NBER WORKING PAPER SERIES

WHAT EXPLAINS HOUSE PRICE BOOMS?: HISTORY AND EMPIRICAL EVIDENCE.

Michael D. Bordo
John Landon-Lane

Working Paper 19584
http://www.nber.org/papers/w19584

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
October 2013

Paper prepared for the 17th International Conference on Macroeconomic Analysis and International Finance Rethymno, Crete from May 30 to June 1, 2013. The authors would like to acknowledge the excellent research assistance provided by Antonio Cusato during this project. All remaining errors are our own. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

What Explains House Price Booms?: History and Empirical Evidence.
Michael D. Bordo and John Landon-Lane
NBER Working Paper No. 19584
October 2013
JEL No. N1

ABSTRACT

In this paper we investigate the relationship between loose monetary policy, low inflation, and easy bank credit with house price booms. Using a panel of 11 OECD countries from 1920 to 2011 we estimate a panel VAR in order to identify shocks that can be interpreted as loose monetary policy shocks, low inflation shocks, bank credit shocks and house price shocks. We show that loose monetary policy played an important role in housing booms along with the other shocks. We show that during boom periods there is a heightened impact of all three "policy" shocks with the bank credit shock playing an important role. However, when we look at individual house price boom episodes the cause of the price boom is not so clear. The evidence suggests that the house price boom that occurred in the US during the 1990s and 2000s was not due to easy bank credit. Loose monetary policy (as well as low inflation) played some role but the residual which may be picking up other factors such as financial innovation and the shadow banking system is the most important shock. This result is robust to many alternative specifications.

Michael D. Bordo
Department of Economics
Rutgers University
New Jersey Hall
75 Hamilton Street
New Brunswick, NJ 08901
and NBER
bordo@econ.rutgers.edu

John Landon-Lane
Department of Economics
75 Hamilton Street
Rutgers University
College Avenue Campus
New Brunswick, NJ 08901-1248
lane@econ.rutgers.edu

I. Introduction

Does expansionary monetary policy lead to house price booms? There is an extensive theoretical empirical and policy literature on this topic. The traditional view sees expansionary monetary policy as raising asset prices in general as part of the transmission mechanism of monetary policy. It works through the adjustment of the community's portfolio as agents substitute from cash to government securities to corporate securities; to equities; to real estate; old masters and commodities—eventually leading to overall inflation. Another view attributed to the Austrian economists in the 1920s and more recently to the BIS sees an environment of low inflation and accommodative monetary policy as creating an environment conducive to asset booms and consequent busts.[2] Finally, Schularick and Taylor (2011), Jorda and Schularick (2012) and Christiano (2010) have emphasized the importance of rapid bank credit growth, possibly driven by financial innovation, in contributing to asset price booms.

Asset booms (especially those leading to bubbles) are often followed by busts which can have serious economic effects. There is a long historical incidence of infamous boom busts ranging from the South Sea bubble in the early eighteenth century, many famous stock market crashes in the nineteenth century, the 1929 Wall Street Crash, the UK housing boom bust of

[2] Related approaches emphasize financial liberalization and innovation accommodated by loose monetary policy as conducive to creating booms.

1973, the Nordic crises of the 1980s, the Japanese housing and equity bubble and crash of 1990 and the more recent dotcom and subprime mortgage boom busts. This history keeps repeating itself.

The policy implications of asset booms are significant, especially since asset busts have often tended to lead to banking crises and serious and prolonged recessions. To the extent monetary policy is a contributing factor, the question arises whether the monetary authorities should use their policy tools to defuse booms before they turn into busts. A vociferous debate raged in the early 2000s and until the aftermath of the recent financial crisis over the subject of preemptive policy action. Central banks were unwilling to divert much attention away from their traditional concern over price and overall macro stability. However the tide has recently turned and the new emphasis on macro prudential monetary policy suggests that asset price booms have been elevated to the top level of interest.

Finally, the issue still remains that asset price booms in addition to sometimes ending with damaging busts can be the precursors to a future run up in inflation. This then leads to the question of when central banks should tighten their policies to prevent inflation from becoming embedded in expectations.

In this paper we develop a method to demarcate asset price booms. We focus on house price booms for 11 OECD countries from 1920 to the present. We then ascertain whether our set of boom events can be related to expansionary monetary policy measured by deviations from Taylor rules as well as to low inflation and bank credit growth. Finally we use panel vector autoregression techniques to identify orthogonalized shocks and their effect on house prices on

average and use historical decompositions to identify the effects of the orthogonalized shocks on individual house price booms.

The paper is organized as follows: Section II discusses the general debate over the linkage between monetary policy and asset price booms, Section III contains historical narratives on some of the salient house price booms from the Twentieth Century. Section IV discusses our methodology of identifying house price booms and presents a chronology from 1920 to the present of the booms so identified. Section V uses econometrics to isolate the links between expansionary monetary policy and asset price booms, controlling for low inflation, bank credit growth and other factors. Section VI concludes with the implications of our findings for monetary policy.

Section II: The Issues

Debate swirls over the causes of the subprime Mortgage Crisis of 2007-08 and the Great Recession of 2007-2009 and the subsequent slow recovery. Two views predominate; the first is that it was caused by global imbalances: a global savings glut in Asia which financed a consumption boom, persistent budget deficits and current account deficits in the U.S and other advanced countries. The second that it reflected domestic imbalances in the U.S. leading to an

unprecedented nationwide housing boom which burst in 2006 precipitating the crisis. This paper focuses on the second view.[3]

A key element of the domestic U.S. story is that the Federal Reserve kept monetary policy too loose from 2002-2006 which fueled a housing boom that had its origins in a long tradition of policies to encourage home ownership in succeeding administrations, financial innovation, lax regulatory supervision and oversight and corporate malfeasance. John Taylor (2007, 2009) has led the indictment of the Fed for fueling the housing boom in the early 2000s. Based on the Taylor Rule (1993) he shows that the Federal Funds rate was as low as 3 percentage points below what a simple Taylor rule would generate for the period 2002-2005. Taylor then simulated the path of housing starts had the Fed followed the Taylor rule over the period 2000 to 2006. His calculations suggest that most of the run up in housing starts from 2002 to 2005 would not have occurred.

An earlier OECD study by Ahrend et al (2005) found a close relationship between negative deviations of the Taylor rule and several measures of housing market buoyancy (mortgage lending, housing investment, construction investment and real house prices) for a

[3] The possibility that monetary policy can produce asset price bubbles has also been studied extensively in equilibrium rational expectations models. In such models, poorly designed monetary policies, such as the use of interest rate rules without commitment to a steady long-run inflation rate, can lead to self-fulfilling prophecies and asset price bubbles. Such outcomes are less likely, Woodford (2003) argues, if monetary policymakers follow a clear rule in which the interest rate target is adjusted sufficiently to stabilize inflation. The theoretical literature thus suggests that consideration of the monetary policy environment may be crucial to understanding why asset booms come about.

number of OECD countries in the early 2000s. The principal examples are the U.S. (2000-2006), Canada (2001-2007), Denmark (2001-2004) and Australia (2000-2003). For the euro area as a whole, they find that ECB policy rates are not far below the Taylor rule but for a number of individual members (Portugal, Spain, Greece, Netherlands, Italy, Ireland and Finland) they are well below it. This evidence as well as evidence in several other papers (Hott and Jakipii 2012, Gerlach and Assenmacher- Wesche 2008a) suggests that expansionary monetary policy had a key role to play in fostering recent housing booms, some of which led to devastating busts. Other literature finds evidence linking expansionary monetary policy to equity booms and commodity price booms (Gerlach and Assenmacher Weshe 2008b, Pagano, Lombardi, Anzuini 2010).

There is an extensive earlier literature on the relationship between monetary policy and asset prices in general. Asset prices are viewed as a key link in the transmission mechanism of monetary policy. The traditional view argues that added liquidity causes asset prices to rise as a link in the transmission mechanism of monetary policy actions to the economy as a whole. Another view, the Austrian/BIS view argues that asset price booms are more likely to arise in environments of low and stable inflation and thus asset price booms can arise because monetary policy is geared to credibly stabilizing prices.

The traditional view has a long history. Early Keynesian models like Metzler (1951) had central bank operations affecting the stock market directly. Friedman and Schwartz (1963a) and later Tobin (1969) and Brunner and Meltzer (1973) spelled out the transmission mechanism following an expansionary Fed open market purchase. It would first affect the prices (rate of return) on short –term government securities, then via a portfolio balance substitution mechanism, the price (rate of return) of long-term government securities then corporate

securities, equities ,real estate, old masters and commodities including gold would be bid up (their returns lowered). Thus substitution from more to less liquid assets would occur as returns on the former decline relative to the latter. Thus the impact of expansionary monetary policy will impact securities, assets and commodities and finally the overall price level. This view sees asset prices as possible harbingers of future inflation.

The Austrian/BIS view which goes back to Hayek, von Mises, Robbins[4] and others in the 1920s posits that an asset price boom whatever its fundamental cause, can degenerate into a bubble if accommodative monetary policy allows bank credit to rise to fuel the boom. This view argues that unless policy-makers act to defuse the boom, a crash will inevitably follow that in turn may cause a serious recession. The Austrians equated rising asset prices with a rise in the overall price level. Although the level of U.S. consumer prices was virtually unchanged between 1923 and 1929, the Austrians viewed the period as one of rapid inflation fueled by loose Federal Reserve policy and excessive growth of bank credit (Rothbard 1983).

The Austrian view has carried forward into the modern discussion of asset price booms. It has been incorporated into the BIS view of Borio and Lowe (2002), Borio and White (2003) and others. They focus on the problem of "financial imbalances" defined as rapid growth of credit in conjunction with rapid increases in asset prices and possibly investment. Borio and Lowe (2002) argue that a build-up of such imbalances can increase the risk of a financial crisis and macroeconomic instability. They construct an index of imbalances based on a credit gap (deviations of credit growth from trend), an equity gap, and an output gap, to identify incipient

[4] See Laidler (2003).

asset price declines that can lead to significant real output losses, and advocate its use as a guide for proactive action. In this vein Borio (2012) discusses a financial cycle based on property prices and credit growth which has much greater amplitude than the business cycle and when its peak coincides with a business cycle peak, a housing bust, banking crisis and deep protracted recession can follow, as occurred in 2007.

Borio and Lowe argue that low inflation can promote financial imbalances regardless of the cause of an asset price boom. For example, by generating optimism about the macroeconomic environment, low inflation might cause asset prices to rise more in response to an increase in productivity than they would otherwise would. Similarly, an increase in demand is more likely to cause asset prices to rise if the central bank is credibly committed to price stability. A commitment to price stability that is viewed as credible, Borio and Lowe (2002) argue, will make product prices less sensitive and output and profits more sensitive in the short-run to an increase in demand. At the same time, the absence of inflation may cause policy makers to delay tightening as demand pressures build up. [5]Thus they contend (pp. 30-31) "these

[5] A related issue to the impact of expansionary monetary policy on asset prices is whether the price index targeted by the central bank should include asset prices. Alchian and Klein (1973) contend that a theoretically correct measure of inflation is the change in the price of a given level of utility, which includes the present value of future consumption. An accurate estimate of inflation, they argue, requires a broader price index than one consisting only of the prices of current consumption goods and services. To capture the price of future consumption, Alchian and Klein (1973) contend that monetary authorities should target a price index that includes asset prices. Bryan et al (2002) concur, arguing that because it omits asset prices (especially housing prices), the CPI seriously understated inflation during the 1990s.

endogenous responses to credible monetary policy (can) increase the probability that the latent inflation pressures manifest themselves in the development of imbalances in the financial system, rather than immediate upward pressure in higher goods and service price inflation."[6]

Christiano et al (2010) present historical evidence showing that stock price booms in the U.S. and Japan often occurred in periods of low inflation. Productivity shocks which raise the natural rate of interest are accommodated by expansion in bank credit which pushes up stock prices. According to their analysis based on a DSGE model, following a Taylor type rule in the face of low inflation will lead to lower interest rates which will further fuel the asset boom.

In section V below we present some evidence consistent with the loose monetary policy explanation for asset price booms and also the Austrian BIS view that regards monetary policy dedicated to low inflation and bank credit expansion as creating an environment conducive to an asset boom. However the weight attributed to the different explanations differs across historical boom episodes.

III Historical narrative

In this section we give a brief overview of house price booms and busts from a historical perspective. For a more detailed discussion on asset price booms and busts from history see Bordo and Landon-Lane (2013).

[6] For evidence that low inflation contributed to the housing booms of the 1990s and 2000s see Frappa and Mesonnier (2010).

III.1 The 1920s

The most famous episode of an asset price boom during the 1920's is the Wall Street Boom beginning in 1923 and ending with the Crash in October 1929. During the boom stock prices rose by over 200%, the collapse from 1929 to 1932 had prices decline by 66%.The boom was associated with massive investment that brought the major inventions of the late nineteenth century, eg electricity and the automobile, to fruition. In addition, major innovations also profoundly changed industrial organization and the financial sector, including the increased use of equity as a financial instrument. The economy of the 1920s (following the sharp recession of 1920-21) was characterized by rapid real growth, rapid productivity advance and slightly declining prices, punctuated by two minor recessions. Irving Fisher and other contemporaries believed that the stock market boom reflected the fundamentals of future profits from the high growth industries that were coming on stream and that it was not a bubble. Recent work by McGrattan and Prescott (2003) concurs with that view although many others regard it as a bubble (Galbraith 1955, White and Rapoport 2004).

Debate continues over the role of expansionary Federal Reserve policy in fueling the boom. In 1932 Adolph Miller, a member of the Federal Reserve Board blamed the New York Fed and its President Benjamin Strong for pursuing expansionary open market purchases to help Britain restore the pound to its prewar parity in 1924 and then again in 1927 to protect sterling from a speculative attack. In both occasions, the U.S. economy was in recession justifying expansionary policy (Friedman and Schwartz 1963b). Miller indicted Strong (who died in 1928)

for fueling the stock market boom and the resultant crash. His views were instrumental in legislation in 1933 which prohibited Reserve banks from engaging in international monetary policy actions.

As mentioned in Section II above the Austrian economists later followed by economists at the BIS saw the 1920s as a credit boom accommodated by monetary policy. Eichengreen and Michener (2004) present evidence for the BIS view for the 1920s as a credit boom gone wild, based on their measures of a credit boom (deviations from trend of the ratio of broad money to GDP, the investment ratio and real stock prices) for a panel of 9 countries.

The 1920s also witnessed a major house price boom in the U.S. from 1923 to 1925. White (2009) argues that the boom was in part triggered by expansionary monetary policy. He finds that deviation from a Taylor rule has some explanatory power for the run up in real housing prices. He also argues that the Fed, established in 1914 to act as a lender of last resort and to reduce the seasonal instability in financial markets, created some elements of a "Greenspan Put' – the view that emerged after Chairman Greenspan engineered a massive liquidity support for the New York money center banks during the October 1987 Wall Street Crash – that the Fed would bail out the financial sector in the event of a crash. Unlike the Wall Street stock market boom, the housing boom bust in the 1920s had little impact on the economy as a whole or on the financial system.

III.2 Post World War II

The post war period has exhibited a large number of housing boom busts. Many of these episodes occurred in an environment of loose monetary policy. We briefly discuss a number of salient episodes.

III.2.1 Asset Booms in the UK.

The UK had a massive house price and stock market boom in 1971-1974, referred to by Tim Congdon (2005) as the Heath Barber Boom after the then Prime Minister and Chancellor of the Exchequer. Congdon documents the rapid growth in broad money (M4) after the passage of the Competition and Credit Control Bill in 1971 which liberalized the UK financial system and ended the rate setting cartel of the London clearing banks. He shows both rapid growth in M4 and a shift in its composition towards balances held by the corporate and financial sectors away from the household sectors. Following the Friedman and Schwartz (1963) transmission story, the excess cash balances went into equities first and properties second, greatly pushing up their prices. The big asset price booms were soon followed by an unprecedented rise in inflation to close to 20% per year by the end of the 1970s. Congdon also shows a tight connection between expansion in broad money supply in 1986/87 and subsequent asset price booms which he calls the Lawson boom after the Chancellor of the Exchequer. As in the 1970s boom, rapid growth in M4 and in its holdings by the corporate and financial sectors fueled a stock market boom which

burst in 1987 and a housing boom which burst in 1989. Finally he attributes a big run up in financial sector real broad money holdings in 1997/98 to an equities boom in the late 90s and a housing boom which peaked in 2006.

III.2.2 Nordic Asset Booms in the 1980s

The Nordic countries, Norway, Sweden and Finland all experienced major asset booms and busts in the 1980s. In each country the run up in asset prices followed liberalization of their financial sectors after 5 decades of extensive controls on lending rates and government control over the sectoral allocation of bank lending. Asset booms were accommodated by expansionary monetary policy as each country adhered to pegged exchange rates which tended to make monetary policy pro-cyclical.

In the case of Norway, quantitative restrictions on bank lending were lifted in 1984 without allowing interest rates to rise. Real interest rates were low and sometimes negative. Banks used their newborn freedom to expand lending on a large scale, all of them with a firm desire to increase their market shares. This stimulated a massive real estate boom until 1986. The boom ended with tighter monetary policy in 1986. The legacy of the collapse of the real estate boom and the buildup in bad assets in the commercial banks was a banking crisis in 1991 and a recession (Steigum 2009).

Similar stories occurred in Finland and Sweden (Jonung et al 2009). Their crises and recessions were much worse than in Norway largely because their currencies were pegged to the

DM in the EMS system and they were hard hit by tight German monetary policy in reaction to the high fiscal costs of German reunification.

III.2.4 Japan in the 1980s

The Japanese boom-bust cycle began in the mid-1980s with a run up of real estate prices fueled by an increase in bank lending and easy monetary policy. The Bank of Japan began following a looser monetary policy after the Plaza Accord of 1985, to attempt to devalue the yen and ease the upward pressure on the dollar. The property price boom in turn led to a stock market boom as the increased value of property owned by firms raised future profits and hence stock prices (Iwaisako and Ito 1995). Both rising land prices and stock prices in turn increased firms' collateral encouraging further bank loans and more fuel for the boom. The bust may have been triggered by the Bank of Japan's pursuit of a tight monetary policy in 1989 to stem the asset market boom.

The subsequent asset price collapse in the next five years led to a collapse in bank lending with a decline in the collateral backing corporate loans. The decline in asset prices further impinged on the banking system's capital, making many banks insolvent. This occurred because the collapse in asset prices reduced the value of their capital. Lender of last resort policy prevented a classic banking panic but regulatory forbearance propped up insolvent banks. It took over a decade to resolve the banking crisis and Japan is still mired in slow growth.

III.2.5 House Price Booms of the 1990s and 2000s

The subprime mortgage crisis in the US of 2007-2009 had its origins in a massive house price boom that began in the 1990s. Its causes include: government policy to encourage housing for a broad swath of the population, loose monetary policy after the tech boom of 2001 to prevent the US from slipping into Japan style deflation and "global imbalances" as the newly emerging countries of Asia invested their growing international reserves in safe US Treasury securities.

The push to encourage housing in the US and other countries goes back to the Great Depression of the 1930s when the Roosevelt administration set up the Federal Housing Authority and the GSEs – Fannie Mae and Freddie Mac – to encourage the development of the mortgage market and to provide housing for much of the of the population. In subsequent decades and especially in the 1990s, as argued by Rajan (2010), successive government administrations and Congress, as an attempt to reduce rising income inequality and income stagnation, pushed for affordable housing for low income families using the GSEs and allowed them to reduce their capital requirements. This led the agencies to take on more risk. Lending was encouraged and rising prices raised the GSEs profits leading them to take on more risk. The FHA in the 1990s also took on riskier mortgages, reduced the minimum down payment to 3% and increased the size of mortgages that would be guaranteed.

The housing boom came to fruition in the George W. Bush administration which urged the GSEs to increase their holding of mortgages to low income households (Rajan, 2010, p.37). Between 1999 and 2007 national house prices doubled according to the Standard and Poor's Case-Shiller repeat sales index.

The private sector also contributed heavily to the boom in an environment of loose regulation and oversight as they recognized that the GSEs would backstop their lending. During this period lending standards were relaxed and practices like NINJA and NODOC loans were condoned, These developments led to the growth of the subprime and Alt A mortgages which were securitized and bundled into mortgage backed securities and then given triple A ratings. Mortgage backed securities (MBSs) were further repackaged into collateralized debt obligations (CDOs). Credit Default swaps (CDSs) provided insurance on many of these new products. Financial firms ramped up leverage and avoided regulatory oversight and statutory capital requirements with special purpose vehicles (SPVs) and special investment vehicles (SIVs).

These factors encouraged a lending boom. As emphasized in this paper the boom was fueled by expansionary monetary policy by the Federal Reserve after the tech boom bust of 2001. Low policy rates were kept in place until 2005 to prevent the economy from slipping into Japan style inflation. Also, as discussed above, the low interest rate environment of the Great Moderation also encouraged risky investment. An additional expansionary impulse may have come from the Asian savings glut (Bernanke (2005)). As China and other countries pegged their currencies at undervalued rates relative to the dollar to encourage export driven growth, they accumulated huge international reserves which were invested in safe US Treasury securities. This imbalance allowed the US to run a persistent current account deficit which provided fuel for the boom.

Other countries had big housing booms in this period as well. The two most notable, Spain and Ireland benefited from joining the Euro in 1999. This gave them access to massive capital flows from the core countries of Europe on the assumption that currency risk had been

eliminated and that in the event of a financial crisis and sovereign debt default they would be bailed out hence reducing country risk. The booms in each case were driven by strong local fundamentals; in the case of Ireland by the development of a high tech export sector and in the Spanish case by rapid growth as Spain emerged as an advanced country. In both these cases loose monetary policy under the ECBs "one size fits" all policy also fueled the boom. Finally the UK like the US had a housing boom partially promoted by government housing policies, financial innovation and high leverage and loose Bank of England policy.

III.5 Summary

The wide history of house price booms displays considerable evidence of a connection between monetary expansion and booms. It also highlights the importance of bank credit expansion. However the circumstances of the different episodes varied considerably. House price booms on some occasions reflected real shocks such as rapid immigration and financial liberalization as well as expansionary monetary policy. In the rest of the paper we provide some empirical evidence on the contribution of monetary policy, bank credit expansion, low inflation and several other factors to a large sample of house price booms.

IV. Identifying House Price Booms

Before outlining our econometric approach we first identify asset price booms for real house prices. Our approach to identifying boom/bust periods is a mixture of the formal and the informal. We first use a well-known dating algorithm to find turning points of our asset price series and then use our discretion to select those expansions/contraction pairs that meet our criteria. We do this to avoid some well-known problems that dating algorithms can have in identifying cycles when the underlying data is purely random (see for example Cogley and Nason (1995)).

The first step of the process is to date the turning points of our asset price series. We do this using the method described in Harding and Pagan (2002) and Pagan and Sossounov (2003). In these two related papers the authors use the method of Bry and Boschan (1971) to date turning points of time series. The dating algorithm of Bry and Boschan (1971) was formulated to mimic the NBER dating process and is successful in dating turning points in time series. For real house prices we look for peaks (troughs) that are higher (lower) than the two nearest observations on each side of the turning point under the constraint that peaks and troughs must alternate. Note however that this is the first stage of our process.

The second stage of our process we do the following: Once turning points are identified we inspect each expansion (defined as the period from a trough to the next peak) to see if it fits our definition of an asset price boom. To identify asset price booms we take a "holistic"

approach. That is we first look for expansions that meet our criteria and then we visually inspect each prospective boom to check whether the dates for the boom should be corrected. For example, starting dates are moved to the point where the gradient of the asset price series first significantly picks up if the initial periods of the expansion are relatively flat.

The definition of a boom that we use is that a boom is a sustained expansion in asset prices that ends in a significant correction. The expansion is such that the rate of growth is higher than what would be considered usual based on previous cycles. For an expansion to meet the definition of a sustained expansion the expansion must last at least two years and average at least 5% per year for real house prices. This is similar to the criteria used in Bordo and Wheelock (2009). The second screening that we use is that the price correction that follows the expansion in prices must be greater than 25% of the expansion in price that occurred during the expansion. We believe that this definition rules out secular trends where there can be large increases in asset prices followed by small corrections followed by another large expansion. The booms that we identify all are followed by significant price corrections which suggest that the price expansion was not sustainable and hence a boom/bust period.

The identified house prices booms are reported in Table 1. [7]We have annual data on real house prices for 18 countries from 1920 to 2010. [8] The approach we follow is similar to that used in IMF WEO (2003), Helbling and Terrones (2004), and Bordo and Wheelock (2009). All of

[7] Figures showing the identified house price booms are not reported due to space considerations but are available from the authors upon request.

[8] For definitions of the data that we use see the data appendix.

these studies used monthly data for a smaller set of countries. Only the Bordo and Wheelock study covered the pre-World War II period.

IV.1 Housing Booms

With the exception of France in the 1930s and the U.S. in the 1920s in Table 1 we did not identify any house price booms before World War II. In the post-World War II period most countries had house price booms in the 1970s and 1980s. The literature at the time associated them with the liberalization of financial markets that occurred after the breakdown of the Bretton Woods system. Many of the boom-busts were dramatic, especially in Japan, the Scandinavian countries, Netherlands and Switzerland. The U.S. only experienced mild booms and corrections in that period. Several dramatic episodes occurred in the late 1990s and early 2000s. In particular, the U.S. housing boom of 1997-2006 when real prices rose by 79% and fell by 33% really stands out. There were other significant increases in house prices during the 1990's and 2000's, e.g. UK from 1996 to 2007, but these are not included in the list of identified house booms as the subsequent correction is not large enough to meet our requirement.

Table 1: Identified Real House Price Booms

	Booms				Corrections			
	Period	Duration	%Δ	APC	Period	Duration	%Δ	APC
Canada								
	1984-1989	5	57.52	11.5	1989-1998	9	-14.39	-1.6
Denmark								
	1982-1986	4	53.08	13.27	1986-1990	4	-25.72	-6.43
	2003-2007	4	53.49	13.37	2007-2009	2	-19.24	-9.62
France								
	1930-1935	5	37.69	7.54	1935-1941	6	-47.15	-7.86
	1971-1980	9	36.74	4.08	1980-1984	4	-16.76	-4.19
	1985-1991	6	30.84	5.14	1991-1997	6	-16.03	-2.67
U.K.								
	1971-1973	2	59.27	29.64	1973-1977	4	-30.91	-10.30
	1977-1980	3	26.18	8.73	1980-1982	2	-10.17	-5.08
	1985-1989	4	67.18	16.8	1989-1993	4	-26.83	-6.71
Italy								
	1980-1981	1	24.02	24.02	1981-1985	4	-30.65	-7.66
	1988-1992	4	49.63	12.41	1992-1997	5	-27.58	-5.52
Japan								
	1986-1991	5	34.16	6.83	1991-1994	3	-12.98	-4.33
Netherlands								
	1958-1964	6	51.11	8.52	1964-1966	2	-27.51	-13.75
	1976-1978	2	36.09	18.05	1978-1985	7	-47.75	-6.82
Norway								
	1983-1986	3	50.29	16.76	1986-1992	6	-35.2	-5.87
Sweden								
	1974-1979	5	22.02	4.4	1979-1985	6	-36.92	-6.15
	1985-1990	5	36.71	7.34	1990-1993	3	-28.58	-9.53
Switzerland								
	1971-1973	2	21.2	10.6	1973-1976	3	-26.01	-8.67
	1983-1989	6	43.31	7.22	1989-1997	8	-36.61	-4.58
United States								
	1921-1925	4	19.12	4.78	1925-1932	7	-12.57	-1.8
	1976-1979	3	14.47	4.82	1979-1982	3	-12.74	-4.25
	1984-1989	5	18.76	3.75	1989-1993	4	-13.01	-3.25
	1997-2006	9	79.38	8.82	2006-2009	3	-33.09	-11.03

V. Empirical Analysis

In this analysis we pool data from 1920 to 2011 from across the 11 countries in our data set to investigate the impact of loose monetary policy, low inflation and rapid bank credit growth on asset prices.[9] By pooling the data across the twentieth century we are in a sense calculating the impact each of our control variables have on asset prices averaged across all the boom periods that we have identified. Low inflation could reflect the credibility for low inflation that occurred in the 1980s and 1990s and 1920s according to Borio and Lowe (2002) and Eichengreen and Michener (2004). In this environment, endogenous asset price booms could arise, financed by easy bank credit, accommodated by the central bank. Loose monetary policy refers to deliberately expansionary monetary policy (as evidenced in the policy rate being below the Taylor rule rate) done for example to prevent deflation as in the 2000s or to stimulate recovery from a recession.

The asset price data that we use in the analysis are real house prices. As a measure of monetary policy we use the deviation of a short term interest rate from the optimal Taylor rule rate.[1011] The optimal Taylor rule rate is given by the following equation:

---

[9] The countries in our sample are Canada, Denmark, France, Great Britain, Italy, Japan, Netherlands, Norway, Sweden, Switzerland, and the USA. Countries are included in our regressions if data is available.

[10] In another related paper (Bordo and Landon Lane 2013), as an alternative measure of monetary policy, we used deviations of the growth of monetary aggregates from Milton Friedman's (1960) famous rule. This measure may be more relevant for earlier episodes when central banks did not use monetary aggregates as their key policy tool.

$$r^{Taylor} = \pi_t + r^* + 0.5\left(y_t - y_t^*\right) + 0.5\left(\pi_t - \pi^*\right) \quad (1)$$

where the output gap term is given by the deviation in log real GDP from its long run trend (as determined by the Hodrick-Prescott filter with a smoothing parameter equal to 100 since the data are annual time series) and the inflation target is 2%. It should be noted that we do not use policy rates in this analysis and that we use for all countries a target interest rate (r^*) of 2% with coefficients of 0.5 and 0.5 as in Taylor (1993**).** Thus the optimal Taylor rule rate that we use is a very rough measure of the optimal policy rate for each country.

The credit variable that we use is the same that is used in by Schularick and Taylor (2012). This variable is bank credit as measured by total bank loans as a proportion of total GDP. It should be noted that there is some discrepancy in the literature when it comes to the discussion of credit growth. Some use a broad measure of credit including data from the formal banking sector and non-financial institutions. This broad measure of credit is not available for many countries before recent decades and so to be able to include as many house price booms as possible in our analysis we use Schularick and Taylor's (2012) long -run series on bank loans as our measure of credit. One important issue is that in the recent house price booms in the US and the UK the prevalence of credit supplied by non-bank financial institutions via the shadow

[11] Using the short rate rather than the policy rate is done because of data availability issues. Using a short-term interest rate is likely to understate the looseness of monetary policy and overstate the tightness. Thus our estimated impact of loose monetary policy on asset prices is likely to be understated.

banking system, has played an important role. Because of this we have to be careful in interpreting the impact of the credit shock in our analysis. Our credit shock does not include credit innovations originating from the shadow banking system.

The three shocks that we identify in our panel VAR are a monetary policy shock, an inflation shock and a bank credit growth shock. To do this we include the deviation of the short term interest rate from the optimal rate, inflation, bank credit and house prices. The deviation of the short-term interest rate from the optimal Taylor Rule rate is included to control for possible correlations between "loose" monetary policy and asset booms. The inflation variable is included to control for possible correlations between low inflation policy and booms and the bank credit variable is included to determine if loose or "easy" bank credit has a role in asset booms. These variables are consistent with the Austrian BIS story as well as recent papers by Schularick and Taylor (2012), Jorda, Schularick and Taylor (2012) and Christiano et al (2010). These are the three main alternative variables that have been argued to play a role in asset booms and the aim of this paper is to use data over the whole twentieth century to shed light on their roles.

In order to do this we use a panel vector autoregression (PVAR). The PVAR that we use is

$$y_{it} = \alpha_i + \beta_i D_{it} + \sum_{j=1}^{p} A_j y_{it-j} + \sum_{j=1}^{p} B_j D_{it} \times y_{it-j} + \varepsilon_{it} \qquad (2)$$

where the dummy variable D_{it} takes the value of 1 if country *i* is in an asset boom in period *t* and takes a value of 0 otherwise. This specification allows us to have a PVAR specification for "regular" periods and another specification for "boom" periods. The data is ordered with the

interest rate variable first, the inflation variable second, the credit variable third and the house price variable last. The data vector y_{it} is therefore defined to be

$$y_{it} = \left(i_{it}^{s} - i_{it}^{TR}, \Delta\pi_{it}, \Delta\left(l / y\right)_{it}, \Delta \log\left(p_{it}\right) \right)', \tag{3}$$

where the price vector is real house prices. Finally it is assumed that $\varepsilon_{it} \sim \left(0, \Sigma_1\right)$ in regular periods and $\varepsilon_{it} \sim \left(0, \Sigma_2\right)$ during "boom" periods. The PVAR is estimated with country specific fixed effects but common slope parameters over the panel.

Orthogonalized shocks are identified using the standard triangular ordering and Cholesky factor. The interpretations of the shocks are as follows: the first shock is a shock to monetary policy with a negative shock being interpreted as policy is loosening. The second shock is a shock to inflation that is orthogonal to the monetary policy shock. This shock reflects inflation pressures and negative shocks for this shock lowers inflation and lessens pressure for the monetary authority to act. This shock plays the role of the BIS story where low inflation leads to upward pressure on asset prices because of inaction by the monetary authority. The third shock is a shock to our measure of bank credit, the ratio of bank loans to GDP, which is orthogonal to the first two shocks – the monetary policy shock and the low inflation shock. A positive shock to bank credit is interpreted as an easing of bank credit and a priori you would expect a positive bank credit shock to have a positive impact on asset prices. The last shock is the "catch-all" shock for everything not captured by the first three shocks. There is no interpretation for this shock except that it represents shocks to asset prices that are orthogonal to our monetary policy shock, our inflation shock and our bank credit shock. Sources of this shock could include financial innovation shocks, external demand shocks, credit expansion from the shadow banking system, and "bubble" behavior shocks.

We use the estimates from the PVAR to construct orthogonalized impulse response functions, forecast error variance decompositions and historical decompositions. The first two represent average effects over the panel while the last – the historical decompositions – are an attempt to look at individual boom episodes across countries.

The historical decomposition is constructed in the following way. Suppose that $\varepsilon \sim (0, \Sigma)$ where Σ is a positive definite matrix. Let P_0 be a lower triangular matrix such that $\Sigma = P_0 P_0'$. That is, P_0 is the Cholesky factor of Σ. Then the orthogonalized shocks u_{it} are constructed via

$$u_{it} = P_0^{-1} \varepsilon_{it}. \tag{4}$$

The historical decomposition is a counterfactual series that is constructed using only one of the estimated structural shocks. For example, to construct the historical decomposition series based on only the first shock – the monetary policy shock – you would first set

$$\tilde{u}_{it} = (u_{1it}, 0, 0, 0)'$$

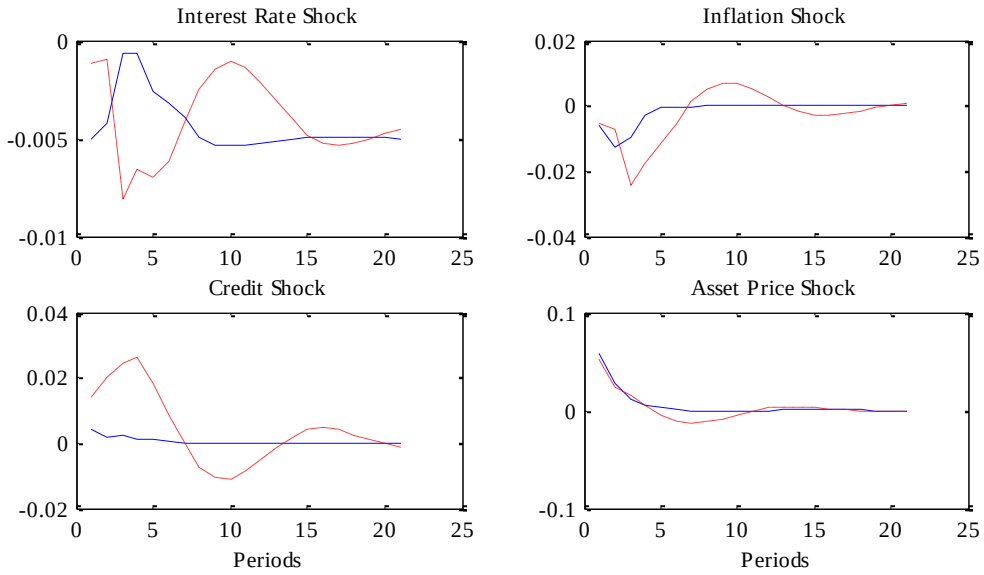
and then set $\tilde{\varepsilon}_{it} = P_0 \tilde{u}_{it}$. The counterfactual residual series, $\tilde{\varepsilon}_{it}$, is the set of residuals that would have been created if there were only monetary policy shocks, in this example.

V.1 Real House Prices

The PVAR given in (2) is estimated with real house prices in the data vector. Using the Schwarz Bayesian information criterion (SBIC) it was determined that the number of lags to use was 3.

The orthogonalized impulse response functions for both the “regular” periods and the “boom” periods are depicted in Figure 1. During “regular” periods the impact of a one standard deviation shock to the monetary policy variable – the deviation of the short-term interest rate from the Taylor rule rate – on real house prices is small. The initial impact is slightly positive and the impact takes about 7 periods to be negative. This is not what you would expect. The other three shocks do appear to impact real house prices as expected. The impact of an increase in inflation is to deflate house prices, the impact of an easing of bank credit is to increase house prices and, of course, the impact of a positive shock to house prices is indeed positive.

Figure 1: Impulse Response Function for Real House Prices (1920-2011)[12]



During "boom" periods the impact of the first three shocks is heightened. The magnitudes of the initial responses are larger and the impact of a tightening of monetary policy is negative after a short period. This result suggests that the three shocks have more of an impact during "boom" periods.

In order to check whether the shocks' impacts are amplified during "boom" periods we next turn to forecast error variance decompositions. These are reported in Figure 2 with the variance decomposition for "regular" periods being represented by the solid blue line and the variance decomposition for the "boom period being represented by the dashed red line. Figure 2

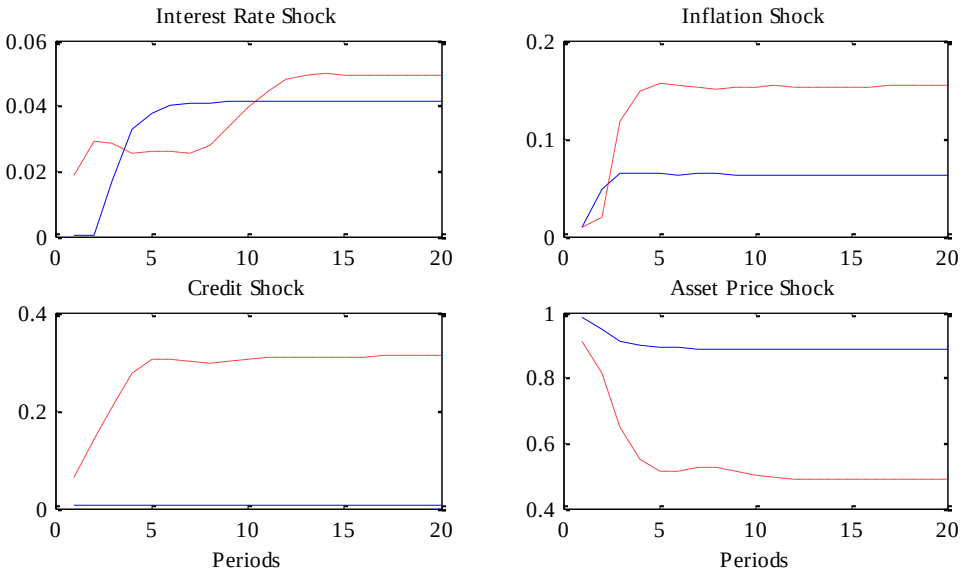
[12] The solid blue line in Figure 1 represents the orthogonalized impulse response function during "regular" periods while the dashed red line in Figure 1 represents the orthogonalized impulse response function during "boom" periods.

shows clearly that during “regular” periods the three competing shocks have little impact on real house prices compared to the “other” shock. However for boom periods the impact of each of the three shocks increases with the largest increase for the bank credit shock. Thus it appears that easy bank credit plays an important role in “boom” periods which reinforces the view of Schularick and Taylor (2012), Jorda, Schularck and Taylor (2012) and Christiano et al (2010).

The impulse response functions and the forecast error decompositions represent average effects across all periods and countries in the panel. One has to be careful to use the results of panel estimates for individual countries as the results presented so far may not be appropriate for individual countries and individual boom periods. In order to check whether the results presented so far are appropriate for individual cases we now turn to a number of important house price booms that have been identified in the literature.

The first house price boom we look at is the house price boom that occurred in the United Kingdom from 1985 to 1989. Congdon (2005) attributes much of this house price boom to loose monetary policy. The historical decomposition for this episode is reported in Figure 3. Here the

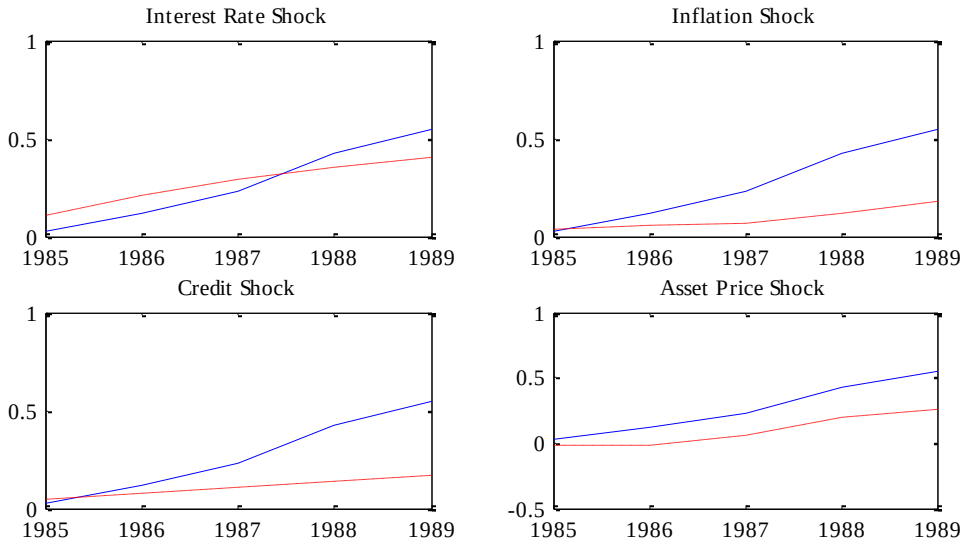
Figure 2: Forecast Error Variance Decomposition for Real House Prices (1920-2011)[13]



solid line represents the actual house price data while the dotted line represents the counterfactual series. As you can see, the historical decomposition does accord with the historical narrative in that the monetary policy shock appears to explain a large part of the rise in prices during this episode. The bank credit shock, on the other hand, does not explain much of the increase in house prices.

[13] The solid blue line represents the FEVD for "regular" periods whilst the dashed red line represents the FEVD for "boom" periods.

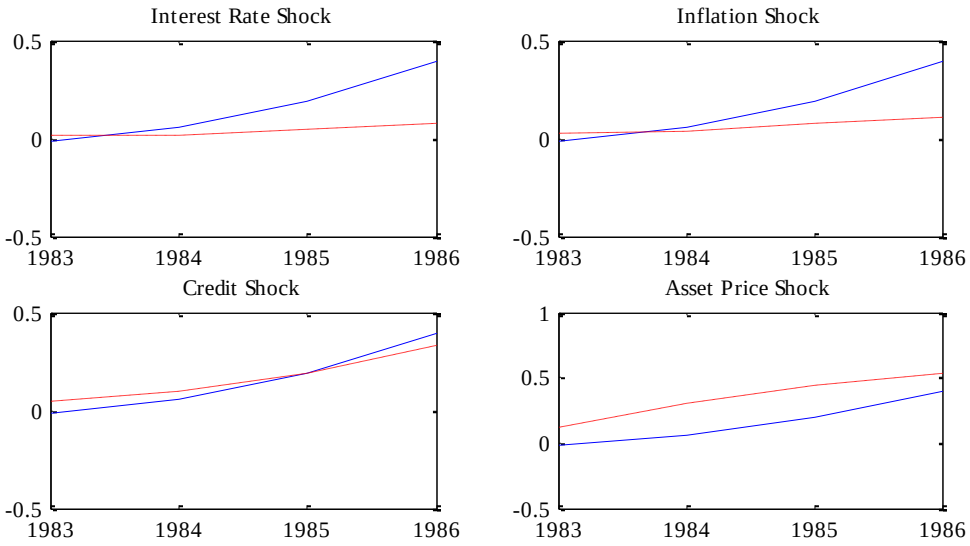
Figure 3: Historical Decomposition for UK (1985—1989)[14]



The next house price boom that we look at is the house price boom in Norway from 1983 to 1986. Steigum (2009) attributes much of this boom to an easing of credit restrictions. The historical decompositions for this episode can be found in Figure 4. The historical decompositions agree with the analysis of Steigum (2009) in that the house price series is pretty much well-explained by the counterfactual series generated with only credit shocks. Another house price boom from that period occurred in Sweden from 1985 to 1990. The historical decompositions, shown in Figure 5, in this case do not allow us to make a case for only one shock being important. It does not appear, however, that credit played a role early in the boom.

[14] The solid blue line in the figure is the actual data while the dashed red line is the counterfactual historical decomposition.

Figure 4: Historical Decomposition for Norway (1983—1986)



Two more important house price booms are the house price boom in Japan in the late 1980's and the house price boom in the US from 1996 to 2006. The historical decompositions for these episodes are found in Figure 6 and Figure 7 respectively. For Japan the house price boom cannot be explained by any one shock – it looks like all four shocks play equal roles.

Figure 5: Historical Decomposition for Sweden (1985—1990)

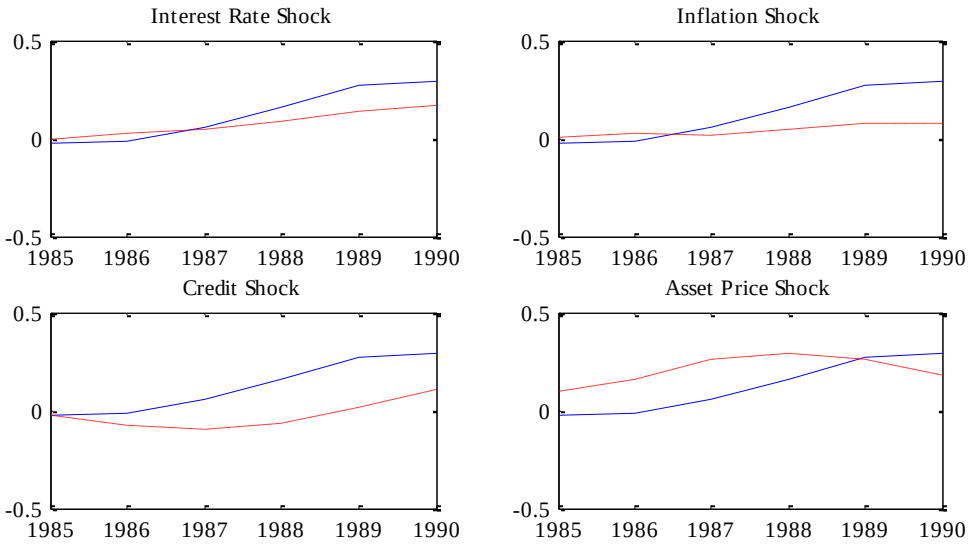
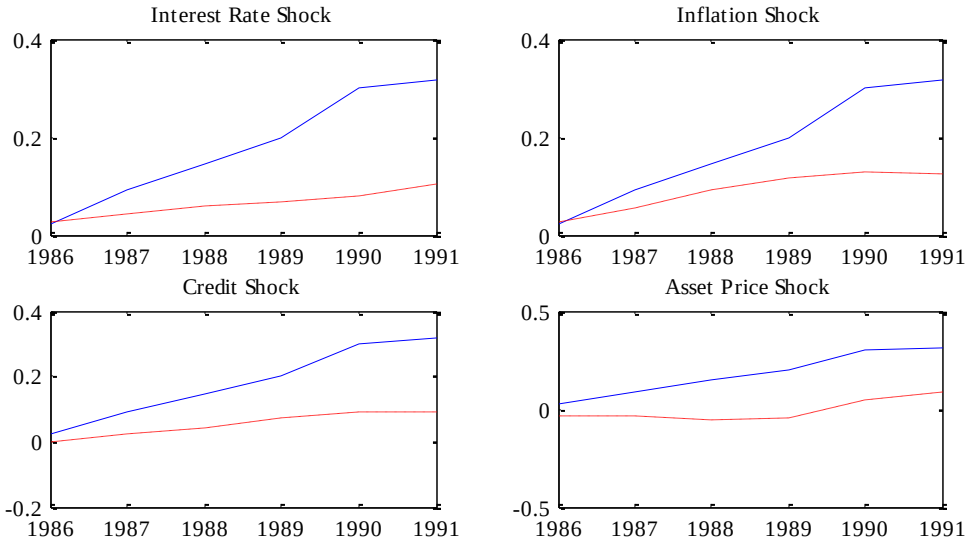
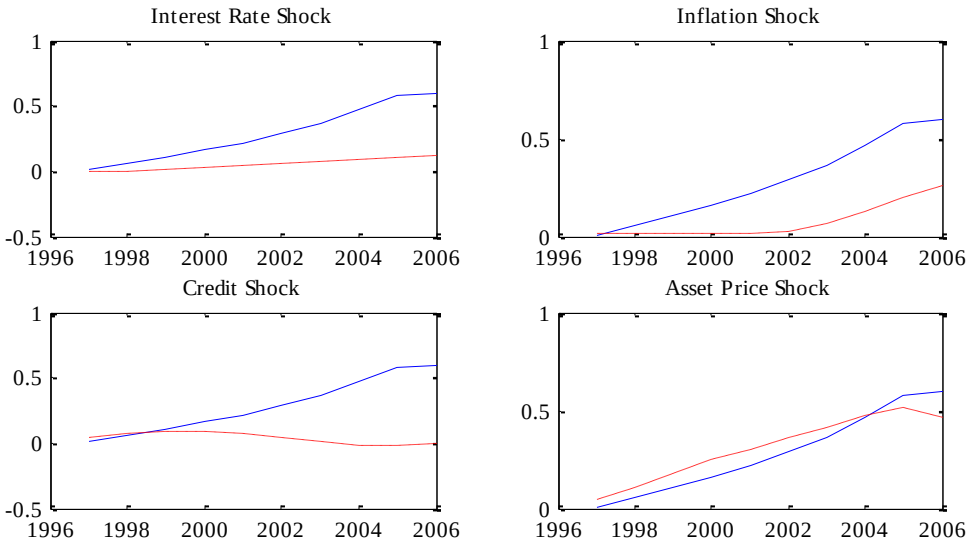


Figure 6: Historical Decomposition for Japan (1986—1991)



The more interesting case is the US. The shock that best mimics the actual data is the "other" shock. The monetary policy shock alone can only predict a small increase in house prices during this period while the inflation shock appears to do better after 2002. One thing that is obvious however is that the credit shock predicts that prices should have fallen over this period. The historical decomposition appears to suggest that the house price boom in the US during the late 1990's and early 2000's was not caused by easy bank credit.

Figure 7: Historical Decomposition for USA (1997—2006)



Our interpretation of the result that the "other" shock does the best in predicting the increase in house prices for this US episode is that the house price boom was mainly caused by financial innovation shocks or by bubble behavior.

The historical decompositions offer sobering evidence for those who want to use the panel results to claim that bank credit shocks are important in explaining house price booms.

While bank credit shocks are important on average for the important house price booms from the 1980s, 1990s and 2000s it does not appear that easy credit play a significant role in all of them, and certainly does not appear to play a role in the US house price boom of the later 1990s and early 2000s.

V.3 Summary

The results shown above show that the predictions of the PVAR does a reasonable job of matching the historical narratives of a number of important and major house price booms of the 1980s, 1990s and 2000s. Loose monetary policy, through deviations from the Taylor Rule, is an important factor in a number of individual house price booms that we look at. Thus there is evidence that asset price booms could be managed with regular monetary policy instruments. The low inflation – BIS/ Austrian explanation – is also not discounted. The historical decompositions show for some individual episodes that low inflation shocks contributed to house price booms. We also find that easy bank credit plays a role. The aggregate results (impulse response functions and forecast error variance decompositions) suggest that bank credit shocks played an important role during boom periods but not during "regular" periods. This is in contrast to the monetary policy and inflation shocks which appear to play a role in all periods with their role magnified during boom periods.

The last shock is the "other" shock that captures innovations to house prices that cannot be explained by loose monetary policy, low inflation or easy bank credit. This is the dominant

shock on average and in all individual cases. The interpretation we give to this shock is that the "other" shock is picking up innovation to the financing of houses, changes in underwriting standards not captured by shocks to loans, and other innovations including "bubble" behavior. The "other" shock would also pick up financial innovations that come via the shadow banking system since the credit variable we use only includes loans made from within the formal banking system.

An interesting result that comes from the individual historical decompositions is that, while on average it plays an important role, the bank credit shock is not important for the US house price boom of the 1990s and 2000s. [15] The US house price boom is mainly explained by "other" shocks and somewhat by the monetary policy and inflation shocks. If there were only bank credit shocks the evidence is that there would not have been any run-up of house prices at all. We explore the robustness of this result in the next section.

VI. Robustness Checks and the Role of Bank Credit

In order to check our results with respect to credit and its apparent lack of importance for the US house boom of the 1990's/2000's we performed a number of robustness checks. These are reported below:

[15] We also show in Section VI.3 that the bank credit shock did not play an important role in the house price run-ups in the UK and Canada during the 1990s and 2000s as well.

VI.1 An Alternative Specification for the PVAR

In this robustness check we estimated a slightly different PVAR than the one that we used to get the results reported above. In the alternative PVAR we replace the first variable – the deviation of the short rate from the Taylor rule rate – with the change in interest rates. In this alternative specification we have

$$y_{it} = \left(\Delta i_{it}^{s}, \Delta\pi_{it}, \Delta\left(l / y\right)_{it}, \Delta\log\left(p_{it}\right)\right)'. \tag{5}$$

The interpretations of the shocks in this specification are different. The first shock is an interest rate shock of which some component might be due to monetary policy. We cannot identify the monetary policy shocks from other interest rate shocks however. The second shock is the inflation shock orthogonal to the interest rate shocks. The third shock is a bank credit shock once interest rate changes and inflation shocks have been accounted for. Thus the bank credit shock here represents those innovations to bank credit that are not due to changes in interest rates or inflation (i.e. not due to changes in both the nominal and the real interest rate).

The impulse response functions are reported in Figure 8 and the forecast error variance decompositions are reported in Figure 9. The impact of an increase in interest rates is strongly negative and all other shocks are as what we would expect. The forecast error variance decompositions remain similar to the previous specification in that the bank credit shock accounts for about a third of the overall forecast error variance. However the historical

decomposition for the US house price boom of the 1990's is quite different. This is reported in Figure 10.

Figure 8: Impulse Response Function for Real House Prices (1920-2011): Alternative Specification

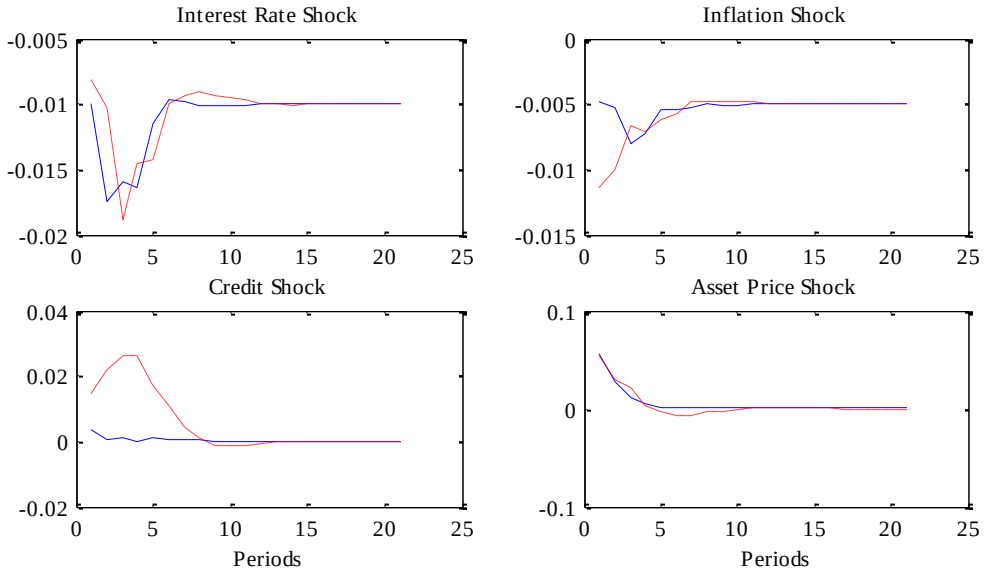


Figure 9: Forecast Error Variance Decomposition for Real House Prices (1920-2011): Alternative Specification

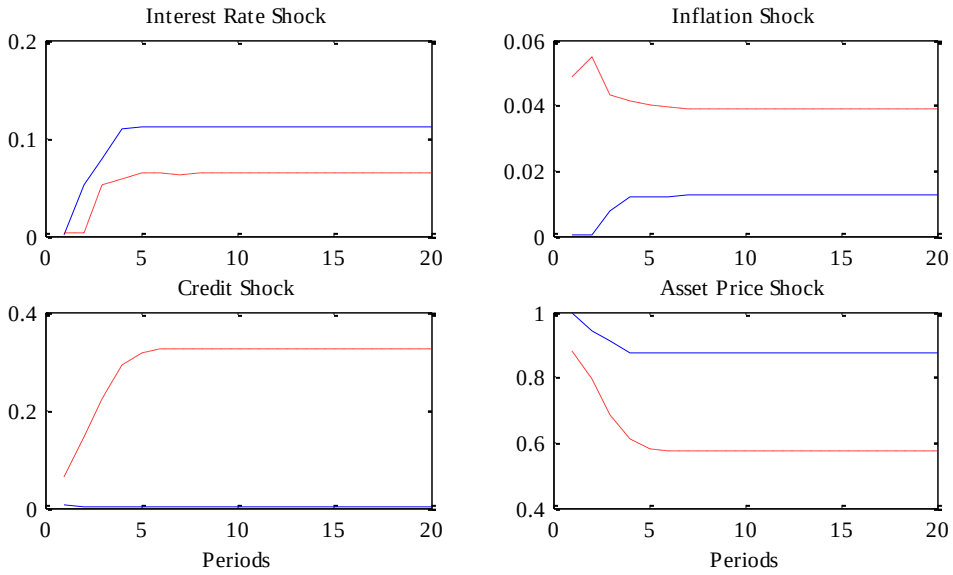
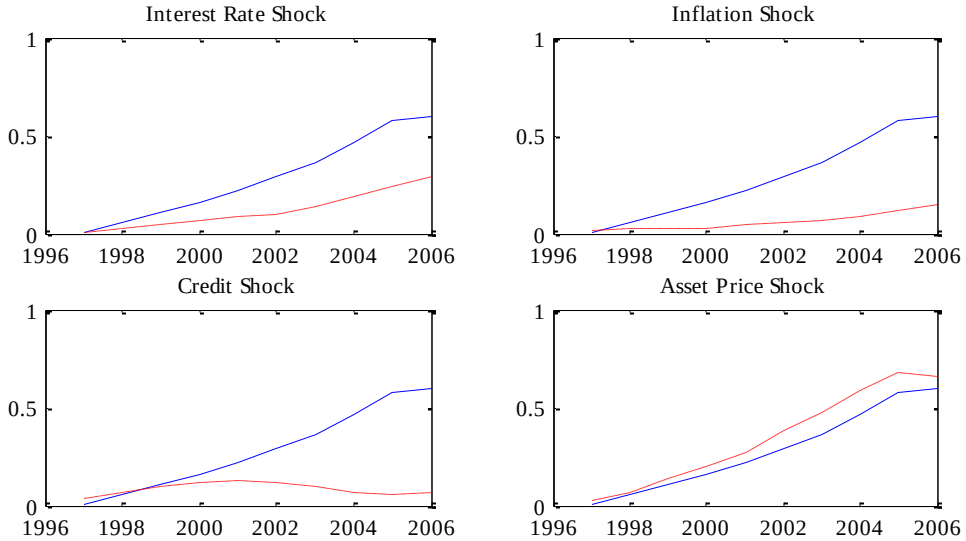


Figure 10: Historical Decomposition for US House Price Boom (1997-2006): Alternative Specification



Using this specification it appears that about half of the actual rise in house prices can be attributed to interest rate shocks. Again the credit shock plays no role in this particular house price boom.

This leads us to believe that the result that bank credit did not play an important role during the US house price boom of the 1990's is quite robust.

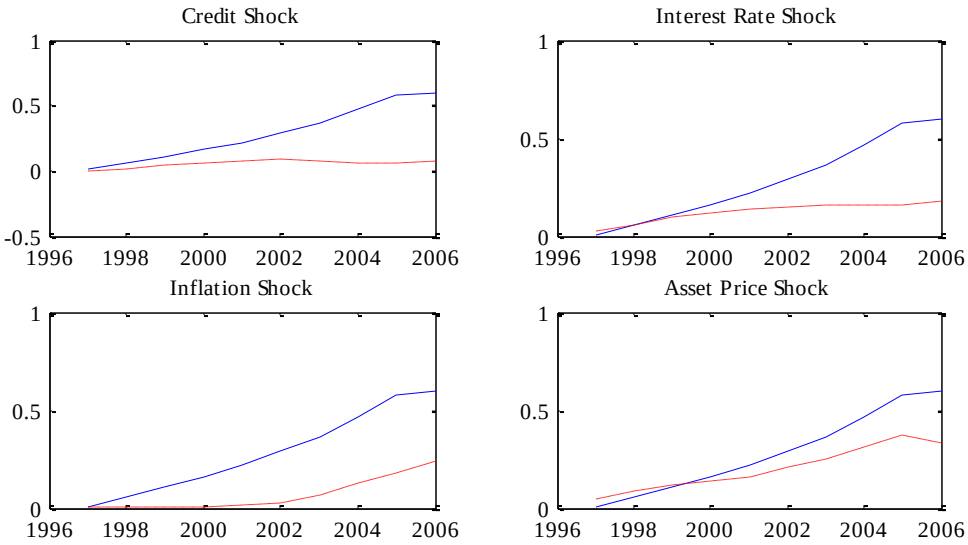
VI.2 An Alternative Ordering in the PVAR

One criticism that is leveled at orthogonalized VARs is that the results are not generally robust to the order that the variables appear in the VAR. It might be claimed that the result that credit plays a small role in the US house price boom of the late 1990s and early 2000s is due to the specific ordering. In this robustness check we report the historical decomposition for an alternative ordering where credit is ordered first, followed by the deviation of the interest rate from the Taylor Rule rate, the first difference of the inflation rate, and the first difference of the house price respectively.

Figure 11 reports the historical decomposition of the US house price boom of the later 1990's and early 2000's under the alternative ordering specification. It is clearly apparent that the results are quantitatively and qualitatively the same as for the original ordering. We are quite confident that the result that bank credit did not play an important role in the US house price boom of the 1990's is robust to ordering. Note that while not reported here the impulse response

functions and the forecast error variance decomposition for this alternative ordering are almost identical to the ones reported above.

Figure 11: Historical Decomposition for US House Price Boom (1997-2006): Alternative Ordering



VI.3 Other House Price Booms of the 1990s and 2000s

During our analysis we only included house price booms that had a subsequent correction that was equivalent to at least 25% of the rise in prices during the boom. This criterion was quite strict and as a result a number of large house price increases were not treated as booms. Booms that only had a small correction or had not yet finished were not included in the boom analysis. There were a number of house price run-ups that started in the 1990s that are nonetheless

interesting. Table 2 reports the house price run-ups from the 1990s and 2000s that were not included in the empirical work above. In this extension these house price run-ups are included with the identified house price booms reported in Table 1.

Table 2: Additional House Price Booms

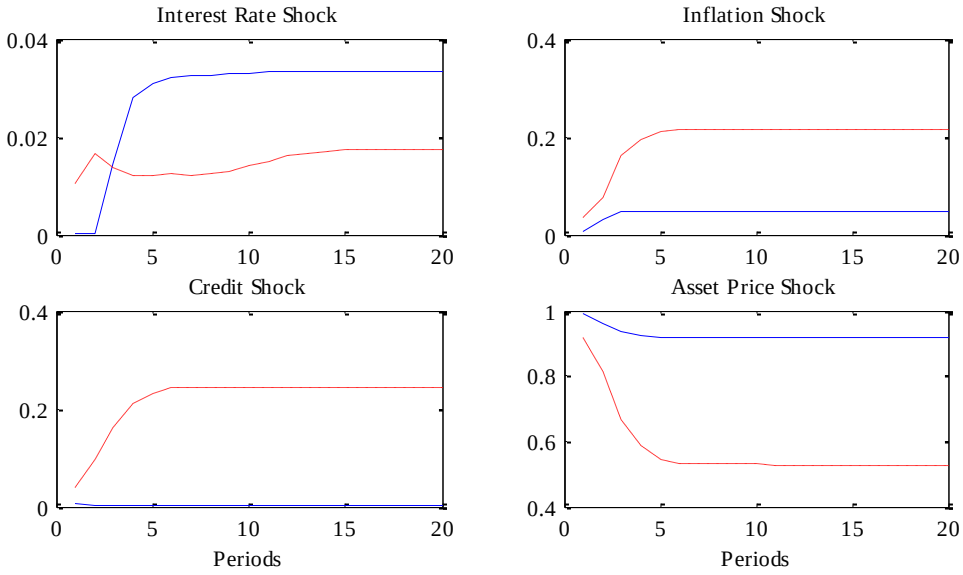
Country	Years	Price Increase
Canada	1998—2011	93.6%
France	1997—2007	111.7%
Italy	1997—2007	57.9%
Netherlands	1991—2008	167.3%
Norway	1993--2005	129.6%
United Kingdom	1995—2007	159.1%
Sweden	1996--2010	136.7%

When we add these house price run-ups there are some changes in the results. [16] The impulse response functions are relatively unchanged but the forecast error variance decompositions are somewhat different.

Figure 12 reports the forecast error variance decomposition with the solid blue line depicting the FEVD during "regular" periods and the dashed red line depicting the FEVD during the extended "boom" periods. The important thing to note here is the added influence of the low-inflation shock and the lessoned impact of the bank credit shock. This result is consistent with the house price booms and/or run-ups of the 1990s and 2000s being influenced by interest rate and low-inflation shocks rather than credit shocks.

[16] Note that we avoid using the word boom in these house price run-ups as the subsequent correction has either no occurred yet or was small.

Figure 12: FEVD for Extended House Price Boom Definition



To look further into the causes of the individual house price booms we turn again to historical decompositions. Figure 13 shows the historical decomposition for the 1990s house price boom in Canada. Just like the results for the US in the 1990s bank credit growth does a poor job of explaining the house price boom. Figure 14 reports the historical decomposition for the United Kingdom. Again, just like the case for Canada and the US, the house price boom/run-up of the 1990s and 2000s is not an easy credit story. For Canada and the UK there is strong evidence that loose monetary policy played an important role – much stronger than for the US where deviations from the Taylor rule did not explain much of the run-up in prices.

Figure 13: Historical Decomposition for House Price Boom in Canada (1998-2011)

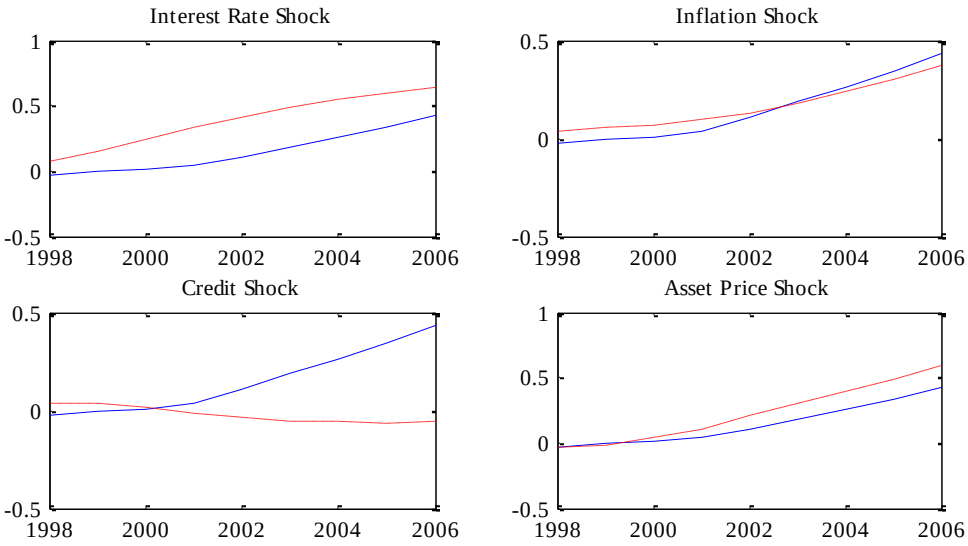
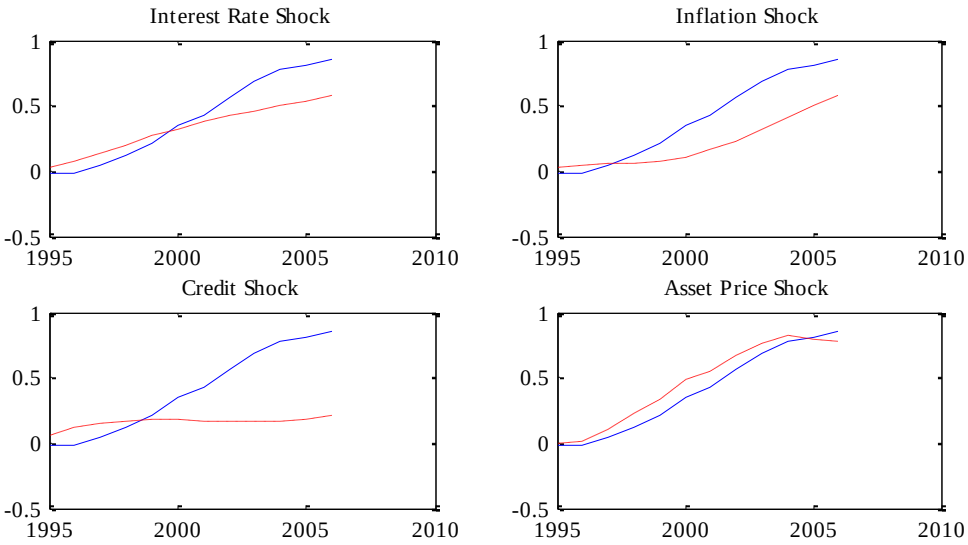


Figure 14: Historical Decomposition of House Price Boom in the UK (1995-2007)



Not all booms in Table 2 are like those reported for Canada, the UK and the US. For France and Italy credit and interest rate shocks play an important role whereas for the Netherlands, Norway and Sweden, both the credit and interest rate shocks play no role. Thus the

result that credit shocks, which on average play an important role, did not necessarily cause the house price booms of the 1990s and 2000s is retained when we add in the large house price run-ups from Canada, France, Italy, the Netherlands, Norway, the UK and Sweden. The evidence suggests that the UK and US house price booms during the 1990s and 2000s were not caused by credit booms.

VII. Discussion and Conclusion

Using a panel VAR we show that the three main explanations, including loose monetary policy, for house price booms all have merit. Averaging across all countries and boom periods the loose monetary policy shock, low inflation shock and easy credit shock all contribute to house prices and this is magnified during boom periods. There is evidence that loose monetary policy played an important role in some historical episodes – for example the UK house price boom of the 1980s and to a lesser extent Sweden and Japan again in the 1980s. The BIS/Austrian explanation is also not ruled out as there are some episodes where the identified low inflation shocks did contribute to the run-up of house prices. The same is true for the credit shock explanation as well.

However there is still room for alternative explanations as the majority of the forecast error variance is explained by the "other" shock identified from the panel VAR. The "other" shock is the dominant shock on average and for a majority of individual cases the "other" shock plays the dominant role in explaining the house price boom (or run-up in some cases). The

"other" shock picks up all innovations to house prices that are not explained by deviations of interest rates from the Taylor rule, inflation shocks or shocks to credit (as measured by total bank loans). The "other" shock could include interest rate or monetary policy shocks that are not measured by the deviation of the interest rate from the Taylor Rule, financial innovation not measured by banks loans, the impact of the shadow banking system on the housing market, or they could just be picking up bubble behavior in house prices.

One interesting result we found was that while credit shocks played an important role on average, it did not play a role at all in some of the major house price booms or run-ups of the 1990s and 2000s. In particular for the US, Canada and the UK during this period, the rise in house prices cannot be explained by innovations to loans from the banking sector. In these individual cases the historical decomposition suggests that house prices would have remained stable if only bank credit shocks were present. Two of these countries, the US and the UK, have significant shadow banking sectors and it could be that financial innovations or easy credit from the shadow banking system are to blame for the house price booms rather than easy credit through the formal banking system.

The housing bust of 2006 in the U.S. and the subsequent financial crisis and Great Recession then led many policy makers to decide that financial stability should be an important goal of monetary policy along with low inflation (and real macroeconomic stability).This view emphasized the use of the tools of macroprudential regulation such as countercyclical capital requirements and liquidity ratios (Kashyap, Rajan and Stein 2008). This case however has in part been predicated on the assumption that excessive bank credit was at the heart of the recent boom. The results in this paper cast some doubt on this assumption. The results also cast doubt on the

usefulness of using panel estimators in attempting to understand the causes of house price booms in general.

The results, especially when we look at individual episodes, suggest that there is no single magic broad spectrum policy prescription for house price booms. The house price booms that we examined all looked different in terms of their causes. However the evidence that loose monetary policy (along with low inflation and credit expansion) does contribute significantly to booms in house prices suggests that this is an important issue for monetary policy makers to consider. There is evidence that raising interest rates could have prevented the house price run-ups we saw in the 1990s and 2000s. This subject received considerable attention during the tech boom of the late 1990s and again during the housing boom of the early 2000s. Economists argued both for and against using the tools of monetary policy to defuse asset price booms but little was changed (Bordo and Landon Lane, 2013).

Our evidence on housing price booms, using data going back nearly 100 years for a number of countries, that expansionary monetary policy is a significant trigger contributes to the ongoing debate about the optimal conduct of monetary policy.

References

Rudiger Ahrend, Boris Cournede, Robert Price (2008), "Monetary Policy, Market Excesses and Financial Turmoil" OECD *Economics Department Working Paper* No. 597

Armen Alchian and Benjamin Klein (1973), "On a Correct Measure of Inflation" Journal of Money, Credit and Banking, February 5(1) Part 1, pp 173-191

Bernanke, B. S. (2005). "The global savings glut and the US current account deficit": Remarks by Governor Ben S. Bernanke at the Sandridge Lecture, Virginia Association of Economics, Richmond, Virginia. *The Federal Reserve Board of Governors*.

Michael Bordo , Michael Dueker and David Wheelock (2003) " Aggregate Price Shocks and Financial Stability: The United Kingdom 1796- 1999" Explorations in Economic History April , 40(4), pp 143-169.

Michael Bordo and Olivier Jeanne (2002b) "Monetary Policy and Asset Prices; Does 'Benign Neglect' Make Sense? International Finance, 5(2) pp 139-164.

Michael Bordo (2003) "Stock Market Crashes, Productivity Boom Busts and Recessions: some Historical Evidence" Chapter III IMF World Economic Outlook April

Michael Bordo and David Wheelock (2004) "Monetary Policy and Asset Prices: A Look Back at Past U.S. Stock Market Booms" NBER Working Paper 10704 August.

Michael Bordo (2010) “Long Term Perspectives on Central Banking” Norges Bank Symposium What is a Useful Central Bank? November.

Michael Bordo and Efraim Benmelech (2008) “The Crisis of 1873 and the Failure of Corporate Governance” NBER DAE Summer Institute.

Michael Bordo and David Wheelock (2009) “When Do Stock Market Booms Occur? The Macroeconomic and Policy of Twentieth Century Booms “ in Jeremy Atack and Larry Neal (eds) The Origins and Development of Financial Markets and Institutions. New York:Cambridge University Press.

Michael Bordo (2012) “Under what Circumstances Can Inflation Be a Solution to Excessive National Debt: Some Lessons from History? ‘”Conference on Paper Money—State financing—Inflation, Deutsche Bundesbank November.

Michael Bordo and John Landon-Lane (2013) “What Explains Asset Booms: History and Empirical Evidence,” mimeo.

Alan Blinder and Jeremy Rudd (2008) “The Supply Shock Explanation of the Great Stagflation Revisited” NBER Working paper 14568

Claudio Borio and Philip Lowe (2002) “Asset Prices, Financial and Monetary Stability: Exploring the Nexus’ BIS Working Paper no.114.

Claudio Borio (2012) “The Financial Cycle and Macroeconomics: What have We Learnt?” BIS (mimeo) September

Karl Brunner and Allan Meltzer (1973), “Mr. Hicks and the ‘Monetarists’.” Economica. February 40(157) pp 44-59.

Frank Browne and David Cronin (2007)" Commodity Prices and Inflation' ECB Working Paper No. 738, March

G. Bry and C. Boschan (1971), Cyclical Analysis of Time Series: Selected Procedures and Computer Programs, NBER, New York.

Michael Bryan, Stephen Cecchetti and Roisin O'Sullivan, (2000), " Asset Prices in the Measurement of Inflation" National Bureau of Economic Research Working paper No. 8700 January

Stephen G. Cechetti, Hans Genberg, John Lipsky , and Sushil Wadhwami, (2000) " Asset Prices and Central Bank Policy" Geneva Reports on the World Economy 2, International Center for Banking Studies and Centre for Economic Policy Research, July.

Stephen G. Cechetti (2003) " What the FOMC Says and Does When the Stock Market Booms", Conference on Asset Prices and Monetary Policy. Reserve Bank of Australia, Sydney, August.

Lawrence Christiano, Cosmin Ilut, Roberto Motto and Massino Rostagno (2010) " Monetary Policy and Stock Market Booms" in Macroeconomic Challenges: The Decade ahead, A Symposium Sponsored by the Federal Reserve Bank of Kansas City. Jackson Hole Wyoming

Matteo Ciccarelli and Benoit Mojon (2010) "Global Inflation" Review of Economics and Statistics, August.

Timothy Cogley and James Nason (1995) “Effects of the Hodrick-Prescott filter on trend and difference stationary time series: Implications for business cycle research,” Journal of Economic Dynamics and Control 19(1—2), p. 253—278.

Tim Congdon(2005) Money and Asset Prices in Boom and Bust. Institute of Economic Affairs London

Rudiger Dornbusch and Jacob Frenkel (1984), The Gold Standard and the Bank of England in the Crisis of 1847” in Michael Bordo and Anna Schwartz (eds) A Retrospective on the Classical Gold Standard 1821-1931. Chicago: University of Chicago Press for the NBER pp 233-276.

Barry Eichengreen and Kris Mitchener (2004) “The Great Depression as a Credit Boom gone Wrong” Research in Economic History Volume 22, 183-237.

Sebastien Frappa and Jean-Stephane Mesonnier (2010) “ The Housing Boom of the Late 1990s: Did Inflation Targeting Matter? “ Journal of Financial Stability Vol. 6 pp243-254

Jeffrey Frankel (2008) “ The Effect of Monetary Policy on Real Commodity Prices’ in John Campbell (ed) Asset Prices and Monetary Policy. Chicago; University of Chicago press

Milton Friedman (1960) A Program for Monetary Stability. New York: Fordham University Press

Milton Friedman and Anna Schwartz (1963a)’ Money and Business Cycles” Review of Economics and Statistics. February 45b, pp 32-64

Milton Friedman and Anna Schwartz (1963b) A Monetary History of the United States, 1867-1960. Princeton; Princeton University Press

John Kenneth Galbraith (1955), The Great Crash, 1929. Boston: Houghton Mifflin.

Stefan Gerlach and Katrin Assenmacher-Wesche. (2008a) "Financial Structure and the Impact of Monetary Policy on Asset Prices" Swiss National Bank Working Paper 2008-16.

Stefan Gerlach and Katrin Assenmacher-Weshe (2008b) "Monetary Policy, Asset Prices and Macroeconomic conditions; A Panel VAR Study" National Bank of Belgium Working Paper 149

Don Harding and Adrian Pagan (2002), "Dissecting the cycle: a methodological investigation," Journal of Monetary Economics 49, pp. 405—438.

Christian Hott, Terhi Jokipii,(2012) " Housing Bubbles and Interest Rates" Swiss National Bank Working paper 2012-07

Tokuo Iwaisako and Takatoshi Ito (1995) " Explaining Asset Bubbles in Japan" NBER Working Paper No. 5350

Lars Jonung, Jaako Kiander and Pentti Vartia (2009), The Great Financial Crisis in Finland and Sweden. Edward Elgar publishers, Northampton, Mass

Oscar Jorda, Moritz Schularick and Alan Taylor, (2012) "When Credit Bites Back: Leverage, Business Cycles and Crises". Journal of Money, Credit and Banking, September

David Laidler (2003) "The Price Level, Relative Prices, and Economic Stability; Aspects of the Interwar Debate" BIS conference" Monetary Stability, Financial Stability and the Business Cycle".

Ellen McGrattan and Edward Prescott (2003) “The 1929 Stock Market: Irving Fisher Was Right.” Federal Reserve Bank of Minneapolis Research Department Staff Report 294. May

Lloyd Metzler (1951), “Wealth, Saving and the Rate of Interest’ Journal of Political Economy. April 5992) pp 93-116

Larry Neal (1998) “The Financial Crisis of 1825 and the Reconstruction of the British Financial System” Federal Reserve Bank of St. Louis Review May/June.

Larry Neal (2011) “I am Not Master of Events” The Speculations of John Law and Lord Londonderry in the Mississippi and South Sea Bubbles. New Haven. Yale University Press.

Arthur Okun (1975) “Inflation: Its Mechanics and Welfare Costs.’ Brookings Papers on Economic Activity 2, pp 351-401.

Adrian Pagan and Kirill Sossounov (2003), “A Simple Framework for Analysing Bull and Bear Markets,” Journal of Applied Econometrics, 18, pp. 23—46.

Patrizio Pagano, Marco Lombardi and Alessio Anzuini (2010). “ The Impact of Monetary Policy on Commodity prices. ECB Working paper 1232

Raghuran G. Rajan (2011). *Fault Lines: How Hidden Fractures Still Threaten the World Economy*, Princeton University Press, May, ISBN-10 0691146837.

Peter Rapoport and Eugene White (1994) ‘Was the Crash of 1929 Expected?” American Economic Review, March.

Murray Rothbard (1983) America's Great Depression. Fourth Edition. New York: Richardson and Snyder

Moritz Schularick and Alan Taylor (2012) " Credit Booms Gone Bust: Monetary Policy, Leverage Cycles and Financial Crises, 1870-2008" American Economic Review Vol. 102 (2) 1029-61.

Anna J. Schwartz (1995), "Why Financial Stability Depends on Price Stability." Economic Affairs, pp 21-25.

Anna J. Schwartz (2002) " Asset Price Inflation and Monetary Policy." NBER Working paper no. 9321.

Erling Steigum (2009) "The Boom and Bust Cycle in Norway' in Lars Jonung et al (eds) The Great Financial Crisis in Finland and Sweden. Edward Elgar publishers, Northampton, Mass. Pp 202-244.

Frank Smets (1997), "Financial Asset Prices and Monetary Policy: Theory and Evidence" BIS Working Paper no.47, September.

Lars Svennson (2010) " Where Do Central Banks go from here?" Norges Bank Symposium. What is a Useful Central Bank . November.

John B. Taylor (1993), "Discretion versus Policy Rules in Practice," Carnegie-Rochester Conference Series on Public Policy, 39, pp 195—214.

John B. Taylor (1999) "A Historical Analysis of Monetary Policy Rules "in John B. Taylor (ed) Monetary Policy Rules Chicago: University of Chicago Press for the NBER. Pp 319-348.

John B. Taylor (2007) '"Housing and Monetary Policy" in Housing, Housing Finance and Monetary Policy Federal Reserve Bank of Kansas City.

John B.Taylor (2009) Getting Off Track. Hoover Press. Stanford CA

James Tobin (1969) "A General Equilibrium Approach to Monetary Theory," Journal of Money, Credit and Banking, February,1(1) , pp 15-29.

Francois Velde (2003) "Government Equity and Money: John Law's System in 1720" Federal Reserve Bank of Chicago Working Paper 2003-31.

George. F. Warren and Frank A. Pearson (1935), Gold and Prices. New York Wiley

Eugene White (2009) "Lessons from the Great American Real Estate Boom and Bust of the 1920s" NBER Working Paper 15573 December

Michael Woodford (2003) Interest and Prices: Foundations of a Theory of Monetary Policy. Princeton; Princeton University Press.

Appendix: Data Sources

Real GDP

See Michael D. Bordo, Christopher M. Meissner "Does Inequality Lead to a Financial Crisis?" NBER Working Paper No. 17896

Real house price index, 2000=100.

Detailed description: US [Robert J. Shiller, Irrational Exuberance, 2nd. Edition, Princeton University Press,2005, 2009, Broadway Books 2006, also Subprime Solution, 2008, as updated by author], Norway [Norges Bank; Eitrheim, Ø. og Erlandsen, S. "Monetary aggregates in Norway 1819-2003", 349-376Chapter 9 in Eitrheim, Ø., J.T. Klovland and J.F. Qvigstad (eds.),Historical Monetary Statistics for Norway 1819-2003, Norges Bank Occasional Papers no. 35, Oslo, 2004], UK [Department for Communities and Local Government, Housing statistics], France [conseil général de l'Environnement et du Développement (CGEDD), Home Prices in France, 1200-2012 : Historical French Property Price Trends, home price index of Paris], Netherlands [Piet M.A. Eichholtz, 1997, "The long run house price index: The Herengracht index, 1628-1973", Real Estate Economics, (25), 175-192., this index is based on the transactions of the buildings on the Herengracht, one of the canals in Amsterdam; for recent data the source is OECD], Australia [Stapledon, Nigel David, "Long-term housing prices in Australia

and Some Economic Perspectives", The University of New South Wales, Sep 2007; Australian median city house prices], Spain [before 1970 - source: Prados de la Escosura; after 1970 source is OECD]; Finland [Hjerppe, Riitta, Finland's Historical National Accounts 1860-1994: Calculation Methods and Statistical Tables, Jyvaskylan Yliopisto Historian Laitos Suomen Historian Julkaisuja, 24, pp. 158-160; and OECD for recent data], Canda [Statistics Canada and OECD], Japan [The Japan Real Estate Institute, for data between 1910 and 1940 Nanjo, Takashi, "Developments in Land Prices and Bank Lending in Interwar Japan: Effects of the Real Estate Finance Problem on the Banking Industry," IMES Discussion Paper Series, 2002-E-10, Bank of Japan, 2002]. For the cases of Denmark, Germany, Ireland, Italy, Sweden, Belgium, Switzerland and New Zealand, the OECD house price index was used.

Short term interest rate:

See Michael D. Bordo, Christopher M. Meissner "Does Inequality Lead to a Financial Crisis?" NBER Working Paper No. 17896

Credit

(We thank Alan Taylor for providing us with this data)

Loans to GDP ratio. Total lending, or bank loans, is defined as the end-of-year amount of outstanding domestic currency lending by domestic banks to domestic households and nonfinancial corporations (excluding lending within the financial system). Banks are defined broadly as monetary financial institutions and include savings banks, postal banks, credit unions,

mortgage associations, and building societies whenever the data are available. We excluded brokerage houses, finance companies, insurance firms, and other financial institutions. See Michael D. Bordo, Christopher M. Meissner "Does Inequality Lead to a Financial Crisis?" NBER Working Paper No. 17896