/freelunch/fl_basket.asp?
Range: January 1991 – February 2010

Disposable Income
Australia
Name: Real net national disposable income per capita, chain volume measures
Source: Australian Bureau of Statistics
Web Address: http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5206.0Sep%202009?OpenDocument
Range: Q3 1985 – Q3 2009

Canada
Name: Disposable income
Source: Statistics Canada
Web Address: http://www.statcan.gc.ca/cgi-bin/af-fdr.cgi?l=eng&keng=1&kfra=1&teng=Download%20file%20from%20CANSIM&tfra=Fichier%20extrait%20de%20CANSIM&loc=http://cansim2.statcan.gc.ca/results/2010041014233212860.CSV
Range: February 1999 – December 2009

Denmark
Name: Gross National Disposable Income
Source: Organization for Economic Co-Operation and Development (OECD) State Extracts
Web Address: http://stats.oecd.org/Index.aspx?datasetcode=SNA_TABLE2
Range: 2004 - 2009

Ireland
Name: Gross National Disposable Income
Source: Organization for Economic Co-Operation and Development (OECD) State Extracts
Web Address: http://stats.oecd.org/Index.aspx?datasetcode=SNA_TABLE2
Range: 2000 - 2008

United Kingdom
Name: Disposable Income Account
Source: Office for National Statistics
Web Address: http://www.statistics.gov.uk/STATBASE/tsdataset.asp?vlnk=221&More=Y
Range: 2002 to 2008

United States
Name: Disposable Personal Income, seasonally adjusted
Source: Federal Reserve Bank of St. Louis
Web Address: http://research.stlouisfed.org/fred2/series/DSPI/downloaddata?cid=110
Range: January 1991 – December 2009

Population
Canada
Name: Total Midyear Population
Source: U.S. Census Bureau, international data base (IDB)
Web Address: http://www.census.gov/ipc/www/idb/country.php
Range: February 1999 – December 2009

Denmark
Name: Population
Source: Statistics Denmark
Web Address: http://www.statbank.dk/statbank5a/SelectVarVal/saveselections.asp
Range: 2004 - 2009

Ireland
Name: Population
Source: Central Statistics Office Ireland
Web Address: http://www.cso.ie/statistics/Population1901-2006.htm
Range: 2000 - 2008

United Kingdom
Name: Population
Source: Office for National Statistics
Web Address: http://www.statistics.gov.uk/STATBASE/ssdataset.asp?vlnk=9544
Range: 2002 to 2008

United States
Name: Total Population, all ages including armed forces overseas
Source: Federal Reserve Bank of St. Louis
Web Address: http://research.stlouisfed.org/fred2/series/POP/downloaddata?cid=104
Range: January 1991 – December 2009

Home Ownership Rate
United States
Name: Home ownership rate
Source: Federal Reserve Bank of St. Louis
Web Address: http://research.stlouisfed.org/fred2/series/USHOWN/downloaddata?cid=98
Range: January 1991 – December 2008

Housing Starts
Australia
Name: Number of total new private sector houses commenced
Source: Australian Bureau of Statistics
Web Address:
http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/8752.0Sep%202009?OpenDocument
Range: Q3 1972 – Q3 2009

Canada
Name: Seasonally Adjusted housing starts
Source: Statistics Canada
Web Address: http://www.statcan.gc.ca/cgi-bin/af-
fdr.cgi?l=eng&keng=1&kfra=1&teng=Download%20file%20from%20CANSIM&tfra=Fichier%
20extrait%20de%20CANSIM&loc=http://cansim2.statcan.gc.ca/results/2010041016100217226.
CSV
Range: Q1 1999 – Q4 2009

Ireland
Name: All housing sectors house completions (I use a one year lead values for each year; for
instance, 1997 house completions are used as a proxy for 1996 house starts)
Source: Central Statistics Office Ireland
http://www.cso.ie/quicktables/GetQuickTables.aspx?FileName=HSA01.asp&TableName=New+
Dwellings&StatisticalProduct=DB_HS
Range: 1997 - 2008

United Kingdom
Name: All dwellings started
Source: Communities and Local Government
Web Address:
http://www.communities.gov.uk/publications/corporate/statistics/housingplanningstatistics2009
Range: 2002 to 2008

United States
Name: Total New Privately Owned Housing Units Starts
Source: Federal Reserve Bank of St. Louis
Web Address: http://research.stlouisfed.org/fred2/series/HOUST/downloaddata?cid=97
Range: January 1991 – January 2010

Consumer Price Index
Housing Indexes
Australia
Name: Consumer Price Index
Source: Australian Bureau of Statistics
Web Address:
http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/6401.0Dec%202009?OpenDocument
Range: Q3 1972 – Q4 2009

Canada
Name: Total Consumer Price Index
Source: Bank of Canada
Web Address: http://www.bankofcanada.ca/en/cpi.html
Range: February 1999 – January 2010

Denmark
Name: Consumer Price Index
Source: Statistics Denmark
Web Address:
http://translate.google.com/translate?hl=en&sl=da&u=http://www.dst.dk/HomeUK/Statistics/Key_indicators/Prices/cpi_2000.aspx&ei=7fKES-O2KNKztgfAiLH5Ag&sa=X&oi=translate&ct=result&resnum=4&ved=0CBUQ7gEwAw&prev=/search%3Fq%3Ddenmark%2Bcpi%26hl%3Den%26client%3Dfirefox-a%26hs%3DnsY%26rls%3Dorg.mozilla:en-US:official
Range: January 2004 – June 2009

Ireland
Name: Annual percentage change in consumer price index (I transform these into index figures)
Source: Central Statistics Office Ireland
Web Address:
http://www.cso.ie/quicktables/GetQuickTables.aspx?FileName=CPA01C3.asp&TableName=Annual+Percentage+Change&StatisticalProduct=DB_CP
Range: 1996 – 2009

United Kingdom
Name: Consumer Price Index
Source: Office for National Statistics
Web Address: http://www.statistics.gov.uk/statbase/TSDtimezone.asp
Range: February 2002 – January 2010

United States
Name: Consumer Price Index for All Urban Consumers: All Items
Source: Federal Reserve Bank of St. Louis, U.S. Department of Labor, Bureau of Labor
Statistics
Web Address: http://research.stlouisfed.org/fred2/series/CPIAUCNS?cid=9
Range: January 1991 – January 2010

Stock Index
Australia
Name: ASX 200
Source: Yahoo! Finance
Web Address:
http://au.finance.yahoo.com/q/hp?s=^AXJO&a=09&b=17&c=2001&d=01&e=26&f=2010&g=
m
Range: Q4 2001 – Q4 2009

Canada
Name: NASDAQ Canada
Source: Yahoo! Finance
Web Address:
http://finance.yahoo.com/q/hp?s=^CND&a=09&b=9&c=2001&d=03&e=10&f=2010&g=m
Range: October 2001 – January 2010

Denmark
Name: OMX Copenhagen 20
Source: Euro Investor Worldwide Network
Web Address: http://www.euroinvestor.co.uk/stock/chart.aspx?id=203548
Range: Q1 2004 – Q2 2009

Ireland
Name: ISEQ
Source: Yahoo! Finance
Web Address:
http://uk.finance.yahoo.com/q/hp?s=^ISEQ&b=7&a=03&c=1998&e=26&d=01&f=2010&g=m
Range: November 1999 – December 2009

United Kingdom
Name: FTSE 100
Source: Yahoo! Finance
Web Address:
http://finance.yahoo.com/q/hp?s=^FTSE&a=03&b=2&c=1984&d=01&e=26&f=2010&g=m
Range: February 2002 – February 2010

United States
Name: S&P 500
Source: Yahoo! Finance
Web Address:
http://finance.yahoo.com/q/hp?s=^GSPC&a=00&b=3&c=1950&d=01&e=26&f=2010&g=m
Range: January 1991 – February 2010

Case-Shiller City Indexes
United States
Name: Case-Shiller Home Price Index
Cities: Atlanta, Boston, Charlotte, Chicago, Cleveland, Denver, Detroit, Las Vegas, Los Angles, Miami, Minneapolis, New York City, Phoenix, Portland, San Diego, San Francisco, Seattle, Tampa, Washington D.C., Composite 10
Source: Standard & Poors
Web Address: http://www.standardandpoors.com/indices/sp-case-shiller-home-price-indices/en/us/?indexId=spusa-cashpidff--p-us----
Range: January 1987 – December 2009

City Data
United States
Variables: Population, Percentage of Renters, Number of Houses, Median Rent, Median House/Condo Value, Median Year Home/Condo Built, Geographic Size, Population Density, Median Income, Percentage of People Living in Poverty, Houses per Person
Name: Cities: Atlanta, Boston, Charlotte, Chicago, Cleveland, Denver, Detroit, Las Vegas, Los Angles, Miami, Minneapolis, New York City, Phoenix, Portland, San Diego, San Francisco, Seattle, Tampa, Washington D.C.
Source: City-Data.com
Web Address: http://www.city-data.com/
Range: July 2008

Historical Figures for Real Home Prices, Population, Building Costs, and Interest Rates (Figure 1)
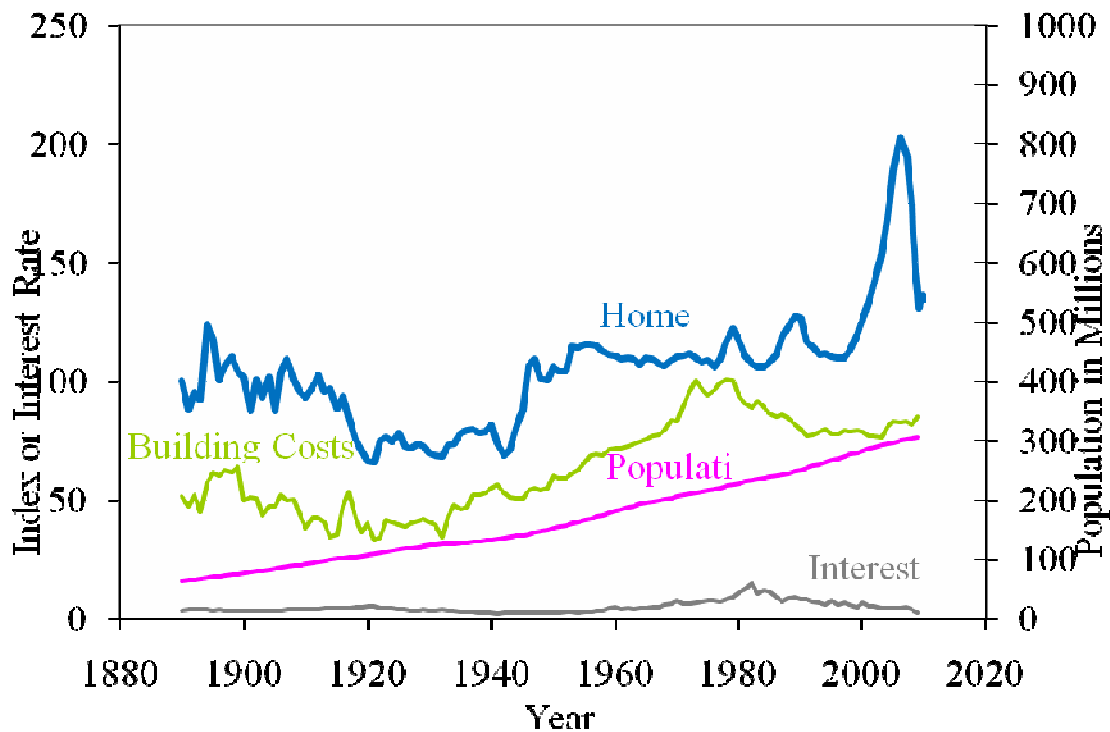
Shiller, Robert. "Online Data - Robert Shiller." Yale Department of Economics. Yale University. Web. 22 Mar. 2010. <http://www.econ.yale.edu/~shiller/data.htm>.

Historical Figures for Real Home Prices, Population, Building Costs, and Interest Rates (Figure 2)
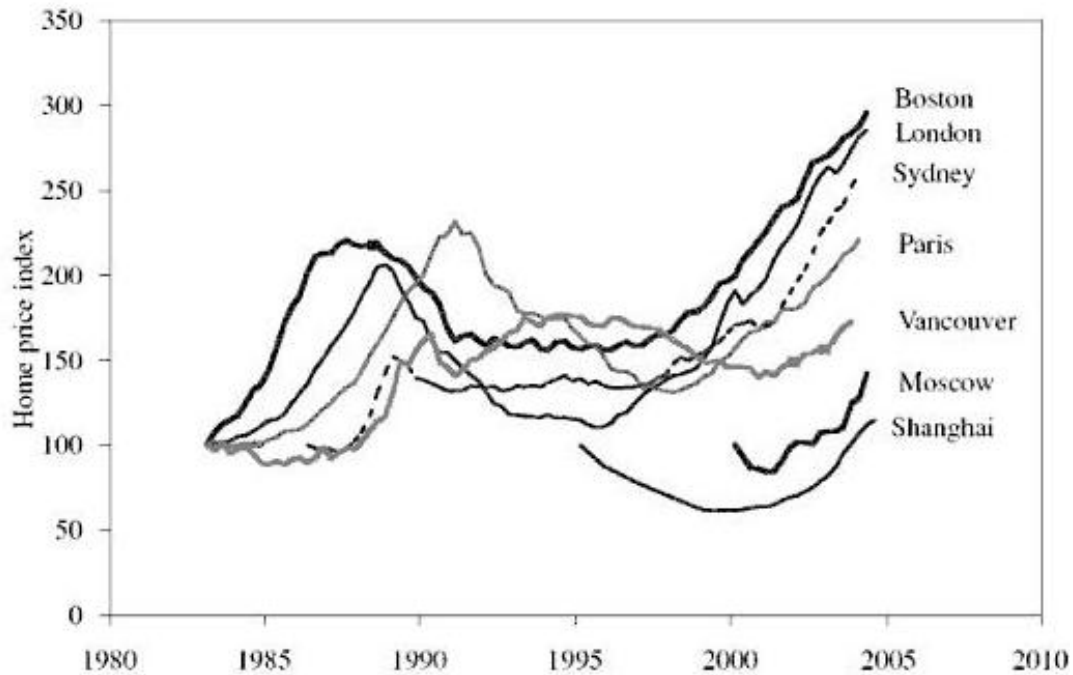
Shiller, Robert J. Irrational Exuberance. 2nd ed. New York: Currency/Doubleday, 2005. Google Books. Google. Web. 21 Mar. 2010.
<http://books.google.com/books?id=x1PaZY_KtBEC&dq=irrational+exuberance&printsec=frontcover&source=bn&hl=en&ei=fMWmS7XrKtCWtgfGztmZCg&sa=X&oi=book_result&ct=result&resnum=5&ved=0CBcQ6AEwBA#v=onepage&q=&f=false>.
(From page 19)

Residential and Non-Residential Construction Spending (Figure 3)
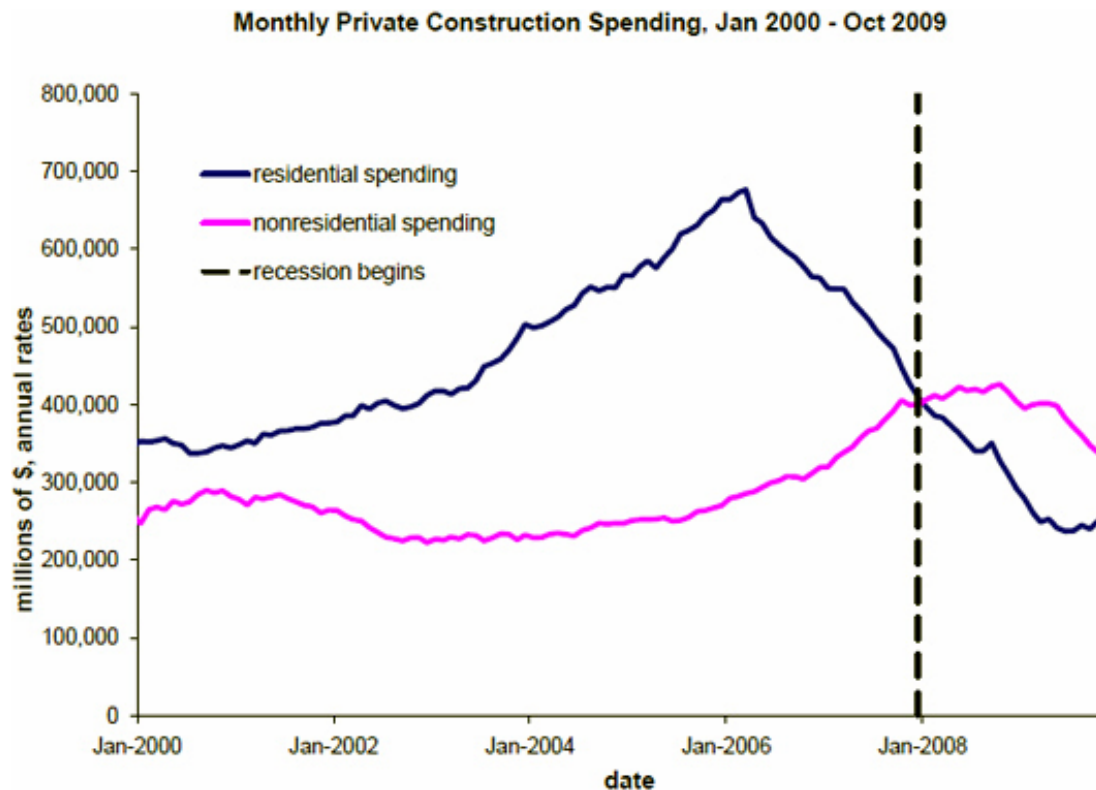
Mulligan, Casey B. "Was There a Commercial Real Estate Bubble?" The New York Times. 13 Jan. 2010. Web. 08 Apr. 2010. <http://economix.blogs.nytimes.com/2010/01/13/was-there-a-commercial-real-estate-bubble/>.

United States Housing Starts (in 1,000s) Graphed Against Various Variables (Figure 4)
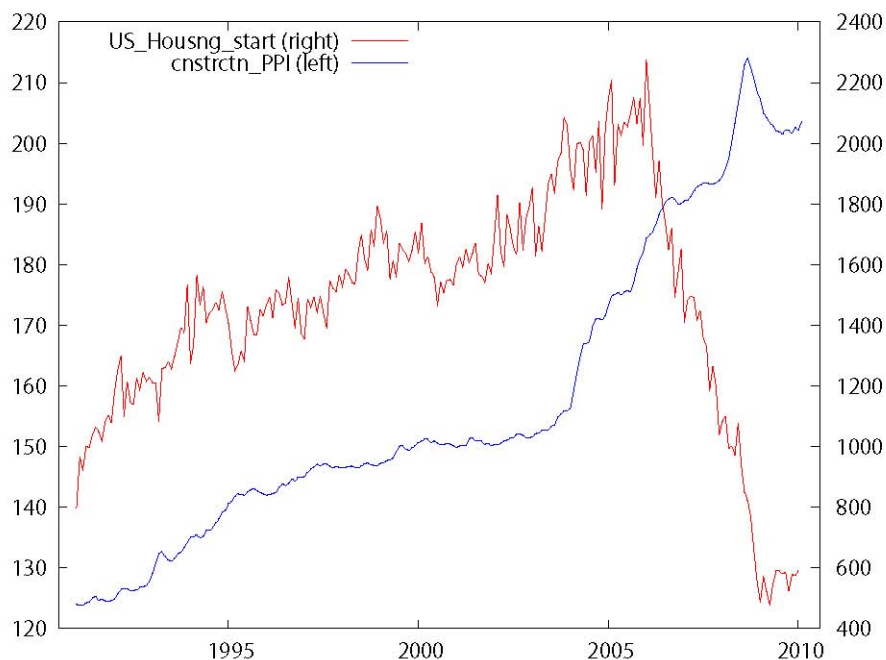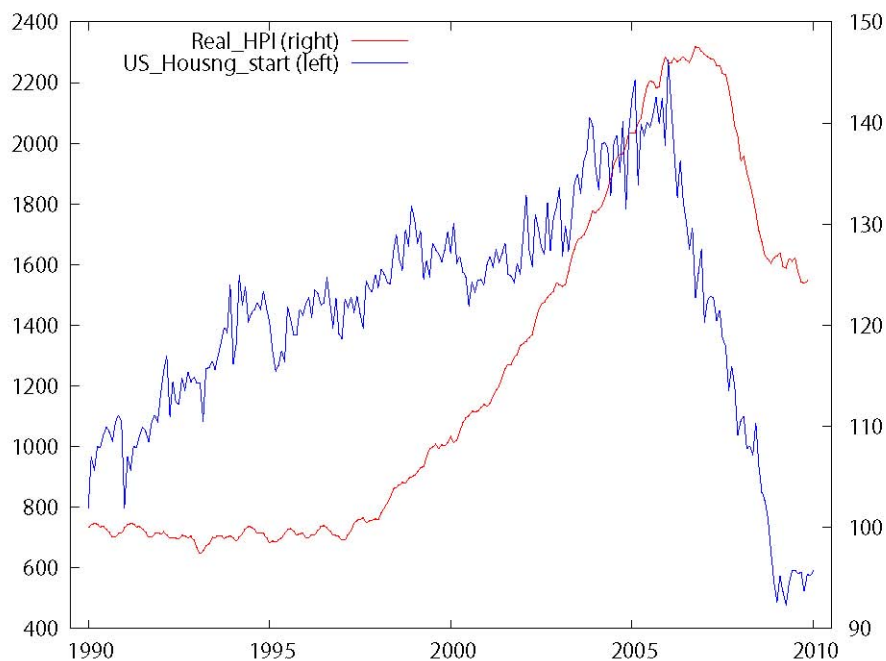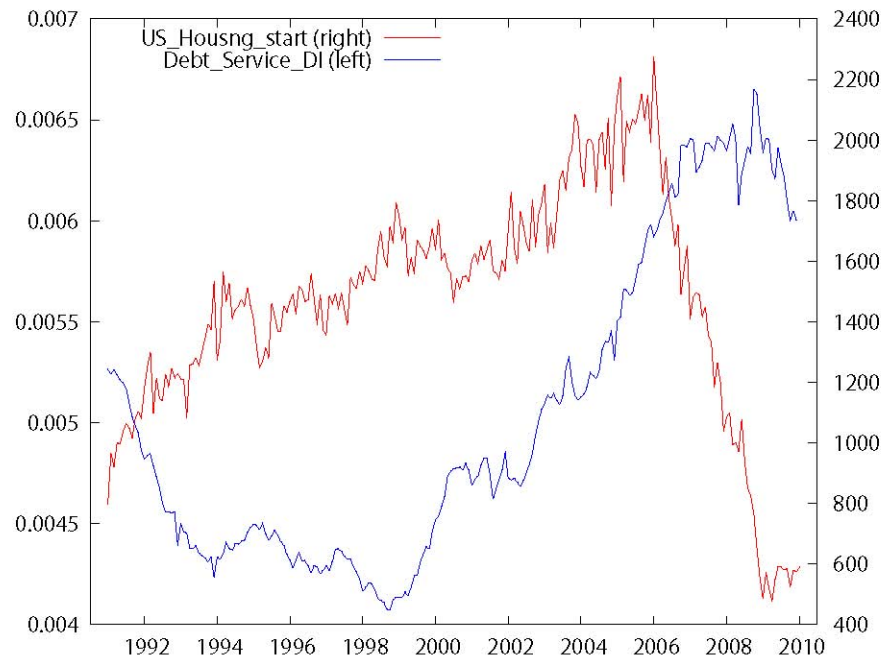
UK Housing Starts Graphed Against Real Home Price Index (Figure 5)
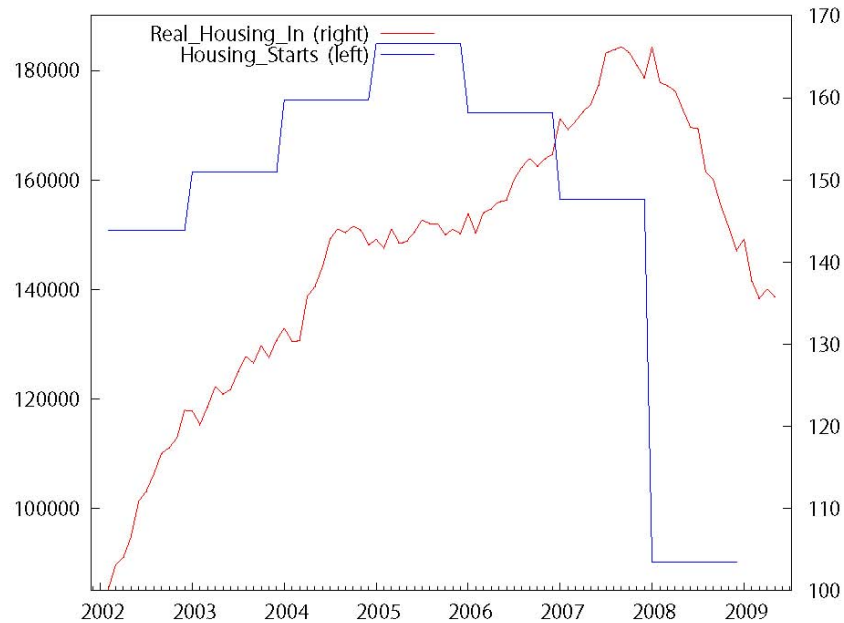
Ireland Housing Starts Graphed Against Real Home Price Index (Figure 6)
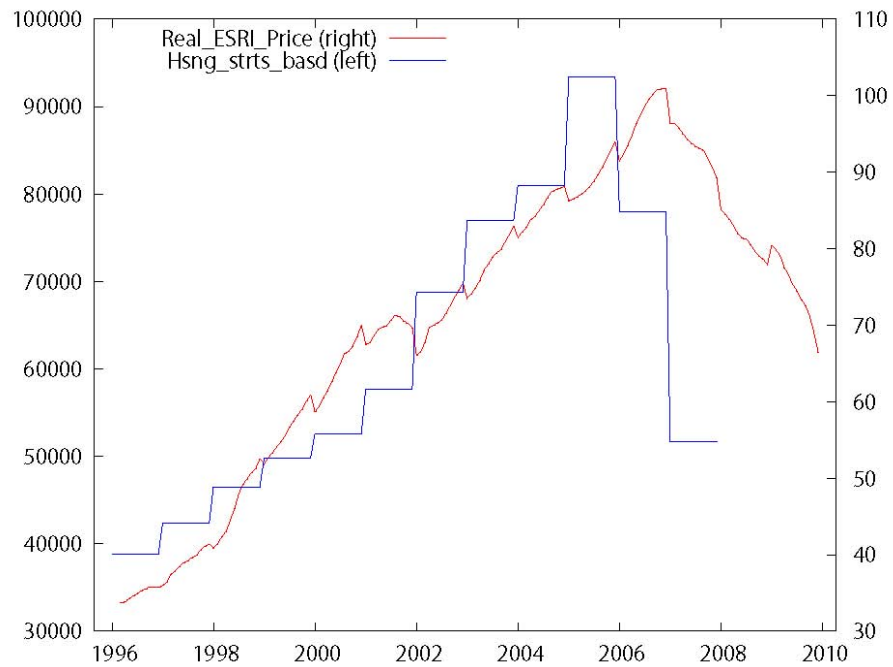
Australia Housing Starts Graphed Against Real Home Price Index (Figure 7)
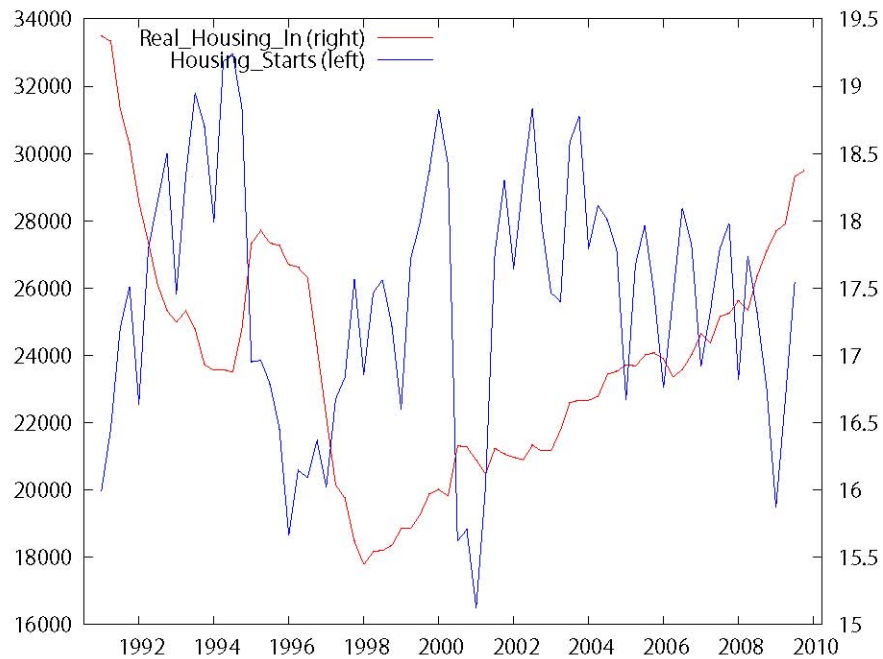
United States Construction PPI Graphed Against Nominal Home Price Index (Figure 8)
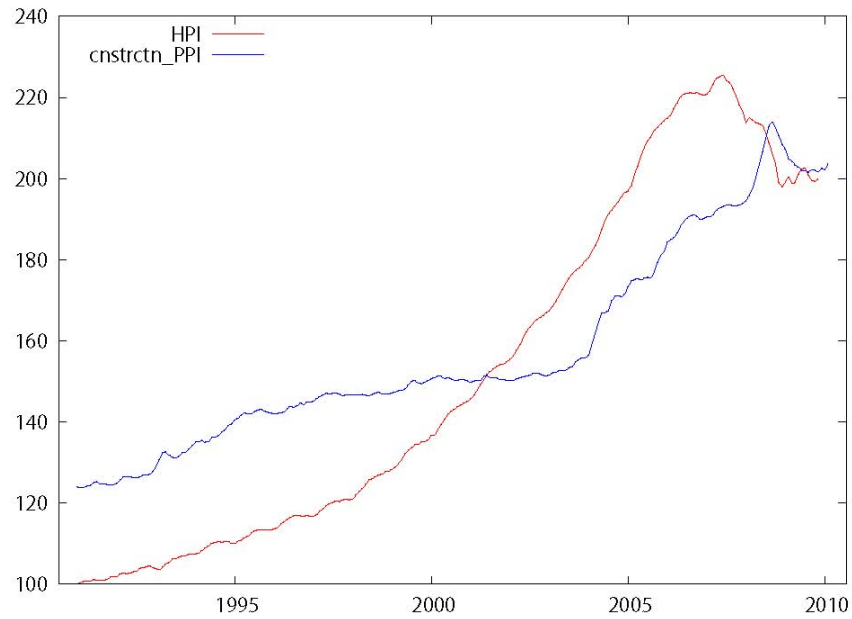
Australia Construction PPI Graphed Against Nominal Home Price Index (Figure 9)
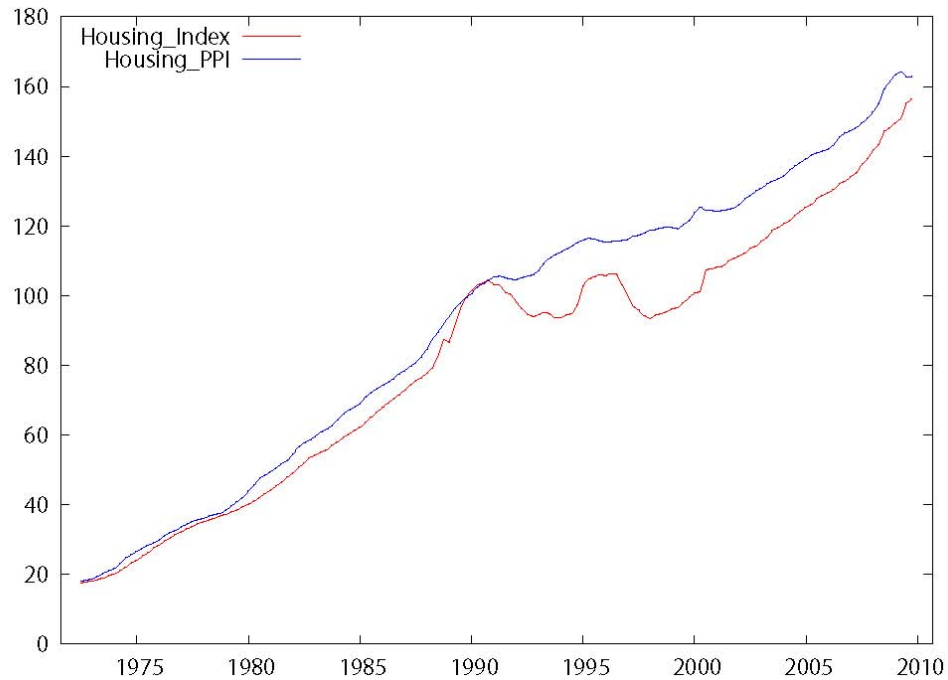
The United States Home Ownership Rate Graphed Against Various Variables (Figure 10)
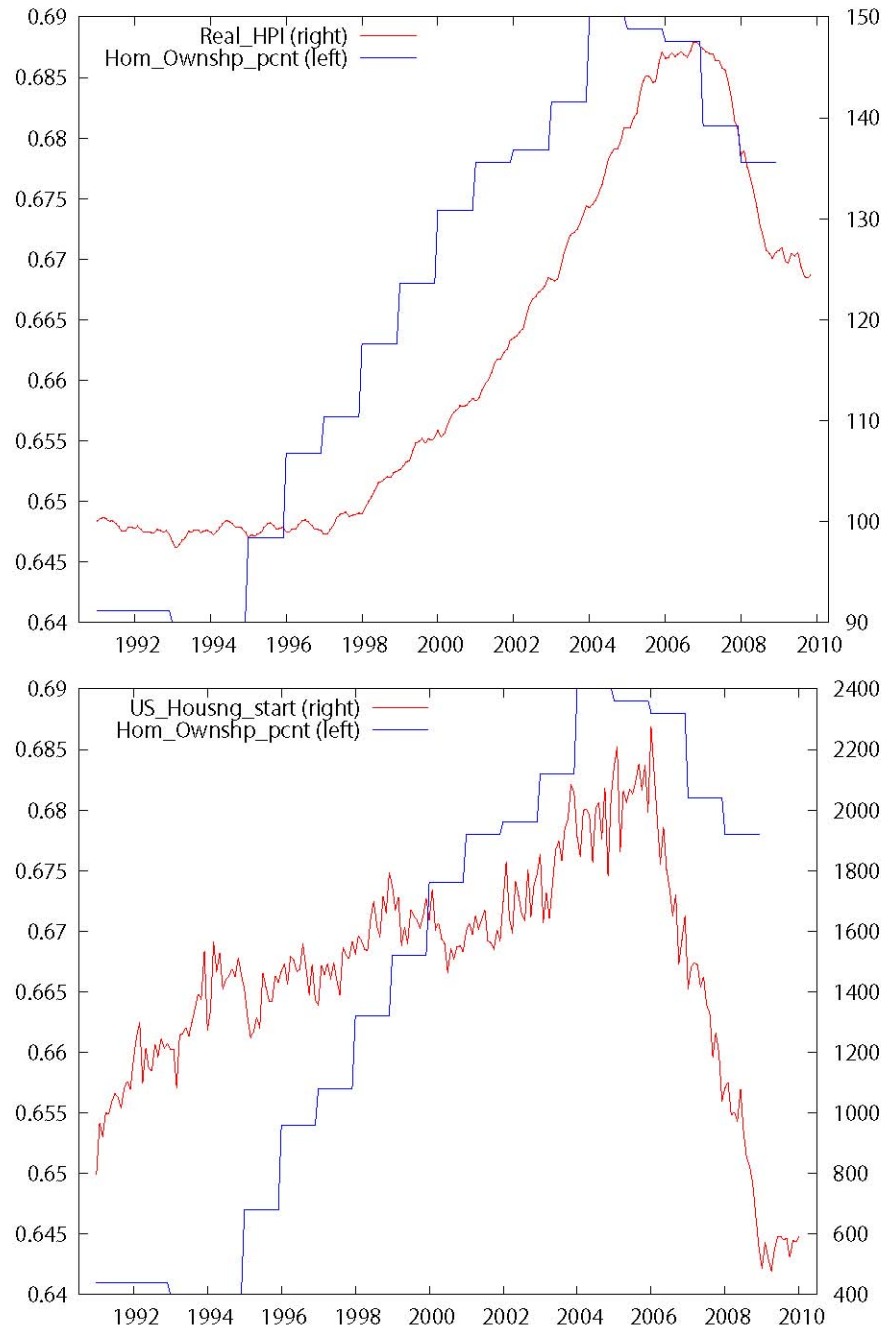
The Relationship between Mortgage Rates and Home Prices (Figure 11)

United States
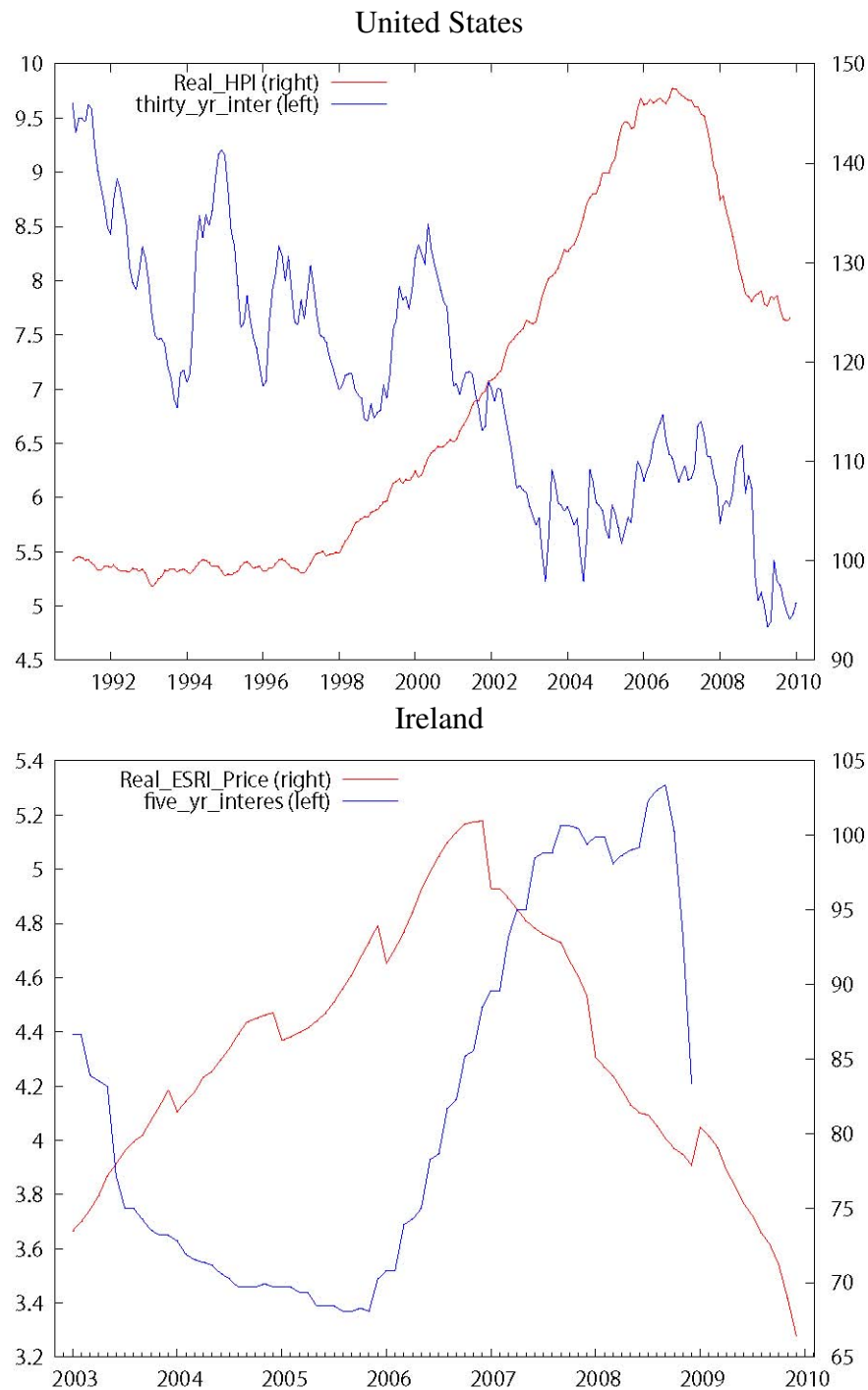
Ireland

United Kingdom

Denmark

Australia
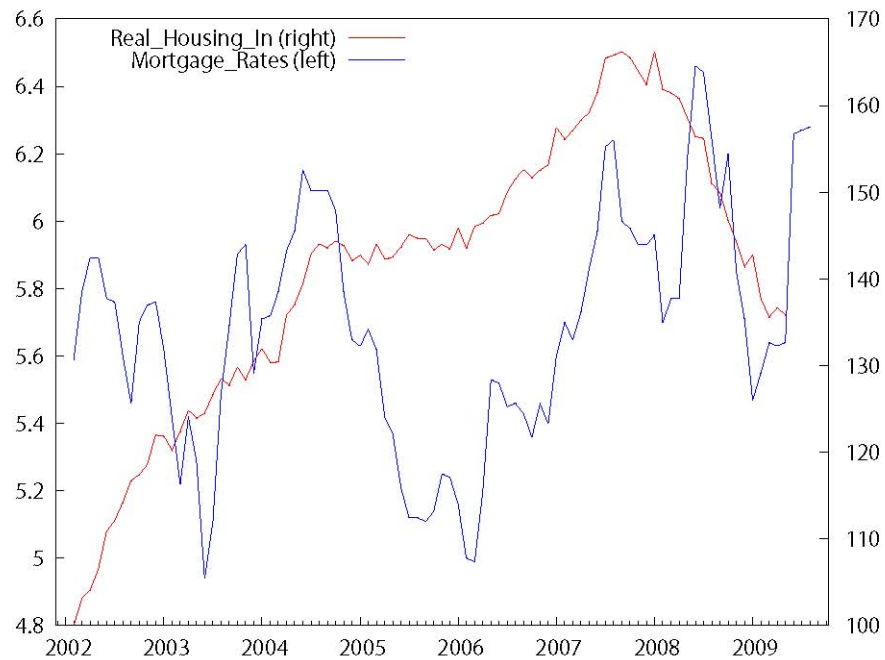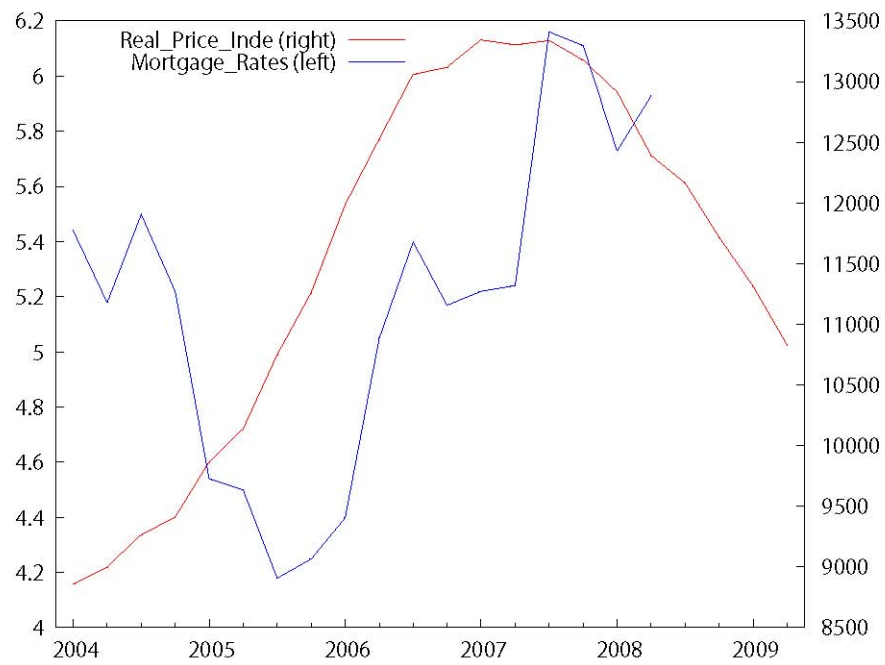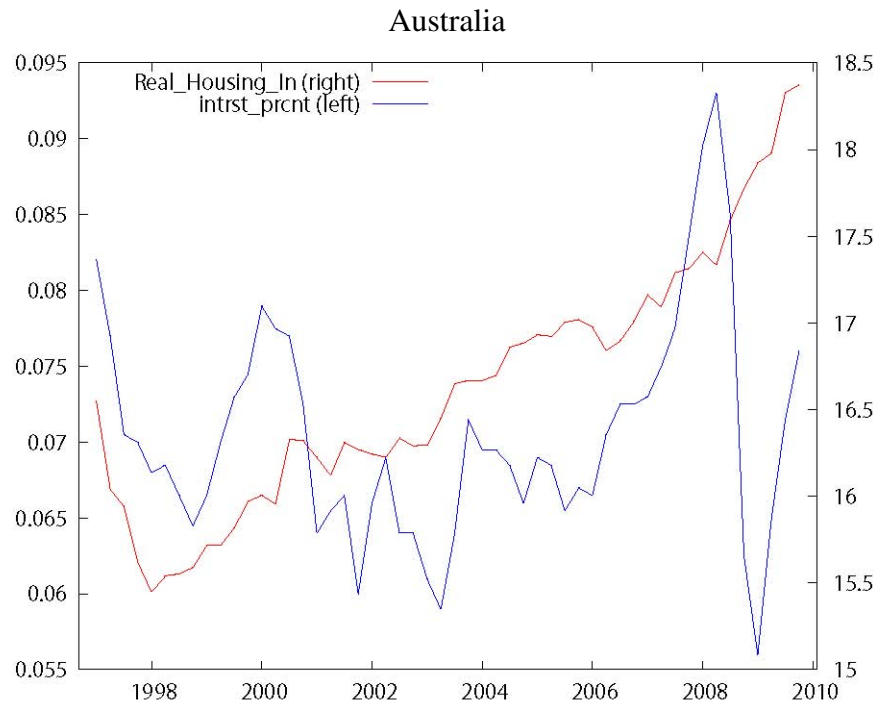
Housing Debt Service to Disposable Income per Capita Compared to the Nominal Housing Index (Figure 12)
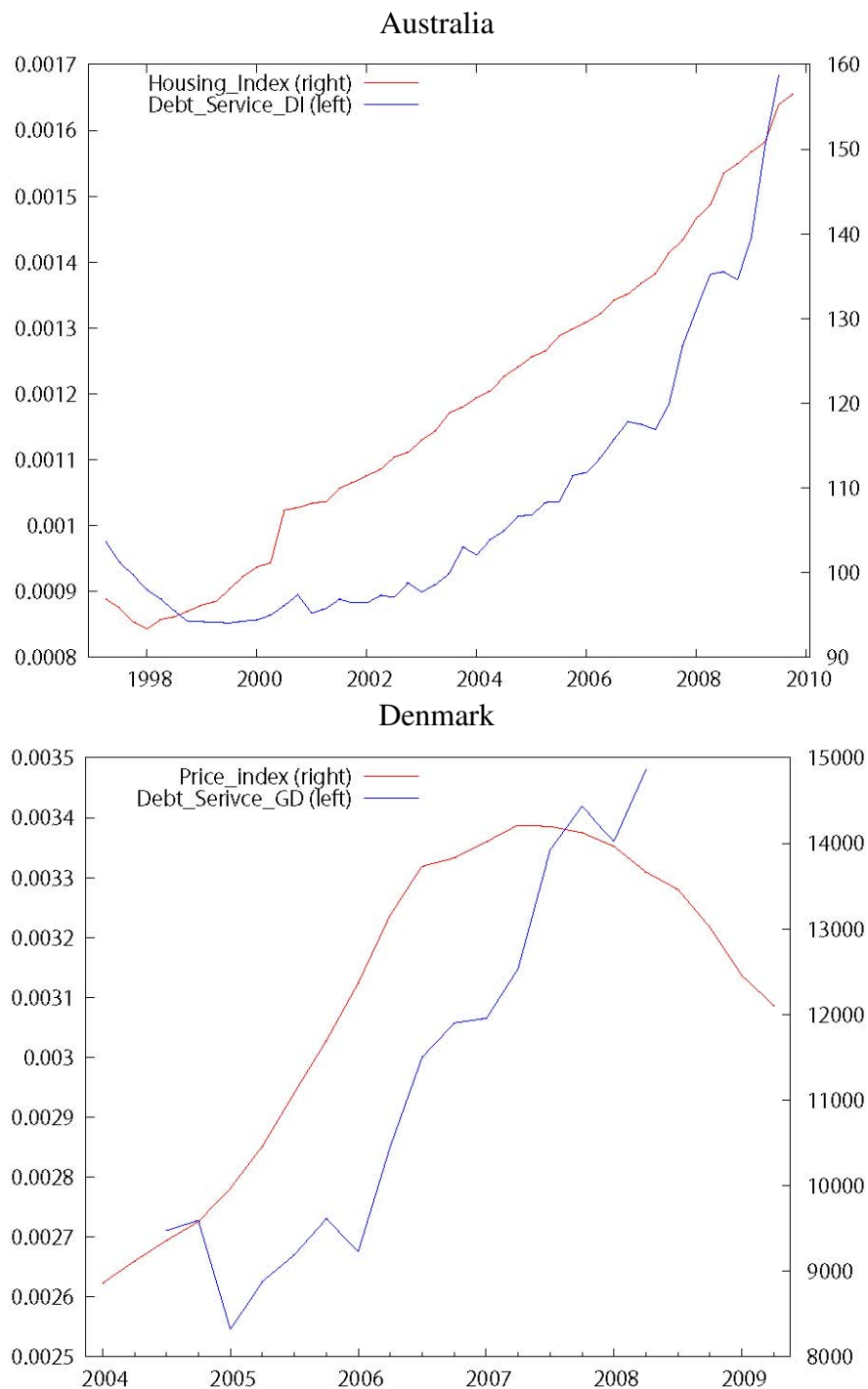
Ireland
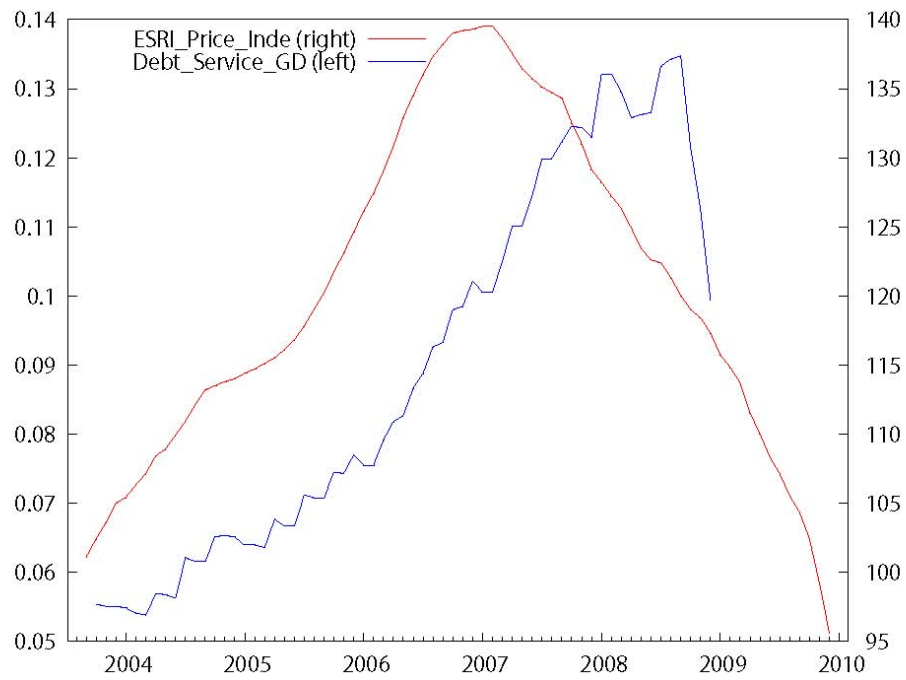
United Kingdom
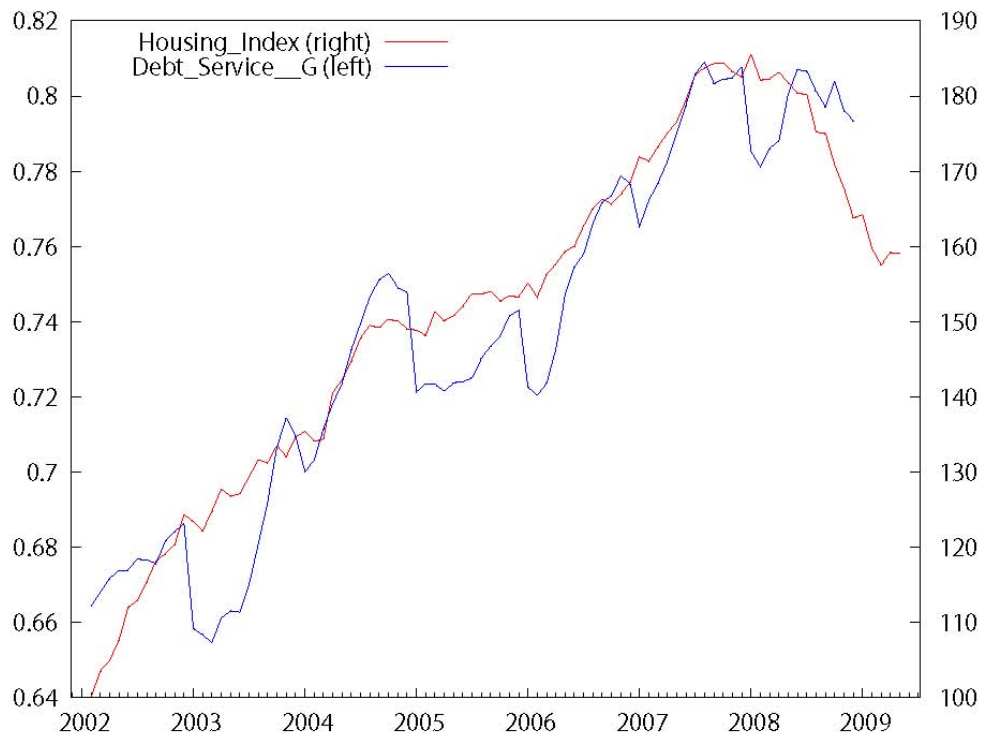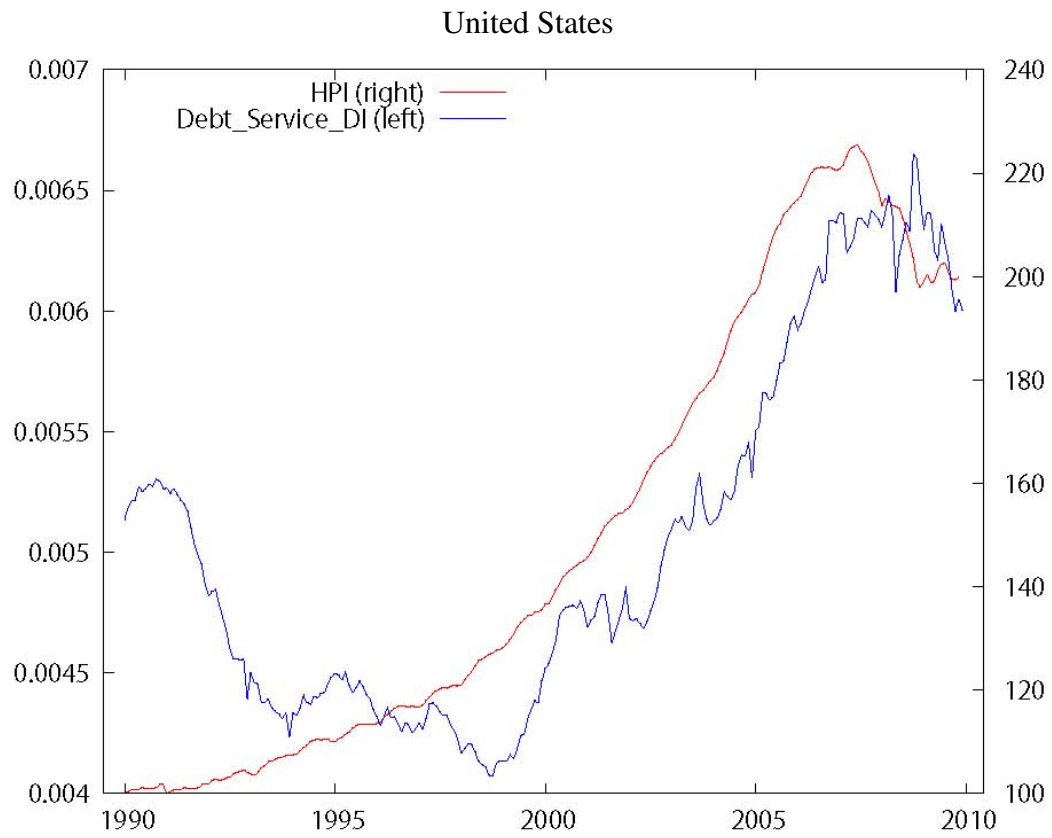
United States

Historic Housing Debt Service to Disposable Income per Capita in the United States since 1971 (Figure 13)
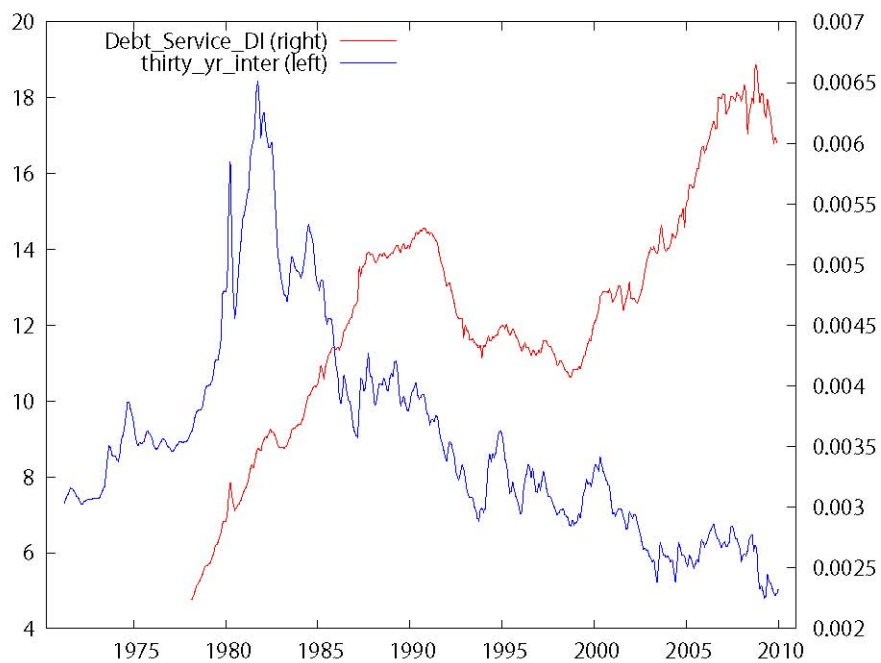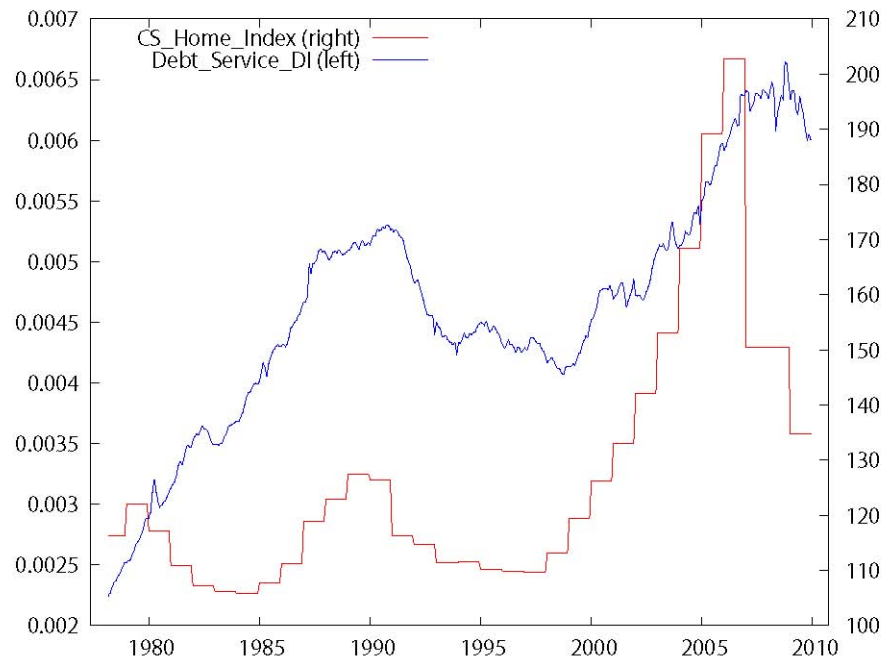
The Pattern in the Rising and Falling in Real Home Prices (Figure 14)

Denmark

Ireland

United Kingdom

United States

Australia (forecast)
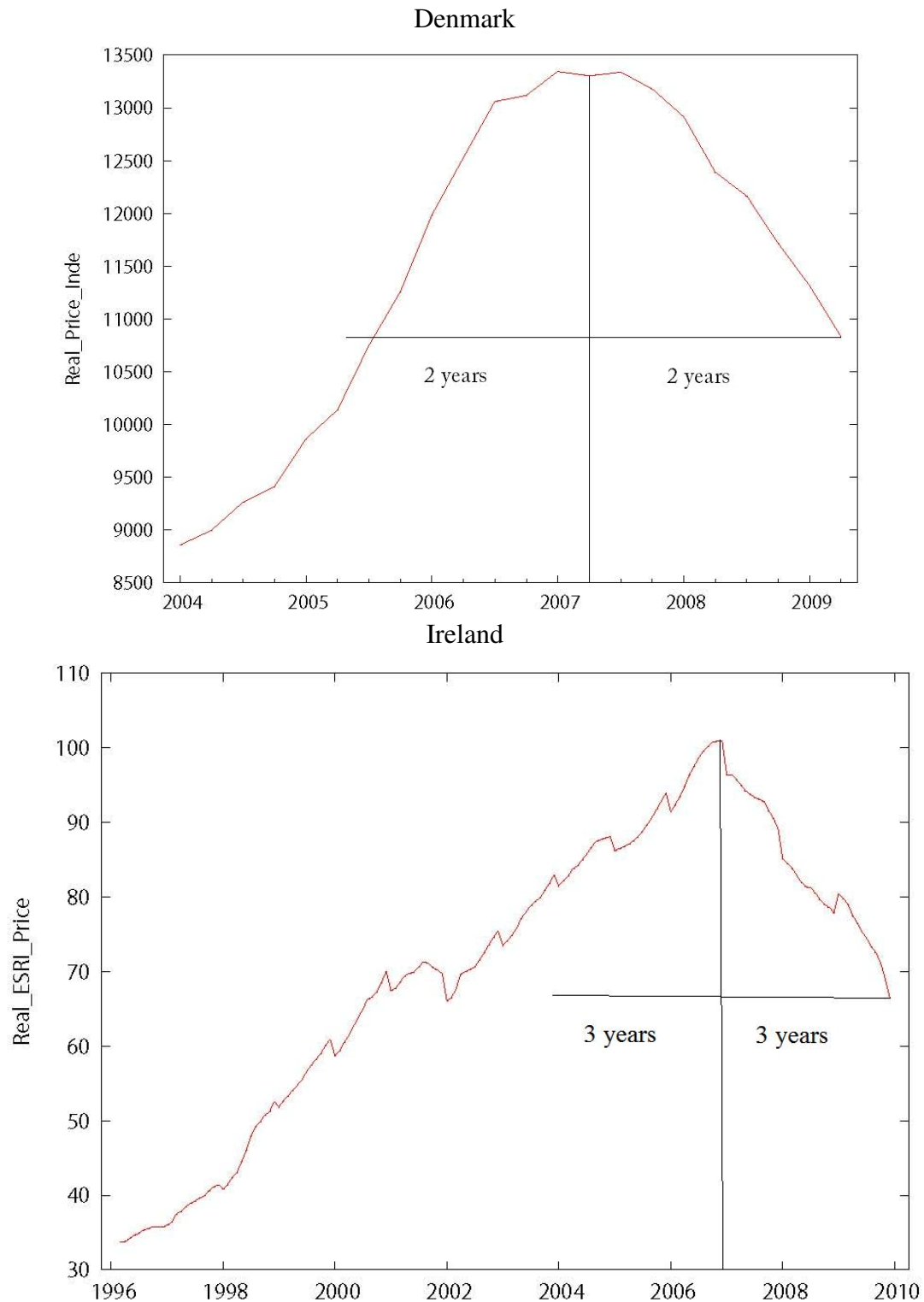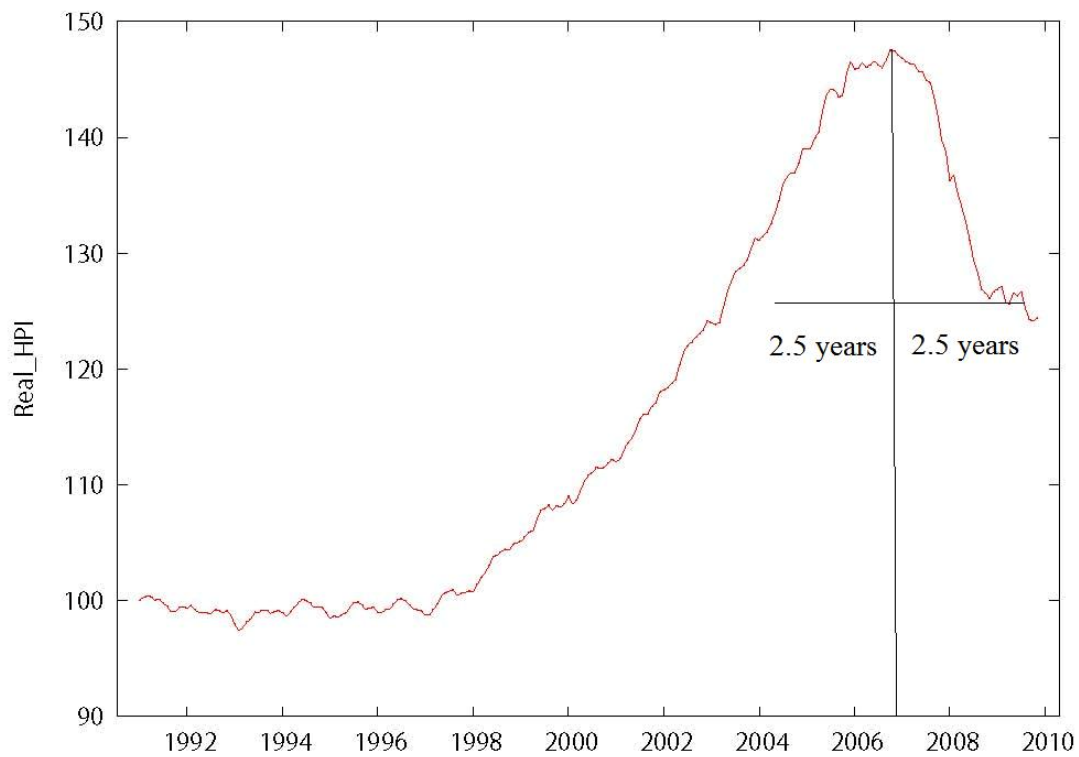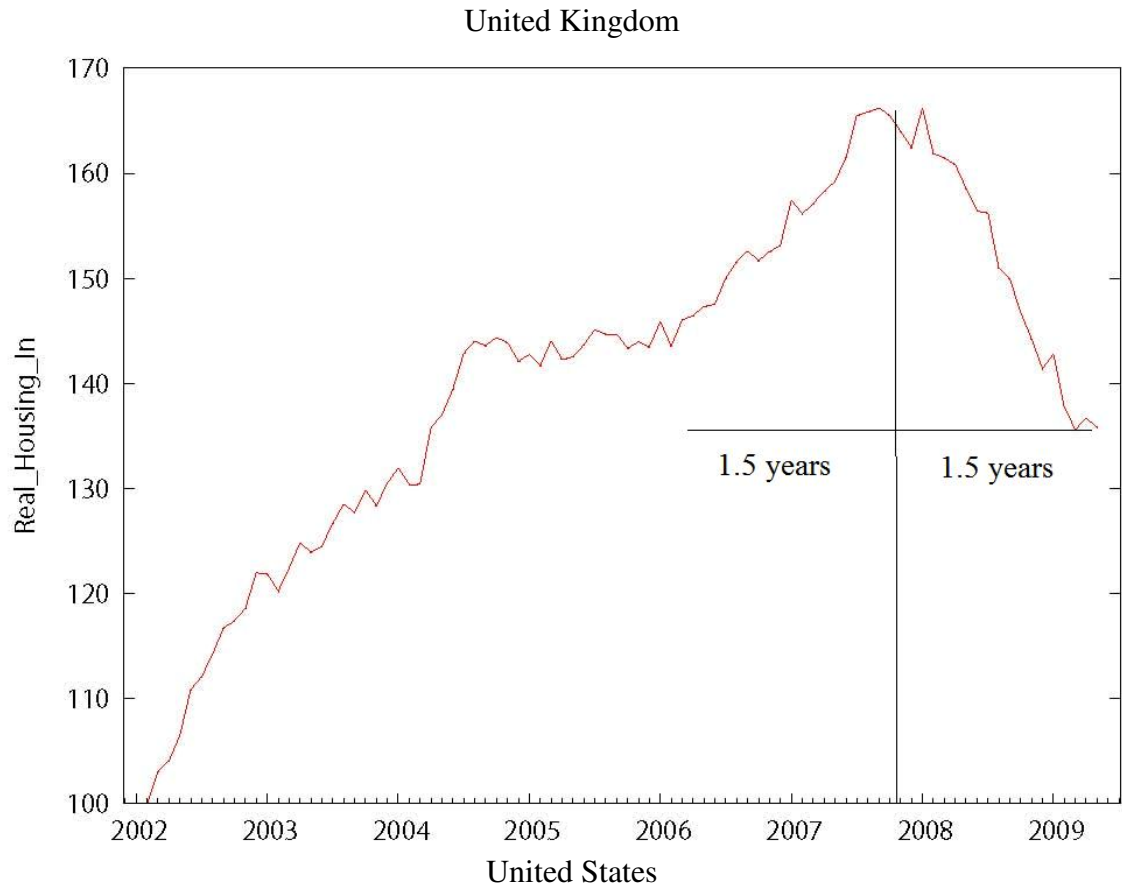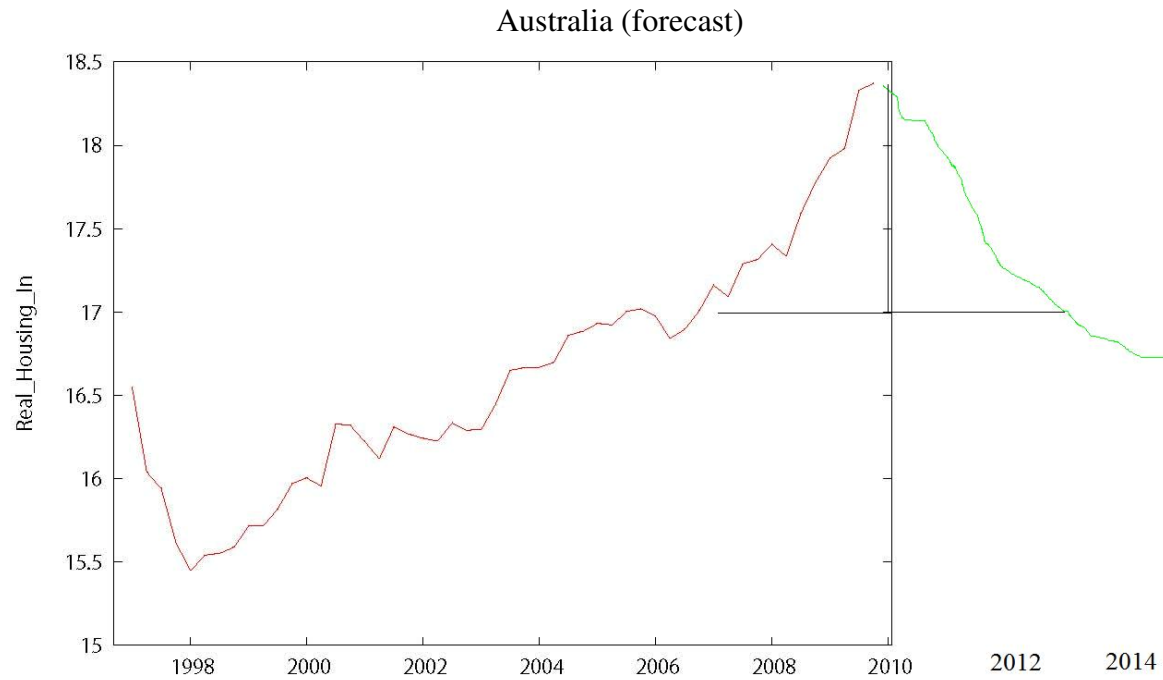
The Relationship between Peaks in Home Prices and Peaks in the Stock Market (Figure 15)

Australia

Ireland

United Kingdom

United States
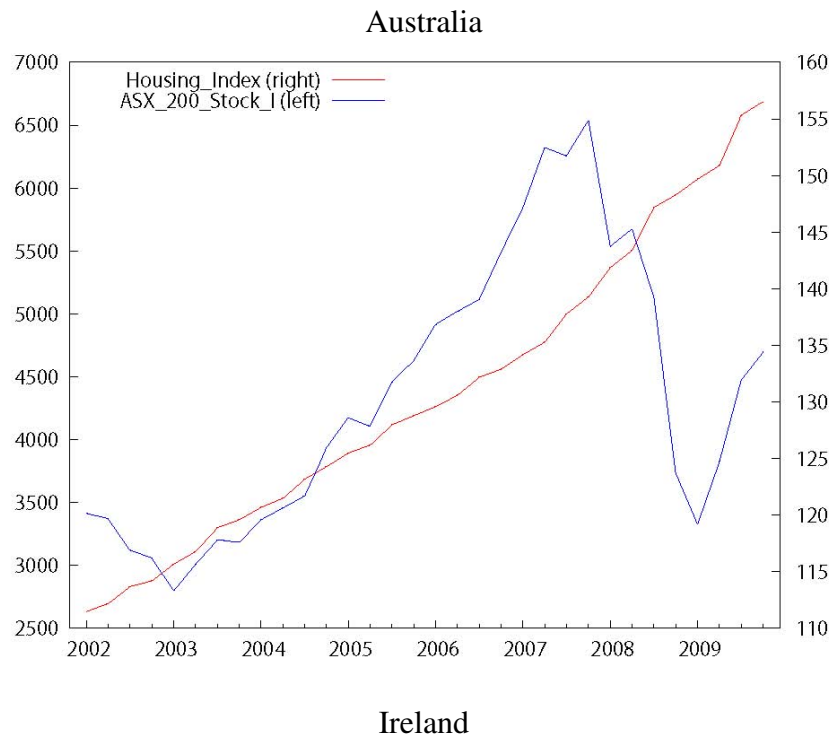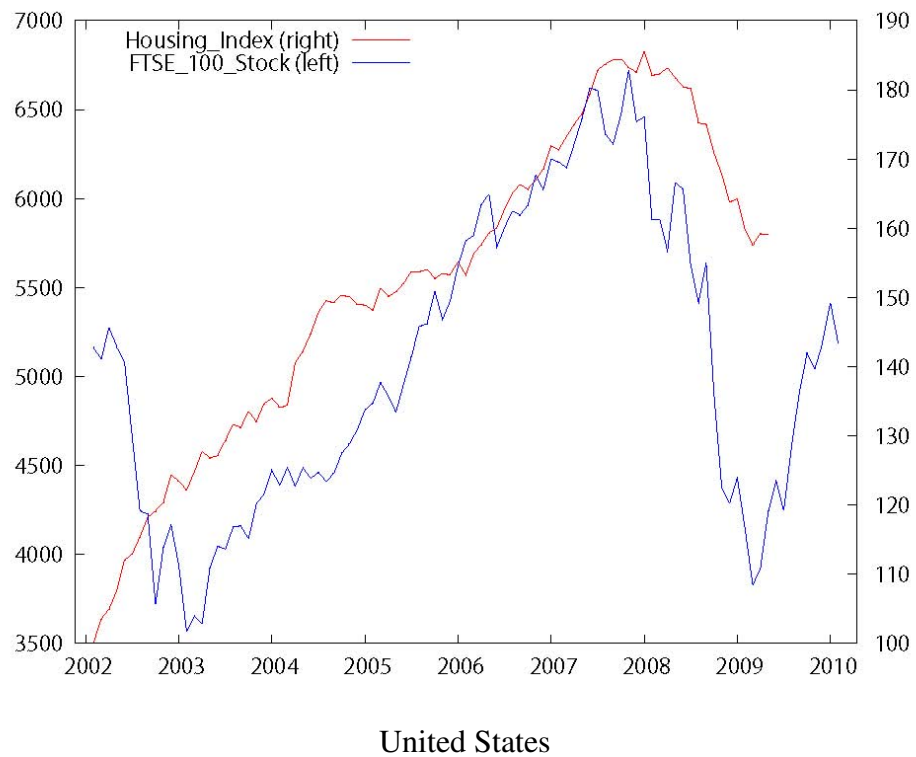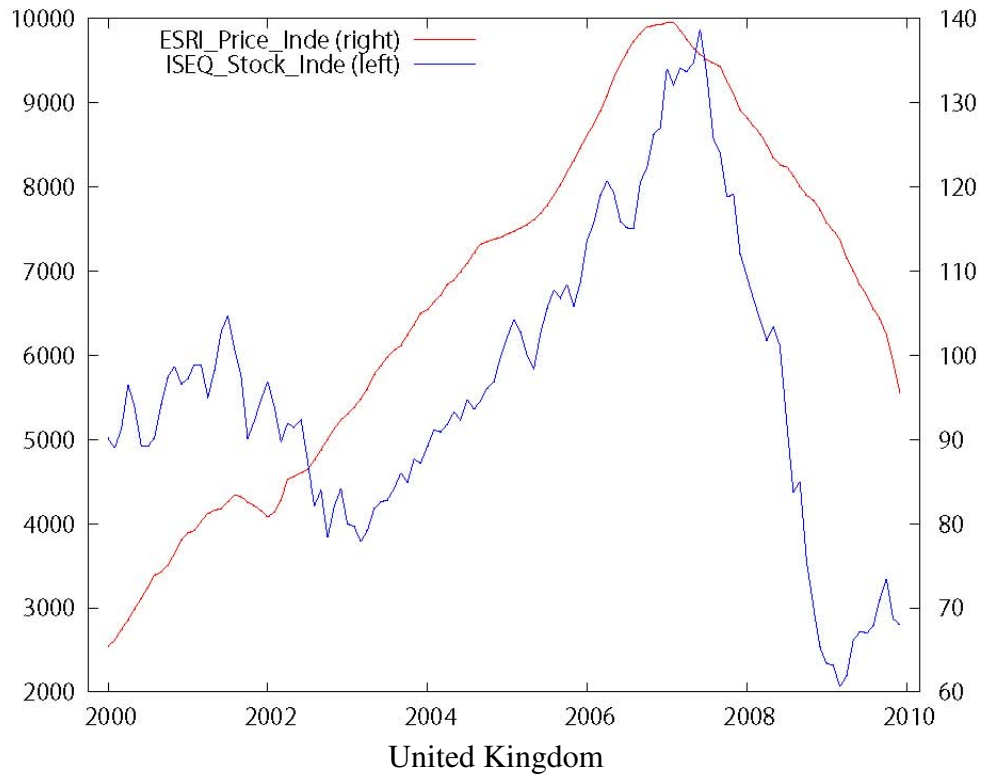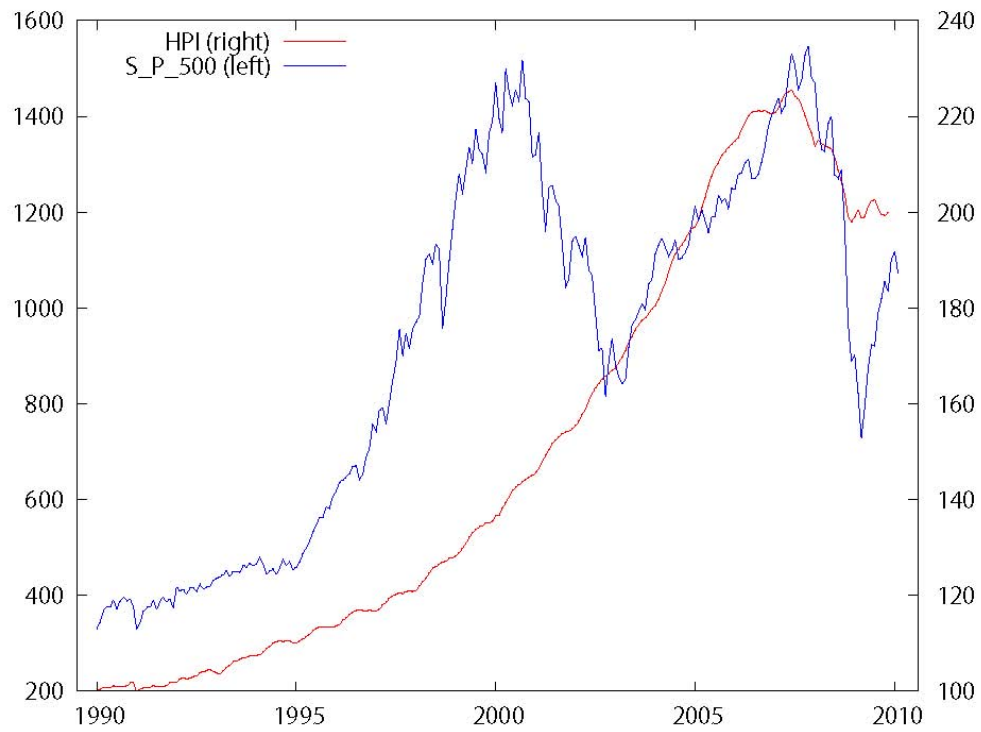
Denmark
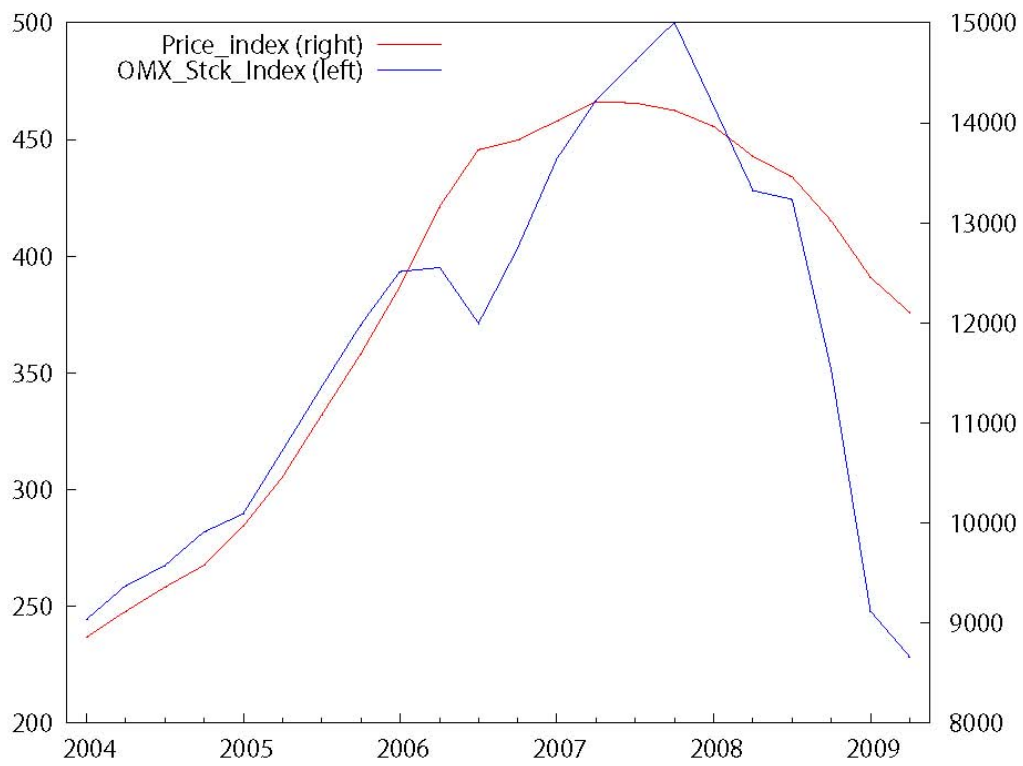
Case-Shiller Composite-10 (CSXR) Index since 1987 (Figure 16)
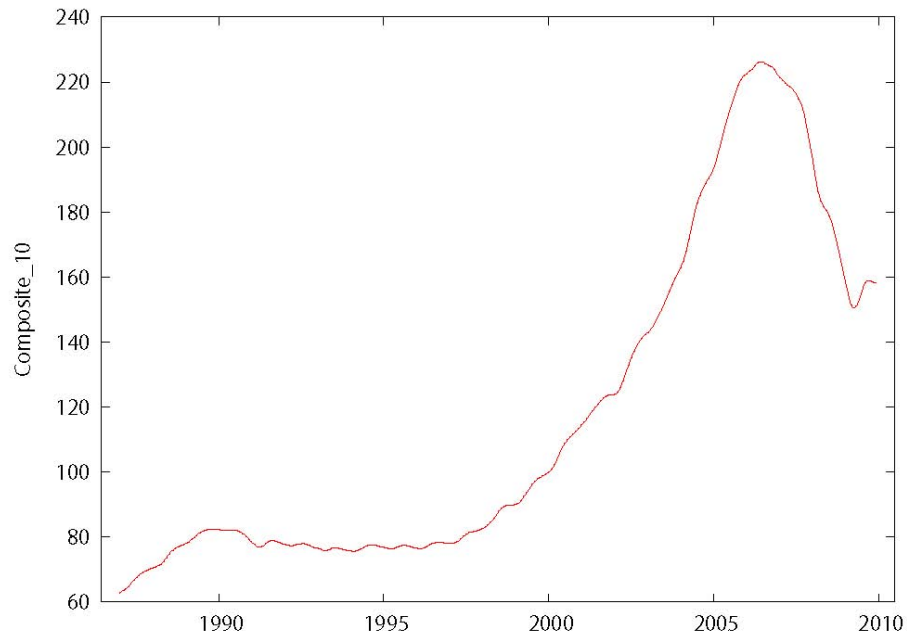
Los Angeles and Cleveland Case-Shiller Indexes since 1987 (Figure 17)
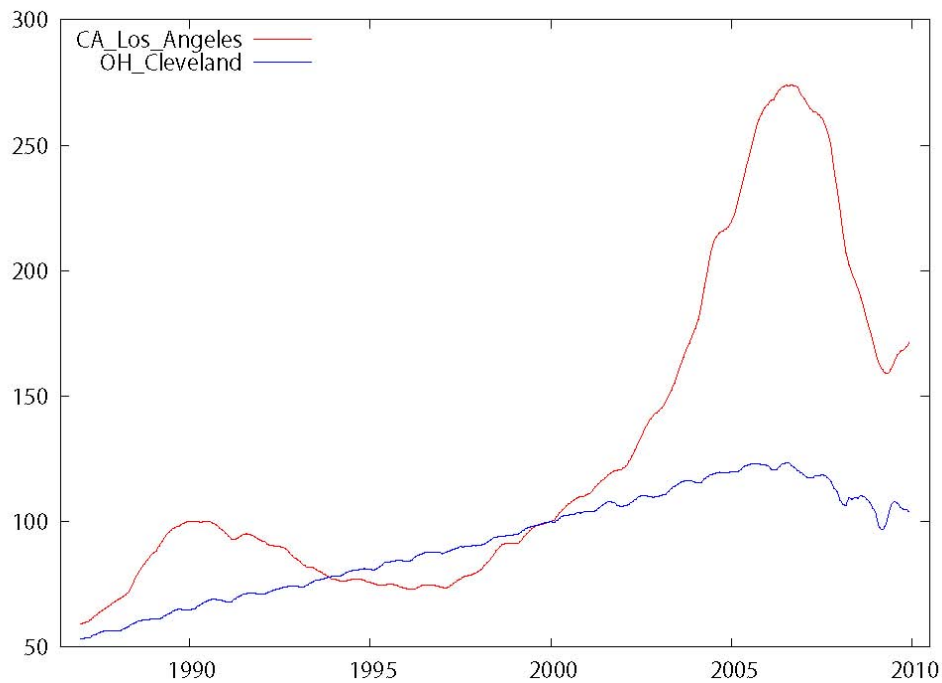
Scatter Plot of Cities' Size of Bubble and Median Multiple (Figure 18)

Siz_o_bubble versus Median_Multiple (with least squares fit)
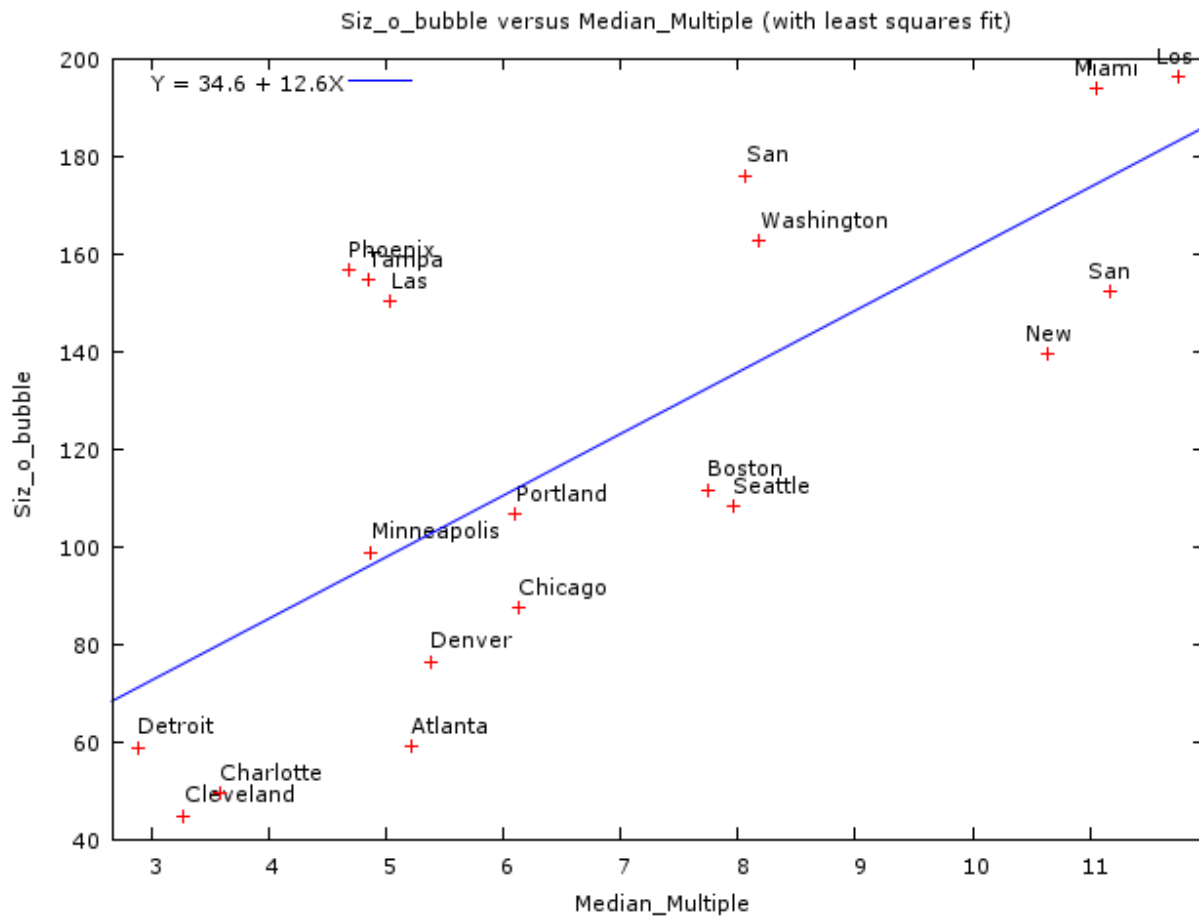
Best Model for Explaining Variation in the Size of a Bubble across U.S. Cities (Figure 19)

Model 46: OLS, using observations 1-19
Dependent variable: Siz_o_bubble

	Coefficient	Std. Error	t-ratio	p-value	
const	182.992	42.1141	4.3452	0.00058	***
Median_Multiple	17.1892	4.44886	3.8637	0.00153	***
percnt_Renters	-372.849	105.714	-3.5270	0.00305	***
Coastal	38.1824	19.9101	1.9177	0.07439	*

|			
Mean dependent var	120.1695	S.D. dependent var	48.90402
Sum squared resid	10304.00	S.E. of regression	26.20941
R-squared	0.760644	Adjusted R-squared	0.712773
F(3, 15)	15.88939	P-value(F)	0.000063
Log-likelihood	-86.77039	Akaike criterion	181.5408
Schwarz criterion	185.3185	Hannan-Quinn	182.1801
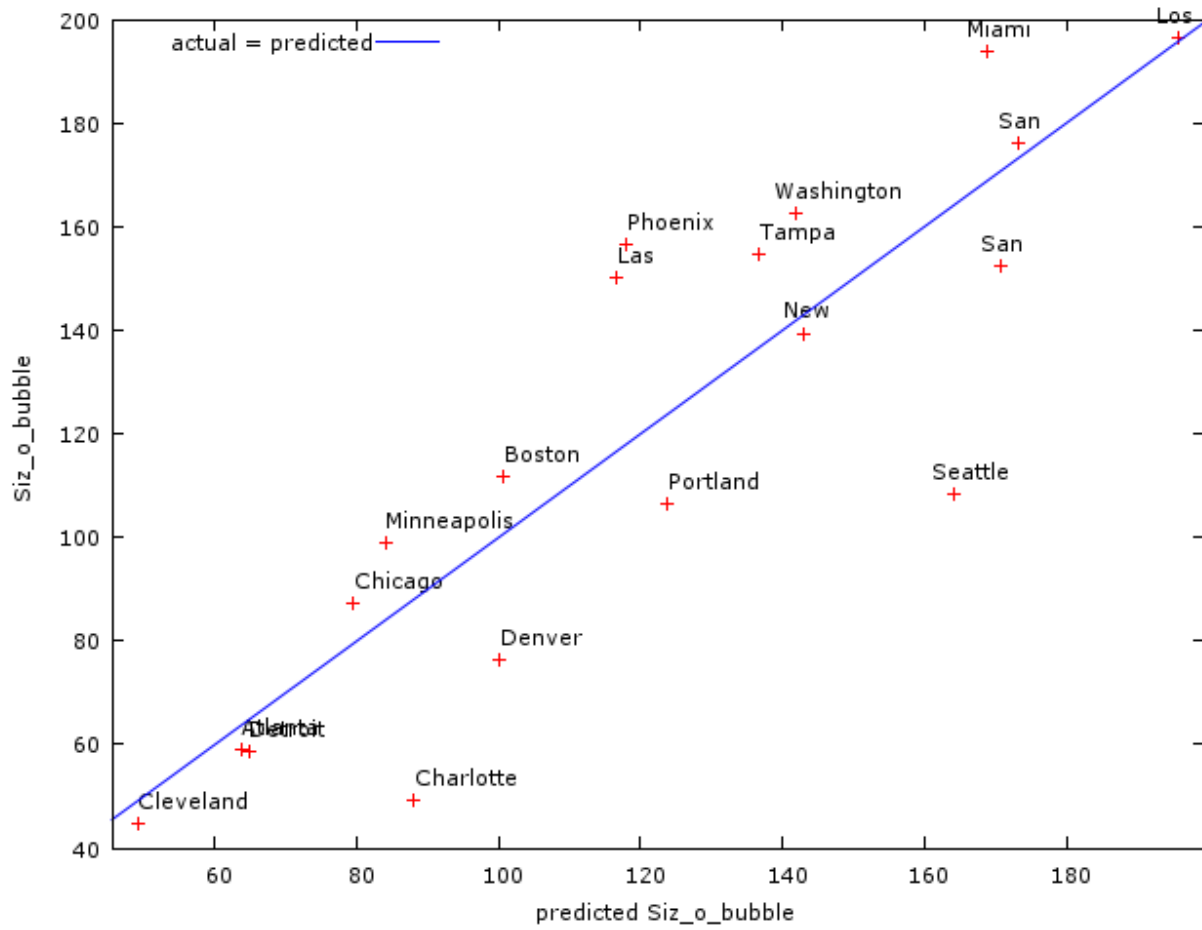
U.S. Commercial Real Estate Prices Graphed Against Residential Real Estate Prices and the Construction PPI (Figure 20)
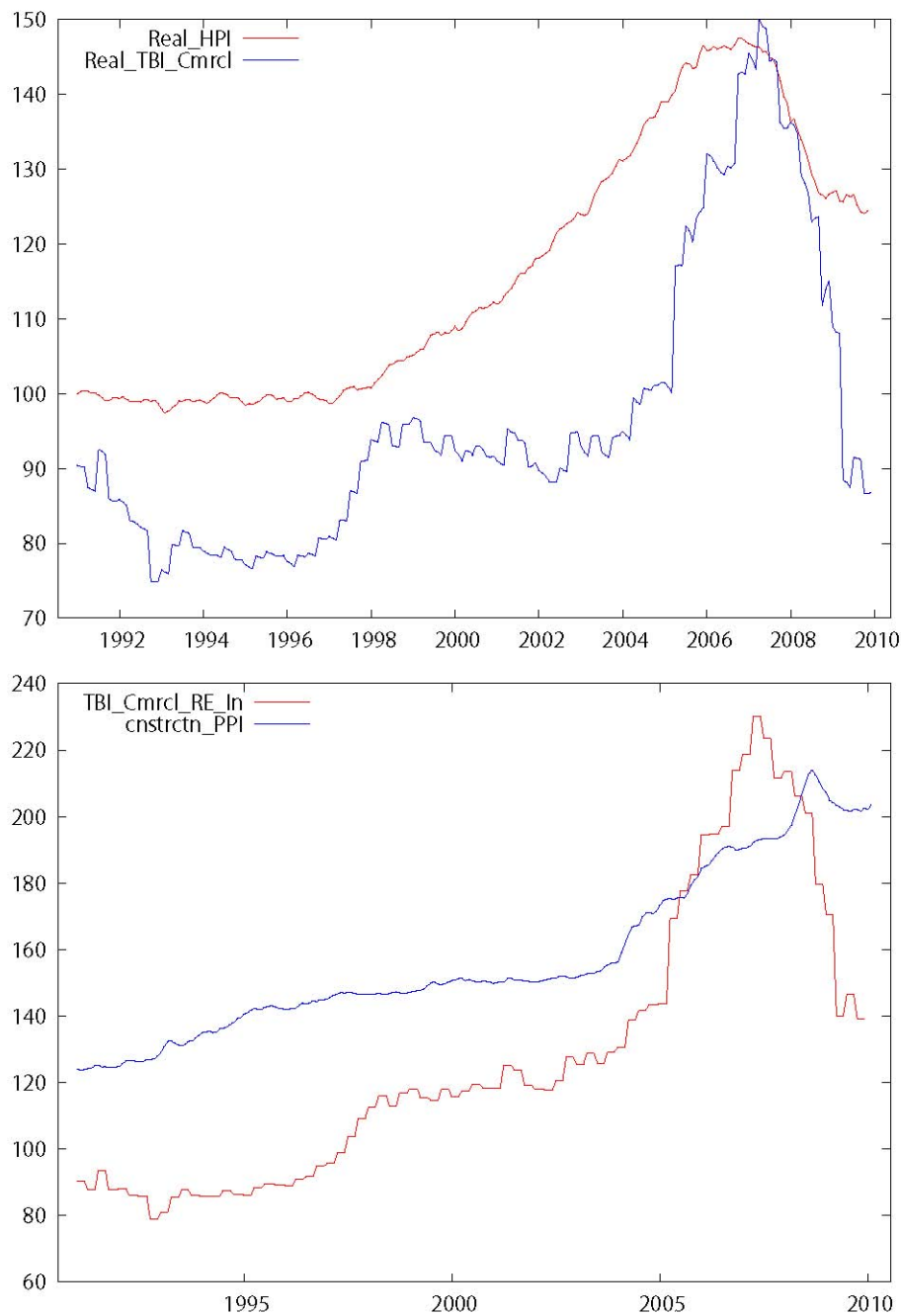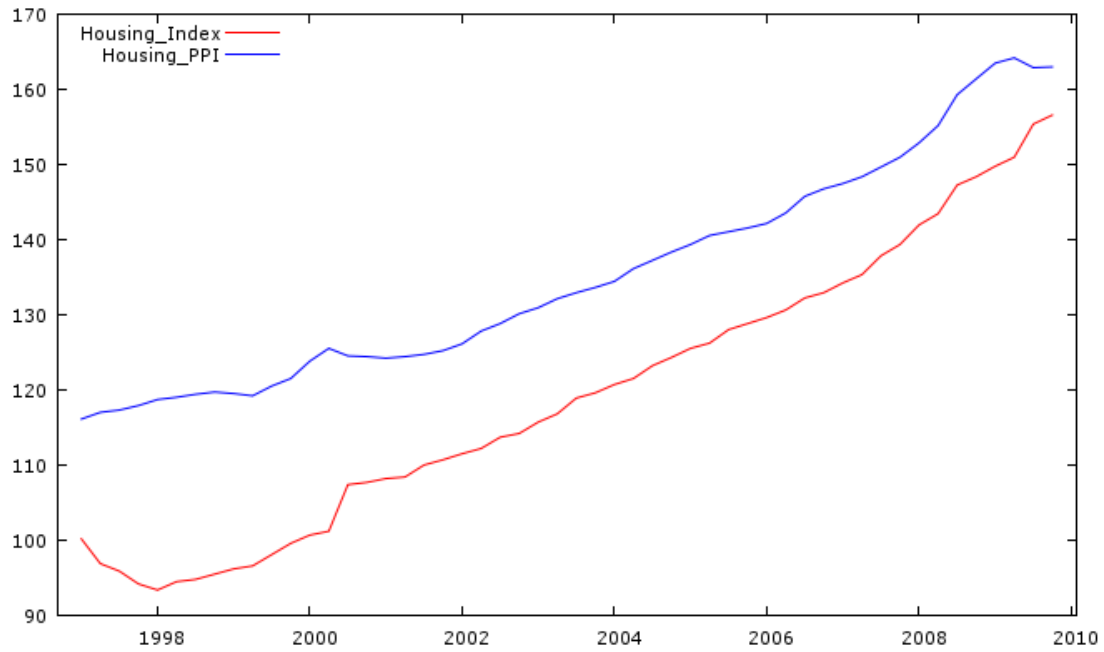
Australian Housing Market (Figure 21)

Australia Real Home Price Index

Australia Housing Starts
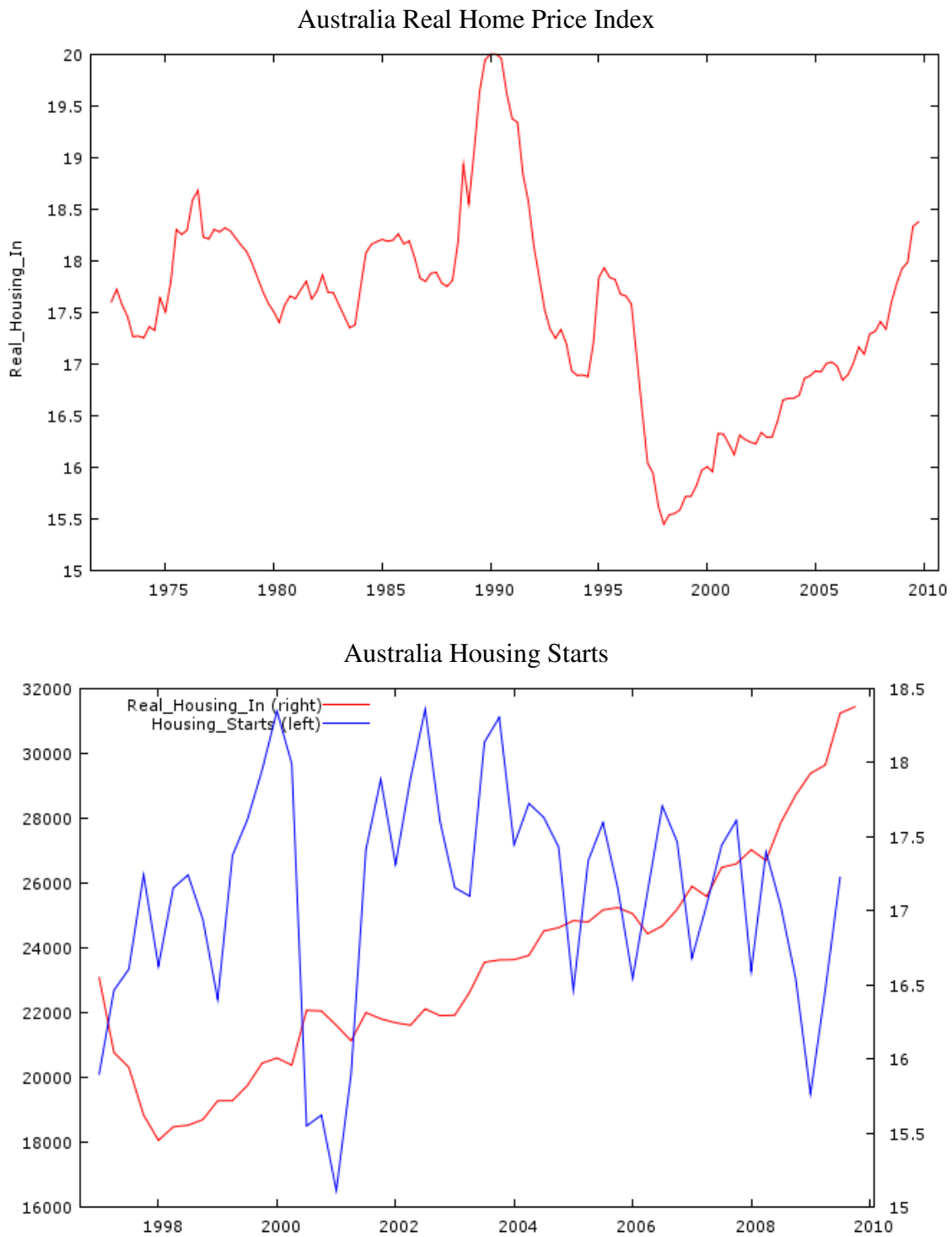
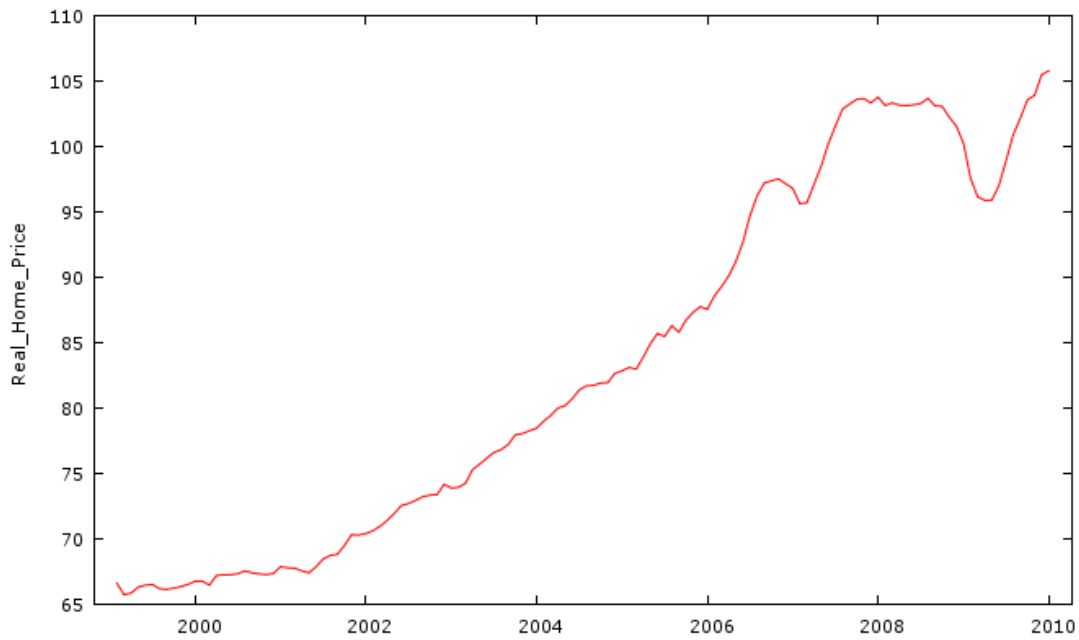## Australia Debt Service to Disposable Income Per Capita
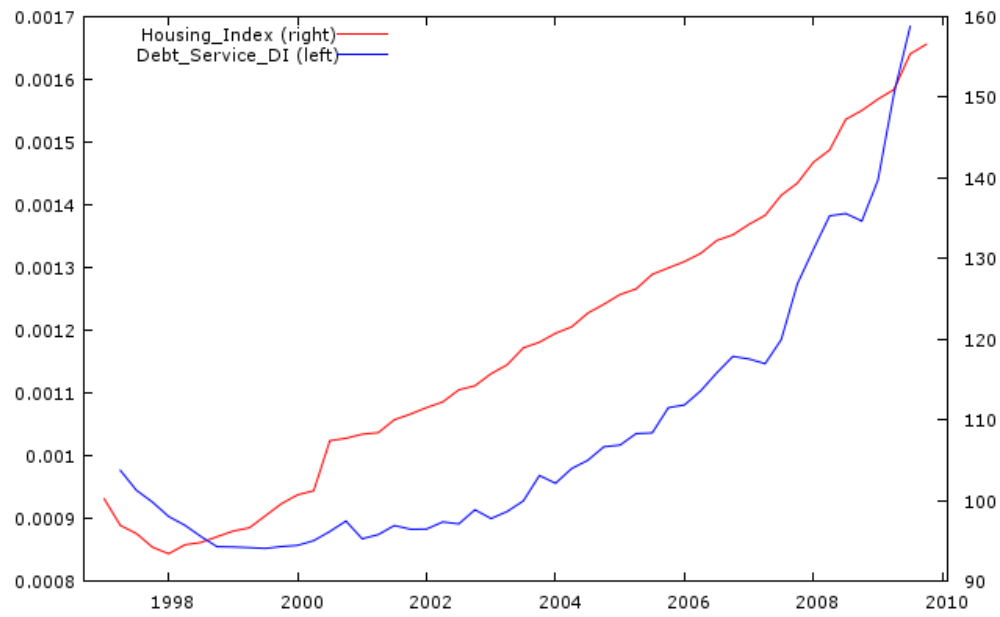
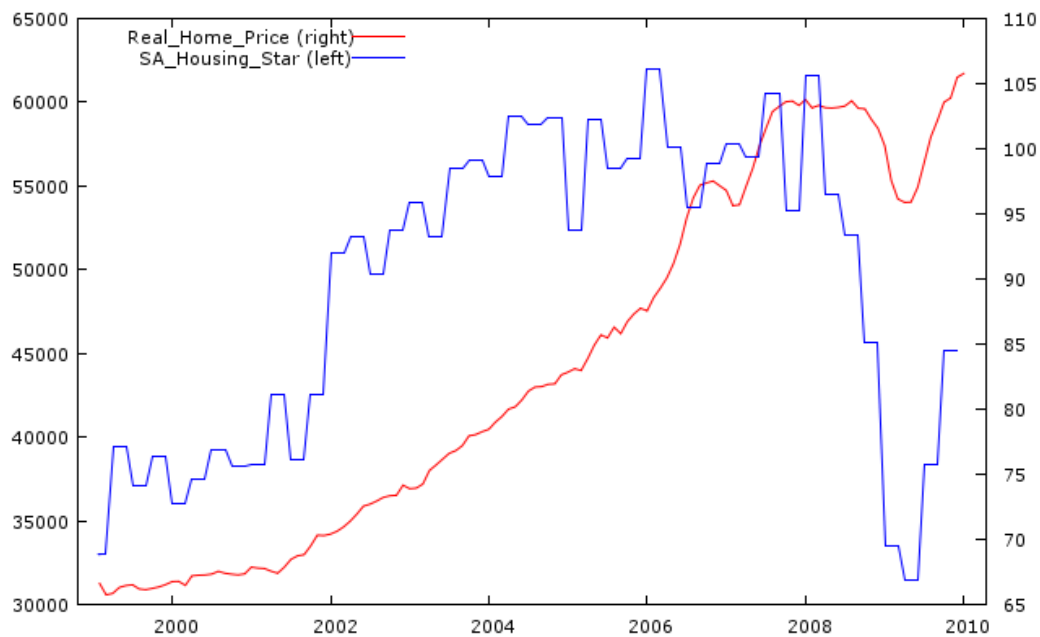

Australia Construction PPI

Canadian Housing Market (Figure 22)
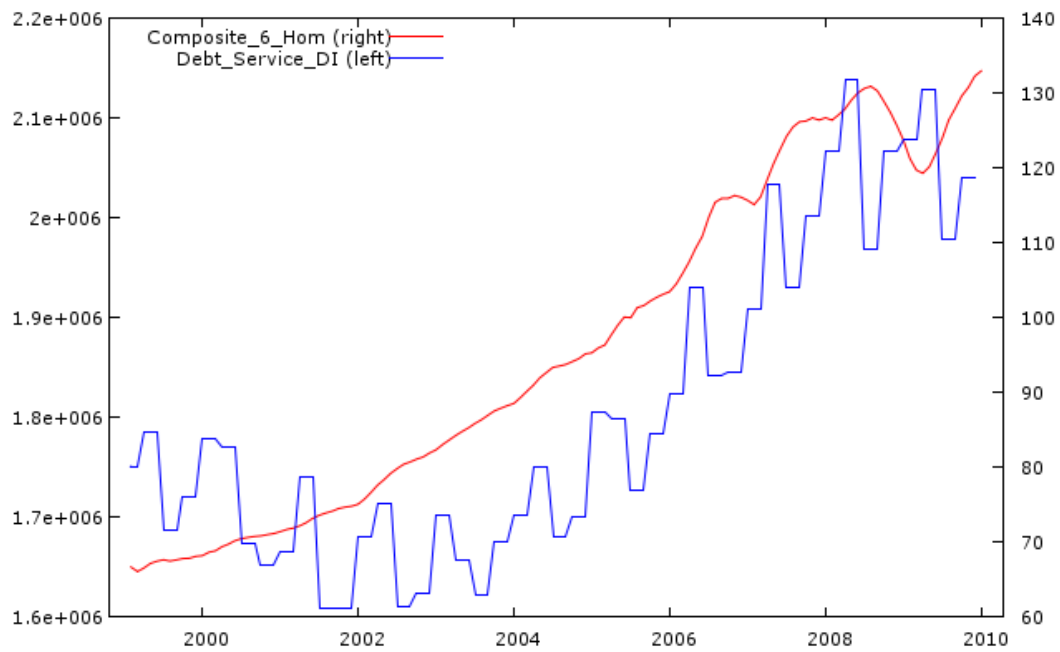
Canada Real Home Price Index

Canada Housing Starts

Canada Debt Service to Disposable Income Per Capita

Canada Construction PPI