Does Expansionary Monetary Policy Cause Asset Price Booms? Some Historical and Empirical Evidence

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Does expansionary monetary policy lead to asset price booms? There is some extensive theoretical, empirical and policy literature on this topic. The traditional view sees expansionary monetary policy as raising asset prices as part of the transmission mechanism of monetary policy. It works through the adjustment of the community's portfolio as agents replace cash with government securities and then by corporate instruments, immediately followed by stocks, real estate, paintings of the Old Masters and natural resources —eventually leading to global inflation. Another view attributed to the Austrian economists in the 1920s, and more recently the BIS, sees an environment of low inflation and accommodative monetary policy as creating an environment conducive to asset booms and consequent busts.[1]

Asset booms (especially those leading to bubbles) are often followed by busts, which can have serious economic effects. There is

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

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a long historical incidence of infamous boom busts ranging from the South Sea bubble in the early eighteenth century, to many famous stock market crashes in the nineteenth century, to the 1929 Wall Street Crash, to the U.K. housing boom bust of 1973, to the Nordic crises of the 1980s, to the Japanese housing and equity bubble and crash of 1990, and to the more recent dot-com and subprime mortgage boom busts. This history keeps repeating itself.

The policy implications of asset booms are significant, especially since asset busts have often led to banking crises and serious, prolonged recessions. To the extent monetary policy is a contributing factor, the question arises whether or not the monetary authorities should use their policy tools to defuse booms before they turn into busts. A vociferous debate raged in the early 2000s 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 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, stock market booms and commodity booms for 18 OECD countries from 1920 to the present. We then ascertain whether or not our set of boom events can be related to different measures of expansionary monetary policy, deviations from Taylor rules, and monetary aggregate growth. Finally, we use panel regression techniques to control for other determinants of asset booms, including inflation, credit growth, output growth, financial liberalization, and the current account deficit.

Section 1 discusses the debate over the link between monetary policy and asset price booms. Section 2 contains historical narratives on some of the salient asset price booms throughout history. We discuss some booms in nineteenth century Great Britain, the Wall Street stock market boom and the U.S. housing boom of the 1920s, the commodity price boom of the 1970s, the U.K. housing booms in the 1970s and 1980s, the Nordic asset booms in the 1980s, the Japanese boom of the late 1980s, the dot-com boom of the 1990s, and the recent subprime mortgage boom bust. Section 3 discusses our methodology of identifying asset price booms and presents a chronology from 1920 to the present booms so identified. Controlling for other factors, section 4 uses econometrics to isolate the links between expansionary monetary policy and asset price booms. Section 5 concludes with the implications of our findings for monetary policy.

1. The Issues

Debate swirls over the causes of the subprime Mortgage Crisis of 2007-2008 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, an excess of global savings in Asia, which financed a consumption boom, and persistent budget deficits and current account deficits in the U.S and other advanced countries. The second is 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.[2]

A key element of the domestic U.S. story is that the Federal Reserve kept monetary policy too loose from the 2002-2006 period, 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 to the indictment of the Fed for fueling the housing boom in the early 2000s. Based on the Taylor rule (1993) showing that the Federal Funds rate was as low as 3 percentage points below what a simple Taylor rule would generate for the 2002-2005 period. Taylor then simulated the path of housing starts if the Fed had followed the Taylor rule over the 2000-2006 period. His calculations suggest that most of the run-up in housing starts from the 2002-2005 period would not have occurred.

An earlier OECD study by Ahrend et al. (2008) found a close relationship between negative deviations of the Taylor rule, and

2. The possibility that monetary policy can produce asset price bubbles has also been studied extensively in rational expectations equilibrium 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, argues Woodford (2003), if monetary policymakers follow a clear rule in which the interest rate target is adjusted sufficiently to stabilize inflation. Thus, the theoretical literature suggests that consideration of the monetary policy environment may be crucial to understanding why asset booms come about.

several measures of housing market buoyancy (mortgage lending, housing investment, construction investment and real house prices) for a 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) periods. 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).

Expansionary monetary policy can also generate booms in commodity prices, which can presage a run-up in global inflation. The Great Inflation of the 1970s was first manifested in commodity prices before feeding into overall inflation. This reflected the basic distinction, first pointed out by Okun (1975), between goods that are traded in auction markets and those whose prices react quickly to both nominal and real shocks, and goods traded in customer markets (manufactured goods and services) whose prices are relatively sticky. In the long run, the paths of prices for both types of goods are determined by the long-run growth of the money supply (reflecting monetary neutrality). What happens in episodes of expansionary monetary policy, characterized by falling real interest rates, is that real commodity prices rise much more quickly than the prices of other goods, and according to Frankel (2008), they overshoot the long-run equilibrium price level. At the same time the prices of other goods react slowly to the monetary pressure. Frankel (2008) finds that commodity prices are a good predictor of future inflation. Browne and Cronin (2007) use time series techniques for the U.S. (1959-2005) period to show that the growth of M2 and headline inflation are cointegrated, but that the adjustment mechanism to the long-run equilibrium involves considerable overshooting by commodity prices. Moreover the deviation of commodity prices from their long-run equilibrium values explains the subsequent path of the CPI.

There is some extensive, earlier literature on the relationship between monetary policy and asset prices. 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's, 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) showed 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, paintings of the 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, 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[3] 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 (2004) 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

3. See Laidler (2003).

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 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 that 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. 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 to an increase in demand in the short-run. At the same time, the absence of inflation may cause policy makers to delay tightening as demand pressures build up.[4] Thus, they contend (pp. 30-31) "these 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."[5]

Christiano et al. (2010) present historical evidence showing that stock price booms in the U.S. and Japan often occurred in periods

4. A related issue to the impact of expansionary monetary policy on asset prices is whether or not 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.

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

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, it will lead to lower interest rates that will further fuel the asset boom.

In section 5 below we present some evidence consistent with the loose monetary policy explanation for asset price booms and 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.

2. Historical Narrative

2.1 The Nineteenth Century

Asset booms and busts have been a major part of the economic landscape since the early eighteenth century. Classic stock market booms followed by wrenching busts were the South Sea Bubble in England and John Law's Mississippi scheme in France (see Neal, 2011 and Velde, 2003). In the nineteenth century there were major stock market boom busts across the world that accompanied the advent of equities to finance the rapid economic development that followed the industrial revolution. Two famous stock market booms and busts in England occurred in the 1820s and the 1840s.

The earliest and probably most famous stock market boom-bust in the modern era ended with the 1824-1825 stock market crash (Bordo, 1998; Bordo, 2003; Neal, 1998). After the Napoleonic wars and the successful resumption of the gold standard in 1821, the British economy enjoyed a period of rapid expansion stimulated by an export boom to the newly independent states of Latin America, and investment in infrastructure projects (e.g. gas lighting, canals and railroads). The sale of stocks to finance those ventures, in addition to gold and silver mines (some real, some fictitious) in Latin America, propelled a stock market boom fueled by the Bank of England's easy monetary policy. Prices rose by 78% in the boom. Indications are that the April 1825 collapse in stock prices was related to the prior tightening of the Bank of England's monetary policy stance in response to a decline in its gold reserves. The collapse, in which stock prices fell by 34%, triggered bank failures which, once they reached important City of London banks, precipitated a full-fledged panic in early December. Only then did the Bank of England begin to act as a lender of last resort, but it was too late to prevent massive bank failures, contraction of loans, and a serious recession.

The 1840s railroad mania was a precedent to the 1990s dot-com boom. After the first successful railroad was established in 1830, optimistic expectations about potential profits, which later turned out to be overly optimistic, led to massive investment in rails and rolling stock that extended the network across the country. The boom was accommodated by expansionary monetary policy in response to gold inflows. The end of the railroad boom was associated with the banking panic of 1847—one of the worst in British history. The crash, in which stock prices fell by 30%, and tightening of the Bank of England's monetary policy stance may have triggered the panic, as in earlier episodes, reflecting its concern over declining gold reserves (Dornbusch and Frankel, 1984). The panic led to many bank failures and a serious recession.

The U.S. had many stock market booms and busts in its history. Several of them were associated with banking panics and serious recessions. One of the classic boom busts was the railroad boom in the 1870s, which opened up the west. The post-civil war era experienced one of the most rapid growth rates in U.S. history. Much of the financing of railroad investment came from British capital inflows, which, in turn, accompanied by gold inflows, permitted monetary expansion. The boom was also accompanied by corporate malfeasance and corruption (Bordo and Benmelech, 2008). The boom ended with a stock market crash in 1873, once the extent of the corporate fraud was revealed. The stock market crash was followed by a banking panic and a recession that ended in 1879.

2.2 The 1920s

The most famous episode of an asset price boom 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 (e.g. electricity and the automobile) to fruition. In addition, major innovations 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 1920-1921, 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 and Rappoport and White, 1994).

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 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 2 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—in which 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 financial system or the economy as a whole.

2.3 Post World War II

The post war period has exhibited a large number of housing and stock market boom busts. Many of these episodes occurred in an environment of loose monetary policy. In addition, expansionary monetary policy across the world in the 1960s and 1970s led to a global commodities boom that presaged the Great Inflation. We briefly discuss a number of salient episodes.

2.3.1 Asset booms in the U.K.

The U.K. had a massive house price and stock market boom in the 1971-1974 period, referred to by Congdon (2005) as the Heath Barber Boom. Named 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 U.K. 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 (1963b) 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 the 1986-1987 period 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 that burst in 1989. Finally, he attributes a big run-up in financial sector real broad money holdings in 1997-1998 to an equities boom in the late 90s and a housing boom that peaked in 2006.

2.3.2 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.

2.3.3 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.

2.3.4 The 1994-2000 U.S. dot-com stock market boom

The stock market of the 1990s in the U.S. (and other countries) had many of the elements of the railroad boom in England in the 1840s and the Wall Street boom of the 1920s, including rapid productivity growth and the dissemination and marketing of technologies that had been developed earlier. Massive funds flowed from IPOs and the stock market to finance companies using the new high tech personal computer and internet based technologies. Significant run-ups in the market value of leaders like AOL and Microsoft (even before they reported profits) led others to join in the game. The investment boom in the IT industry led to a stock price boom in the late 1990s, which burst in 2000.

As in earlier booms, easy bank (and non-bank credit) finance was crucial, as well as accommodative monetary policy. As in the 1920s boom, the question arose whether the rise in stock prices reflected underlying fundamentals (referred to as the "New Economy") or a speculative bubble. The BIS view attributed the boom to the environment of low inflation and credibility for low inflation produced by the Federal Reserve and other central banks during the Great Moderation of the 1980s and 1990s. In this opinion, central banks, focused on low inflation, did not see the risks that the benign environment had for fostering an asset boom.

2.4.1 Commodity price booms: the 1930s

The recovery from the Great Contraction after 1933 witnessed a global commodity boom. Friedman and Schwartz (1963a) document the policies of Franklin Roosevelt and his Secretary of the Treasury, Henry Morgenthau, to purchase gold and silver in the London market to reflate the U.S. economy. They were following the approach suggested by Warren and Pearson (1935). The Treasury's gold and silver purchases succeeded in pushing up gold and silver prices in the London commodity market and may have also helped produce the general commodity boom of the mid-1930s. Other factors would have been global recovery and the looming threat of World War II.

2.4.2 Commodity Price Booms: the 1970s

The massive commodities boom in the 1970s has been viewed as a precursor to the Great Inflation. Following the monetarist transmission mechanism, expansionary monetary policy pushed up highly inelastic raw materials prices, which later fed into the prices of intermediate goods and final goods (Bordo, 1980). An alternative, widely held view at the time was that there were a series of negative supply shocks in the 1970s, which accounted for the boom (Blinder and Rudd, 2008). The most memorable events of the time were the two OPEC oil price shocks of 1974 and 1978. However, Barsky and Killian (2001) present evidence that what led to the formation of the OPEC cartel and its constriction of supply was an attempt to compensate the oil producers for a decline in the real value of oil prices in terms of dollars. This reflected global inflation aided by expansionary U.S. (and other countries) monetary policies beginning in the mid-1960s.

2.4.3 Commodity price booms: the 2000s

A run-up in commodity prices in the 2000s has popularly been attributed to globalization and the rapid growth of emerging market economies, especially China, which pushed up the prices of commodities, like copper, crucial to their economic development. However, there is also an argument that the boom reflected expansionary monetary policy in the U.S. and other advanced countries concerned over the threat of deflation after the dot-com boom burst (Frankel, 2008). The rise in commodity prices then fed into global inflation (Browne and Cronin, 2007; Ciccarelli and Mojon, 2010).

2.5 Summary

The wide history of asset price booms displays evidence of a connection between monetary expansion and booms. However, the circumstances of the different episodes varied considerably. In the case of some famous stock price booms (e.g. the 1840s, 1870s, 1920s and 1990s), the fundamental drivers were productivity shocks, such as the advent of the railroads, consumer durables and the internet. The run-up in asset prices was fueled by bank credit in an environment of accommodative monetary policy.

House price booms reflected real shocks on some occasions, such as rapid immigration, financial liberalization, as well as expansionary monetary policy. Commodity price booms also reflected both real shocks and highly expansionary monetary policy. In the rest of the paper we provide some empirical evidence on the contribution of monetary policy and several other factors in a large sample of asset price booms.

3. Identifying Asset Price Booms

Before outlining our econometric approach, we first identify asset price booms for real house prices, real stock prices and real commodity prices. Our approach to identifying boom/bust periods is a mixture of the formal and informal. We first use a well-known dating algorithm to find turning points in 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 are 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 and real commodity 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. For real stock prices, because of the higher volatility of stock prices and the lower duration that is found for cycles in stock prices, we use a modified rule where a turning point is declared if the observation on each side of the peak (trough) is lower (higher) than the candidate turning point. Note that this is the first stage of our process. It is possible that the rule for the stock price series may identify expansion/contraction pairs that are nothing more than short-term "blips." This is the reason why in the second stage of the process we inspect the cycles found by the algorithm and reject those that do not meet our criteria.

For 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 and commodity prices, and average at least 10% per year for real stock 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 are all followed by significant price corrections which suggest that the price expansion was not sustainable and, hence, a boom/bust period

The identified asset price booms are reported in tables 1, 2 and 3 and are depicted in figures in the appendix. We have annual data on real house prices and real stock prices for 18 countries from 1920 to 2010. We also have a single, real global commodity price index for that period.[6] The approach we follow is similar to that used in IMF WEO (2003), Helbling and Terrones (2004), and Bordo and Wheelock (2009). All of these studies used monthly data for a smaller set of countries. Only the Bordo and Wheelock study covered the pre-World War II period. As in the earlier studies we identify many more stock price booms than house price booms.

3.1 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, the Netherlands and Switzerland. The U.S. only experienced mild booms and corrections in that period. Several

6. For definitions of the data that we use, see the data appendix.

dramatic episodes occurred in the late 1990s and early 2000s. The U.S. housing boom of 1997-2006, when real prices rose by 79% and fell by 33%, and the Irish boom of 1996-2007, when real prices rose by 195% and then fell by 40%, really stands out.

Table 1. Identified Real House Price Booms

Booms				Corrections			
Period	*Duration*	*%Δ*	*APC*[a]	*Period*	*Duration*	*%Δ*	*APC*[a]
Belgium							
1971-1979	8	58.9	7.36	1979-1985	6	-37.06	-6.18
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
Finland							
1947-1955	8	50.77	6.35	1955-1958	3	-19.81	-6.6
1971-1974	3	14.42	4.81	1974-1979	5	-26.82	-5.36
1986-1989	3	61.85	20.62	1989-1993	4	-45.79	-11.45
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
Ireland							
1976-1979	3	40.58	13.53	1979-1987	8	-21.54	-2.69
1996-2007	11	194.53	17.68	2007-2011	4	-40.52	-10.13
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

Table 1. (continued)

	Booms				*Corrections*			
	Period	*Duration*	*%Δ*	*APC*[a]	*Period*	*Duration*	*%Δ*	*APC*[a]
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
New Zealand								
	1971-1974	3	66.96	22.32	1974-1980	6	-38.19	-6.37
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

Source: Authors' calculations.
a. APC = annualized percentage change.

3.2 Stock Price Booms

Stock prices show considerably more volatility than house prices, and many more booms and busts (table 2). In the pre-World War II period, most countries had major stock market booms and busts. In the 1920s, many countries had booms similar to that of Wall Street. The Wall Street boom saw real prices rising by 183% between 1923-1928, and collapsing by 63% between 1928-1932. The U.S. was surpassed by Canada and Switzerland, but Australia, Finland and Sweden were not far behind. This pattern of international concordance of stock prices is well known (Goetzmann, Li and Rouwenhorst, 2005). The recovery from the Great Contraction in the mid-1930s also displayed some major booms, especially in Australia, Canada, Finland, the U.K., Sweden, Switzerland and the U.S.

In the post-World War II era, booms reflecting Europe's recovery and catch up in the 1950s occurred in France, Italy and Switzerland. Japan also had a major boom in the 1950s. The Marshall Plan and the Dodge Plan may have been keen drivers of both rapid real growth and the rise in asset values in those years (Bordo and Wheelock, 2009).

The next big wave of stock market booms occurred in the 1980s and especially, the 1990s. The growth of the high tech industry led to dramatic booms in the U.S., U.K., Germany, Ireland, Italy, Spain, Sweden and Switzerland.

3.3 Commodity Price Booms

As discussed in section 3 above, table 3 shows the post-Great Contraction commodity price boom in the mid-1930s. The boom in the 1970s associated with the oil price shocks and the Great Inflation is also evident. The last big boom in the 2000s associated with the rapid growth of emerging markets and expansionary monetary policy is also very visible in the table.

Table 2. Identified Real Stock Price Booms

Booms				*Corrections*			
Period	*Duration*	*%Δ*	*APC*[a]	*Period*	*Duration*	*%Δ*	*APC*[a]
Australia							
1920-1928	8	128.67	16.08	1928-1930	2	-35.73	-17.87
1930-1936	6	154.21	25.7	1935-1941	5	-30.93	-6.19
1956-1959	3	65.71	21.9	1959-1960	1	-15.02	-15.02
1966-1969	3	79.3	26.43	1969-1971	2	-31.71	-15.85
1978-1980	2	61.93	30.96	1980-1982	2	-44.92	-22.46
2002-2007	5	88.03	17.61	2007-2008	1	-45.04	-45.04
Belgium							
1987-1989	2	58.41	29.2	1989-1990	1	-28.21	-28.21
1994-1998	4	141.32	35.33	1998-2002	4	-44.69	-11.17
2002-2006	4	115.02	28.75	2006-2008	2	-53.95	-26.97
Canada							
1920-1928	8	269.07	33.63	1928-1932	4	-64.99	-16.25
1932-1936	4	146.19	36.55	1936-1937	1	-23.19	-23.19
1953-1956	3	67.9	22.63	1956-1957	1	-24.81	-24.81
1977-1980	3	61.95	20.65	1980-1982	2	-29.57	-14.79
1998-2000	2	30.08	15.04	2000-2002	2	-29.22	-14.61
2002-2007	5	88.93	17.79	2007-2008	1	-35.77	-35.77

Table 2. (continued)

Booms				Corrections			
Period	*Duration*	*%Δ*	*APC*[a]	*Period*	*Duration*	*%Δ*	*APC*[a]
Denmark							
1932-1936	4	43.24	10.81	1936-1940	4	-42.37	-10.59
1952-1956	4	32.81	8.2	1956-1957	1	-13.46	-13.46
1957-1960	3	33.99	11.33	1960-1962	2	-11.88	-5.94
1987-1989	2	81.72	40.86	1989-1992	3	-31.93	-10.64
1998-2000	6	127.32	21.22	2000-2002	2	-35.79	-17.9
2002-2007	5	145.41	29.08	2007-2008	1	-50.17	-50.17
Finland							
1924-1927	3	154.64	51.55	1927-1929	2	-30.12	-15.06
1932-1936	4	115.41	28.85	1936-1940	4	-35.82	-8.96
1952-1956	4	87.27	21.82	1956-1958	2	-40.76	-20.38
1969-1973	4	1531.34	382.83	1973-1977	4	-68.6	-17.15
1985-1988	3	176.55	58.85	1988-1991	3	-63.41	-21.14
1995-1999	4	704.66	176.17	1999-2002	3	-62.93	-20.98
2004-2007	3	75.7	25.23	2007-2008	1	-54.95	-54.95
France							
1920-1923	3	82.56	27.52	1923-1926	3	-28.59	-9.53
1926-1928	2	109.19	54.59	1928-1931	3	-51.04	-17.01
1950-1957	7	241.61	34.52	1957-1958	1	-21.13	-21.13
1958-1962	4	76.66	19.17	1962-1967	5	-44.34	-8.87
1977-1979	2	39.84	19.92	1979-1982	3	-31.33	-10.44
1982-1986	4	218.43	54.61	1986-1987	1	-31.57	-31.57
1987-1989	2	84.78	42.39	1989-1990	1	-27.72	-27.72
1995-1999	4	195.91	48.98	1999-2002	3	-48.85	-16.28
2002-2007	4	78.47	19.62	2007-2009	2	-44.86	-22.43
United Kingdom							
1920-1928	8	41.11	5.14	1928-1931	3	-35.11	-11.7
1931-1936	5	73.77	14.75	1936-1940	4	-53.24	-13.31
1952-1954	2	47.91	23.96	1954-1857	3	-21.08	-7.03
1957-1959	2	87.9	43.95	1959-1962	3	-16.48	-5.49
1966-1968	2	70.35	35.17	1968-1970	2	-30.58	-15.29
1970-1972	2	36.77	18.38	1972-1974	2	-76.72	-38.36
1990-1999	9	143.86	15.98	1999-2002	3	-45.25	-15.08
2002-2006	4	49.8	12.45	2006-2008	2	-34.7	-17.35

Table 2. (continued)

Booms				Corrections			
Period	*Duration*	*%Δ*	*APC*[a]	*Period*	*Duration*	*%Δ*	*APC*[a]
Germany							
1956-1960	4	231.36	57.84	1960-1968	2	-34.69	-17.34
1966-1969	3	64.14	21.38	1969-1971	2	-27.79	-13.9
1981-1986	5	180.19	36.04	1986-1987	1	-37.81	-37.81
1987-1989	2	65.88	32.94	1989-1992	3	-29.3	-9.77
1992-1999	7	189.84	27.12	1999-2002	3	-59.73	-19.91
2002-2007	5	130.96	26.19	2007-2008	1	-44.98	-44.98
Ireland							
1957-1968	11	248.42	22.58	1968-1970	2	-33.05	-16.52
1976-1978	2	106.51	53.25	1978-1982	4	-58.36	-14.59
1982-1989	7	303.94	43.42	1989-1990	1	-33.33	-33.33
1992-2000	8	279.45	34.93	2000-2002	2	-36.21	-18.11
2002-2006	4	109.43	27.36	2006-2008	2	-76.48	-38.24
Italy							
1922-1924	2	59.29	29.64	1924-1926	2	-44.26	-22.13
1926-1928	2	65.13	32.57	1928-1932	4	-50.07	-12.52
1956-1960	4	140.27	35.07	1960-1964	4	-53.85	-13.46
1977-1980	3	92.61	30.87	1980-1982	2	-29.77	-14.89
1982-1986	4	212.07	53.02	1986-1987	1	-35.78	-35.78
1987-1989	2	25.67	12.84	1989-1992	3	-45	-15.00
1995-2000	5	190.82	38.16	2000-2002	2	-46.2	-23.10
2002-2006	4	68.33	17.08	2006-2008	2	-55	-27.50
Japan							
1923-1926	3	43.2	14.40	1926-1930	4	-16.49	-4.12
1931-1933	2	89.73	44.87	1933-1938	5	-30.73	-6.15
1957-1960	3	169.68	56.56	1960-1963	3	-25.68	-8.56
1967-1969	2	66.51	33.26	1969-1970	1	-22.05	-22.05
1970-1972	2	136.21	68.10	1972-1974	2	-48.76	-24.38
1977-1989	12	479.01	39.92	1989-1992	3	-59.64	-19.88
2001-2006	4	101.39	25.35	2006-2008	2	-49.13	-24.56
Netherlands							
1924-1928	4	41.18	10.30	1928-1931	3	-62.06	-20.69
1951-1955	4	119.73	29.93	1955-1956	1	-18.80	-18.80
1956-1959	3	71.87	23.96	1959-1961	2	-14.00	-7.00
1965-1967	2	56.05	28.02	1967-1970	3	-38.24	-12.75
1993-1998	5	203.19	40.64	1998-2001	3	-54.89	-18.3
2001-2006	5	57.64	11.53	2006-2007	1	-52.68	-52.68

Table 2. (continued)

	Booms				Corrections			
	Period	*Duration*	*%Δ*	*APC*[a]	*Period*	*Duration*	*%Δ*	*APC*[a]
New Zealand								
	1931-1934	3	52.51	17.50	1934-1938	4	-28.15	-7.04
	1958-1964	6	117.6	19.60	1964-1966	2	-16.12	-8.06
	1967-1969	2	47.54	23.77	1969-1971	2	-27.91	-13.95
	1979-1981	2	45.44	22.72	1981-1982	1	-28.34	-28.34
	1982-1986	4	324.35	81.09	1986-1988	2	-61.76	-30.88
Norway								
	1921-1929	8	70.84	8.85	1929-1937	8	-41.47	5.18
	1953-1956	3	36.23	12.08	1956-1958	2	-26.25	-13.12
	1967-1970	3	69.70	23.23	1971-1971	1	-28.42	-28.42
	1971-1973	2	37.59	18.79	1973-1975	2	-54.25	-27.12
	2002-2007	5	231.3	46.26	2007-2008	1	-55.44	-55.44
	2008-2010	2	76.58	38.29	2010-2011	1	-15.49	-15.49
Spain								
	1950-1956	6	163.74	27.29	1956-1959	3	-48.60	-16.20
	1961-1963	2	31.47	15.73	1963-1964	1	-13.87	-13.87
	1967-1972	5	112.35	22.47	1972-1982	10	-91.31	-9.13
	1982-1989	7	294.4	42.06	1989-1992	3	-38.81	-12.94
	1994-1999	5	208.7	41.74	1999-2002	3	-43.39	-14.46
	2002-2007	5	120.31	24.06	2007-2008	1	-41.40	-41.40
Sweden								
	1923-1928	5	177.56	35.51	1928-1932	4	-62.81	-15.70
	1932-1936	4	102.71	25.68	1926-1941	5	-35.40	-7.08
	1958-1950	2	29.61	14.8	1950-1952	2	-19.58	-9.79
	1952-1954	2	47.97	23.98	1954-1957	3	-17.92	-5.97
	1957-1959	2	58.37	29.18	1959-1962	3	-17.90	-5.97
	1962-1965	3	36.16	12.05	1965-1966	1	-26.52	-26.52
	1970-1972	2	17.60	8.80	1972-1974	2	-18.40	-9.20
	1979-1989	10	503.68	50.37	1989-1990	1	-37.86	-37.86
	1992-1999	7	443.67	63.38	1999-2002	3	-56.63	-18.88
	2002-2006	4	141.66	35.42	2006-2008	2	-48.28	-24.14
	2008-2010	2	74.64	37.32	2010-2011	1	-18.09	-18.09
Switzerland								
	1920-1928	8	214.08	26.76	1928-1931	3	-46.72	-15.57
	1935-1938	3	88.88	29.63	1938-1940	2	-35.94	-17.97
	1957-1961	4	187.92	46.98	1961-1966	5	-67.27	-13.45
	1990-2000	10	342.77	34.28	2000-2002	2	-44.58	-22.29
	2002-2006	4	91.21	22.8	2006-2008	2	-38.88	-19.44

Table 2. (continued)

Booms				*Corrections*			
Period	*Duration*	*%Δ*	*APC*[a]	*Period*	*Duration*	*%Δ*	*APC*[a]
United States							
1923-1928	5	182.59	36.52	1928-1932	4	-63.07	-15.77
1934-1936	2	73.15	36.57	1936-1937	1	-40.34	-40.34
1953-1956	3	83.34	27.78	1956-1957	1	-16.73	-16.73
1962-1965	3	40.03	13.34	1965-1966	1	-16.00	-16.00
1966-1968	2	19.82	9.91	1968-1970	2	-20.86	-10.43
1970-1972	2	19.97	9.98	1972-1974	2	-52.44	-26.22
1994-1999	5	184.55	36.91	1999-2002	3	-44.29	-14.76

Source: Authors' calculations.
a. APC = annualized percentage change.

Table 3. Identified Real Commodity Price Booms

Booms				*Corrections*			
Period	*Duration*	*%Δ*	*APC*[a]	*Period*	*Duration*	*%Δ*	*APC*[a]
1933-1938	5	88.86	17.77	1938-1940	2	-17.7	-8.85
1950-1952	2	38.11	19.06	1952-1954	2	-22.98	-11.49
1963-1967	4	27.52	6.88	1967-1969	2	-19.56	-9.78
1972-1975	3	141.94	47.31	1975-1976	1	-13.23	-13.23
1976-1981	5	113.44	22.69	1981-1983	2	-24.74	-12.37
1986-1989	3	53.3	17.77	1989-1992	3	-24.96	-8.32
1994-1996	2	35.62	17.81	1996-2000	4	-28.96	-7.24
2002-2009	7	139.08	19.87	2009-2010	1	-19.71	-19.71

Source: Authors' calculations.
a. APC = annualized percentage change.

4. Empirical Analysis

In this analysis, we pool data from across the 18 countries in our data set to investigate the impact of loose monetary policy and low inflation on asset prices.[7] By pooling the data across the twentieth century, we are in a sense calculating the impact each of our control variables has 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, 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 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) made, 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, real stock prices, and real commodity prices. We include two different measures of monetary policy: the deviation of a short-term interest rate from the optimal Taylor rule rate, and the deviation of the money growth rate from 3%. The optimal Taylor rule rate is given by the following equation:

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

where the output gap term is given by the deviation in logging 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.[8] The same goes for our measure of monetary policy using the

7. The countries in our sample are Australia, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland and the U.S. Countries are included in our regressions if data is available. When the number of countries reported for a regression is less than 18, it is because data for a country is missing.

8. As we collect more data, in particular data on policy rates, we will check the sensitivity of our results to this rough measure of the optimal policy rate.

growth rate of broad money. We use the deviation of the growth rate of money from 3% as a simple measure of the stance of monetary policy present at the time. It also represents Milton Friedman's original (1960) monetary rule—to set money growth equal to the underlying trend growth rate of real output.[9] If we assume the trend growth rate in velocity is constant, this rule would give stable prices.[10] Money growth is also a useful measure of the stance of monetary policy in earlier periods when central banks engaged in monetary targeting or in episodes when it is more difficult to estimate a Taylor rule.

The three main controls that we use in our regressions are the deviation of monetary policy from the "optimal" policy rule, either the Taylor rule or the Friedman money growth rule, a measure of the inflationary state of the economy—a measure of the deviation of inflation from its long run trend, and a measure of the credit conditions present as measured by the deviation of the share of bank loans to GDP from its long run mean.

The deviation of the short-term interest rate (money growth rate) from the optimal rate is included to control for possible correlations between "loose" monetary policy and asset booms. The inflation control is included to control for possible correlations between low inflation policy and booms, and the credit control variable is included to determine if loose or "easy" 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. Of course these are not the only determinants of asset prices, so we also include other controls, such as the growth rate of GDP, a measure of current account imbalances and a measure of financial liberalization.[11]

The data in their raw form are non-stationary, either through the presence of a unit root or a time trend. In this paper we are mainly interested in the role that our three main controls play in boom/

9. The trend growth rate of real output would roughly hold for the U.S. 1920-2010 but may be too high for some countries like the U.K., and too low for others.

10. Over the 1920-2010 period, the trend growth rate of velocity was close to zero, averaging a decline to the 1960s and an increase since Bordo and Jonung (1987).

11. See the Data Appendix for a description of the sources for the data used in this analysis.

bust periods. These periods are identified earlier as periods where there were sustained run-ups in asset prices followed by significant corrections. That is, these asset price booms are periods in which asset prices move away from their long-run trend. Our interest is to see whether or not there is a systematic relationship between deviations of our three main variables from their long-run trend, or in the case of the policy variable, the optimal rate, and the deviation of asset prices from its long-run trend. Thus, we are not focusing on secular movements and the relationship between asset price levels and the rate of inflation, interest rates, or the amount of credit available in the economy, but rather we are focusing on examining the departures from the norm.

Because of this, we convert all variables to deviations from a long-run trend. The policy variables, the short-term interest rate and the growth rate of M2 are deviated from the "optimal" rate. We do this using the Hodrick-Prescott (HP) filter with a smoothing parameter set to 100, since our data are collected at the annual frequency. [12]

Therefore, the variables used in our regression analysis are negative when the value is below the long-run trend, and positive when the variable is above the long run trend. Our regression analysis then investigates the relationship between the deviation from the long run trend of asset prices, the deviation of inflation and credit from their long term trend, and the deviation of the short term interest rate from the "optimal" Taylor rule rate (or deviation of the growth rate of money from 3% in the case where we use money growth rates in our regression). When the short term rate is below the "optimal" Taylor rule rate or the money growth rate is above 3%, then the monetary policy conditions are "loose".

The model that is used is an autoregressive distributed lag (ARDL) model given by

$$\hat{p}_t = \alpha + \sum_{j=1}^{p} \beta_j \hat{p}_{t-j} + \sum_{k=1}^{3} \sum_{j=0}^{q} \gamma_{kj} \hat{x}_{kt-j} + \varepsilon_t. \tag{2}$$

12. In order to make the current account variable stationary, we use deviations from its long-run (HP) trend. Thus, if the deviation is negative, the current account has worsened relative to its recent past; and if the value of this gap is positive, the current account has improved relative to its recent past. A positive value does not necessarily mean the current account is in surplus, and a negative value does not necessarily mean the current account is in deficit.

Here, variables in "hats" refer to deviations from trend, or in the case of the monetary policy variables, the "hats" refer to deviations from the optimal policy—the Taylor rule for interest rates and the Friedman rule for money growth. We include the three main control variables into the regression with lags in order to investigate the dynamic structure of low inflation, "loose" monetary policy, and relatively abundant or "easy" credit on asset prices. In determining the number of lags to include from each variable in our regression equation, sequential likelihood ratio tests are used. For simplicity we do not allow for different numbers of lags for each of the right hand side control variables.

Tables 4, 5 and 6 show the results for real house prices, real stock prices and real commodity prices for each of the monetary variables, respectively. The first two sets of regressions—the ones with house and stock prices as dependent variables—are panel regressions, and in these two regression equations country specific fixed effects are included. For the regression for real commodity prices, because the market for commodities is a global market, lacking measures of global monetary policy, we use U.S. data as covariates.

4.1 Real House Prices

Tables 4A and 4B report the results from our panel regressions where real house prices are the dependent variable. In all tables the numbers in parentheses are p-values. Country specific fixed effects are included, but their estimates are not reported for space considerations. There are four regressions reported in each table. The first regression is the basic ARDL model with only current and lagged deviations of trend of the three main control variables included. In table 4A the "policy" variable that is included is the deviation of the short-term interest rate from the "optimal" rate given by the Taylor rule in (1). Table 4B includes the deviation of the growth rate of M2 from 3%. In both regressions it was determined that one lag of the dependent variable, the current value and two lags of the control variables should be included. In order to allow for the possibility that the three main covariates are only important during the boom periods, we include interactions between a dummy variable (D), that for each country takes a value of 0 if period t is not in a boom, and a value of 1 if period t is in a boom. Thus, we are able to tell if there are any nonlinearities present in the relationship between the controls and asset price deviations.

Regression (1) reported in table 4A reports the estimates of (2) when we include the policy variable, the inflation variable, and the credit variable. For the policy variable, which is the deviation of the short-term interest rate from the Taylor rule rate, the coefficient on the first lag is significant and negative. This means that for every 1 percentage point you lower the short-term interest rate below the implied Taylor rule rate, real house prices would increase by 0.40% in the next period.[13] This is obviously a very small impact and given that the second lag is significant and positive the overall impact of a sustained period with the short-term interest rate below its target would not have a large initial impact on house prices.

As for the deviation of inflation from its long-run trend, again, the first lag is significant and negative. Thus a negative deviation of one percentage point in the inflation from its long-run trend would lead to an increase in house prices of 0.85%. Again, this initial impact is small. As for the variable that measures the deviation of credit from its long-run trend, there are no significant terms.

The results above are what you would expect in "normal" situations, that is, when $D = 0$. During boom periods, when $D = 1$, the impacts of deviations from trend are more striking. For the policy deviation variable, $(r^s - r^{Taylor})_t$,there is a significant and large negative coefficient on the second lag. Thus, when in a boom period the initial impact of a negative deviation from the Taylor-rule rate of one percentage point leads to a 2.15 percent increase in house prices two periods later. This large and significantly negative estimate is consistent across all specifications of our regression models and indicates that "loose" monetary policy is associated with increases in house prices during the identified boom periods.

The same results are apparent for the inflation deviation and the credit deviation. For inflation during boom periods, there are significant and negative coefficients on the current period and the second lag. The first lag is also significant but is positive, which means that the impact of a sustained one percentage point fall in inflation will be negative and in the range of 2.5%, initially.

13. Note that all variables are in decimals, so that a 1 percentage point change is equivalent to a change of 0.01. Also note that the presence of a lagged dependent variable means that the long-run cumulative impact of this change can be higher than the initial impacts, but for the purposes of this discussion we will discuss only the initial impacts.

Table 4A. Panel Regression Results for Real House Prices (Taylor Rule)[a]

Dependent Variable: Deviation of log Real House Prices from lon–run trend (HP trend)

Regressors	*(1)*	*(2)*	*(3)*	*(4)*
$(p - \overline{p})_{t-1}$	0.77*** (0.00)	0.80*** (0.00)	0.80*** (0.00)	0.79*** (0.00)
$(r^s - r^{Taylor})_t$	0.04 (0.77)	0.10 (0.42)	-0.02 (0.90)	-0.16 (0.35)
$(r^s - r^{Taylor})_{t-1}$	-0.40** (0.02)	-0.24 (0.16)	-0.06 (0.78)	-0.05 (0.80)
$(r^s - r^{Taylor})_{t-2}$	0.26** (0.03)	0.05 (0.66)	0.03 (0.87)	0.02 (0.88)
$(\pi - \overline{\pi})_t$	0.17 (0.43)	0.26 (0.21)	-0.06 (0.84)	-0.17 (0.59)
$(\pi - \overline{\pi})_{t-1}$	-0.85*** (0.00)	-0.55** (0.04)	-0.07 (0.83)	-0.07 (0.85)
$(\pi - \overline{\pi})_{t-2}$	0.12 (0.57)	-0.15 (0.50)	-0.35 (0.26)	-0.44 (0.17)
$(L/Y - \overline{L/Y})_t$	-0.07 (0.17)	0.01 (0.89)	-0.12 (0.12)	-0.11 (0.15)
$(L/Y - \overline{L/Y})_{t-1}$	-0.03 (0.67)	-0.08 (0.21)	-0.06 (0.49)	-0.05 (0.56)
$(L/Y - \overline{L/Y})_{t-2}$	0.01 (0.89)	0.03 (0.57)	0.08 (0.23)	0.14** (0.05)
$D^*(p - \overline{p})_{t-1}$	0.17** (0.02)	0.14* (0.09)	0.10 (0.29)	0.00 (1.00)
$D^*(r^s - r^{Taylor})_t$	0.22 (0.48)	0.26 (0.42)	0.15 (0.68)	1.01 (0.06)
$D^*(r^s - r^{Taylor})_{t-1}$	0.47 (0.27)	0.49 (0.26)	0.68 (0.16)	0.24 (0.75)
$D^*(r^s - r^{Taylor})_{t-2}$	-1.30*** (0.00)	-1.19*** (0.00)	-1.33*** (0.00)	-1.69*** (0.00)
$D^*(\pi - \overline{\pi})_t$	-0.80* (0.09)	-0.71 (0.14)	-0.75 (0.19)	-0.13 (0.85)
$D^*(\pi - \overline{\pi})_{t-1}$	1.11* (0.10)	1.16* (0.09)	1.27 (0.11)	0.79 (0.38)
$D^*(\pi - \overline{\pi})_{t-2}$	-2.32*** (0.00)	-2.17*** (0.00)	-2.16*** (0.00)	-2.13*** (0.01)
$D^*(L/Y - \overline{L/Y})_t$	0.51*** (0.00)	0.44*** (0.00)	0.55*** (0.00)	0.56*** (0.00)
$D^*(L/Y - \overline{L/Y})_{t-1}$	-0.11 (0.58)	-0.18 (0.38)	-0.19 (0.41)	-0.20 (0.43)
$D^*(L/Y - \overline{L/Y})_{t-2}$	-0.35** (0.02)	-0.31** (0.03)	-0.35** (0.04)	-0.39** (0.03)

Table 4A. (continued)

Regressors	*(1)*	*(2)*	*(3)*	*(4)*
GDP growth		0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)
Current account			-0.01*** (0.00)	-0.01*** (0.00)
Change in financial innovation				0.00 (0.65)
R^2	0.69	0.72	0.75	0.75
$\bar{R}^2$	0.67	0.70	0.73	0.72

Source: Authors' calculations.
a. Fixed effects included in regression but not reported. Numbers in parentheses are p-values.

The credit variable showed little impact during normal periods, but during the identified boom periods the coefficients are significant and positive for the current period and significant and negative for the second lag. This suggests that a one percent increase in loans, as a proportion of GDP, would lead house prices increasing in the short term but that this increase would be small and to the order of 0.25% to 0.5%. It should be noted that the modest size of this effect is in contrast to results reported in Jorda et al. (2012) and Christiano et al. (2010). Our estimates are based on panel estimates using evidence for booms across most of the twentieth century and so the estimates we report are essentially averages of the impact of credit expansion for each of the booms. It could be that the credit expansion story is appropriate for the most recent boom but not for earlier booms. The fact that we get a lower impact, on average, does not necessarily contradict the results from these authors.

As in the case of the policy variable, the evidence points to there being a bigger effect during booms than in calmer periods. This result that "loose" monetary policy, low inflation, and "easy" credit are associated with increases in house prices during boom periods is consistent across the other specifications and the impact of these variables is higher in magnitude than GDP growth and the measure of current account imbalance. The financial liberalization variable does not have any impact.[14]

14. Data for the financial liberalization variable are only available from 1970 onwards; so this regression only includes data after 1970.

Thus, there is evidence that during boom periods the relationship between interest rates, low inflation, credit conditions and house prices is heightened and conducive to fueling even higher prices.

Table 4B reports the same regression results as above, except this time the deviation of money growth (M2) is used as our measure of expansionary monetary policy instead of the deviation of the short term interest rate from the optimal Taylor-rule rate. The results are reasonably consistent with the one reported above. A "loose" monetary condition which, in this case, means having a growth rate of money larger than the Friedman rule rate of 3%, is associated with an increase in house prices and this impact is greater during the identified boom periods than during normal periods. The same goes for credit, in that "easy" credit is associated with higher house prices; again, this is heightened during boom periods.

However, the one result that is different from the results reported in Table 4A for the interest rate variable is that low inflation does not appear to have a heightened impact during boom periods. Low inflation does have a significant and negative effect in normal times, but the interaction term where the boom dummy is interacted with the deviation of inflation from its long-run trend is not significant. Our conjecture is that money growth and inflation have been correlated in the past, for example during the 1960's and 1970's, and this is why the impact of inflation in the money growth regressions is reduced.

Overall, the results reported in table 4B do indicate that the impact of the three variables is to increase house prices, and this impact is heightened during the identified boom periods. Again, the results are reasonably consistent across the different specifications.

Another reason why there might be differences between the two approaches is that some of the bigger booms occurred in the late 1980s and early 1990s in a period when the use of interest rates became more prevalent than money growth rates as policy instruments for the countries in our sample. This is obviously only speculation but does warrant further investigation.

Table 4B. Panel Regression Results for Real House Prices
(Money Growth Rate Rule)

Dependent Variable: Deviation of log Real House Prices from long–run trend (HP trend)

Regressors	*(1)*	*(2)*	*(3)*	*(4)*
$(p - \bar{p})_{t-1}$	0.72*** (0.00)	0.73*** (0.00)	0.80*** (0.00)	0.78*** (0.00)
$(\Delta\log(m) - 0.03)_t$	0.01 (0.86)	0.07 (0.29)	0.13 (0.11)	0.12 (0.17)
$(\Delta\log(m) - 0.03)_{t-1}$	0.14*** (0.01)	0.13* (0.08)	0.01 (0.88)	0.06 (0.51)
$(\Delta\log(m) - 0.03)_{t-2}$	-0.04 (0.45)	-0.06 (0.33)	-0.13* (0.09)	-0.12 (0.15)
$(\pi - \bar{\pi})_t$	-0.12 (0.26)	-0.12 (0.26)	0.06 (0.77)	0.14 (0.52)
$(\pi - \bar{\pi})_{t-1}$	-0.08 (0.41)	0.00 (0.98)	-0.06 (0.74)	-0.04 (0.85)
$(\pi - \bar{\pi})_{t-2}$	-0.51*** (0.00)	-0.45*** (0.00)	-0.33*** (0.08)	-0.44*** (0.04)
$(L/Y - \overline{L/Y})_t$	-0.05 (0.33)	0.00 (0.92)	-0.14 (0.06)	-0.14 (0.08)
$(L/Y - \overline{L/Y})_{t-1}$	0.03 (0.60)	0.01 (0.86)	-0.02 (0.83)	-0.02 (0.83)
$(L/Y - \overline{L/Y})_{t-2}$	-0.02 (0.62)	-0.03 (0.58)	0.07 (0.32)	0.12 (0.08)
$D^*(p - \bar{p})_{t-1}$	0.29*** (0.00)	0.30*** (0.00)	0.19** (0.04)	0.17* (0.10)
$D^*(\Delta\log(m) - 0.03)_t$	0.17 (0.16)	0.17 (0.24)	0.32** (0.05)	0.26 (0.15)
$D^*(\Delta\log(m) - 0.03)_{t-1}$	0.30** (0.02)	0.07 (0.67)	-0.02 (0.93)	-0.14 (0.49)
$D^*(\Delta\log(m) - 0.03)_{t-2}$	0.23* (0.06)	0.29* (0.06)	0.25 (0.15)	0.32* (0.09)
$D^*(\pi - \bar{\pi})_t$	-0.18 (0.55)	-0.40 (0.26)	-0.55 (0.17)	-0.75 (0.14)
$D^*(\pi - \bar{\pi})_{t-1}$	0.17 (0.63)	0.31 (0.46)	0.27 (0.54)	0.67 (0.29)
$D^*(\pi - \bar{\pi})_{t-2}$	0.06 (0.82)	-0.24 (0.43)	-0.24 (0.48)	-0.25 (0.61)
$D^*(L/Y - \overline{L/Y})_t$	0.27** (0.04)	0.22 (0.14)	0.33** (0.04)	0.32* (0.06)
$D^*(L/Y - \overline{L/Y})_{t-1}$	-0.09 (0.66)	-0.07 (0.76)	-0.05 (0.83)	-0.06 (0.80)
$D^*(L/Y - \overline{L/Y})_{t-2}$	-0.15 (0.28)	-0.21 (0.18)	-0.28* (0.10)	-0.32* (0.07)

Table 4B. (continued)

Regressors	*(1)*	*(2)*	*(3)*	*(4)*
GDP growth		0.00*** (0.00)	0.01*** (0.00)	0.01*** (0.00)
Current account			-0.01*** (0.00)	-0.01*** (0.00)
Change in financial innovation				0.00 (0.50)
R^2	0.69	0.72	0.75	0.75
$\bar{R}^2$	0.67	0.70	0.73	0.72

Source: Authors' calculations.
a. Fixed effects included in regression but not reported. Numbers in parentheses are *p*-values.

4.2 Real Stock Prices

Tables 5A and 5B repeat the analysis for real stock prices. The specification used in his regression was to include one lag of the dependent variable and the current value, and one lag of the three control variables. The results for the case, when the interest rate deviation is used as a measure of the looseness of monetary policy, are reported in table 5A.

For the "normal" periods, that is, for periods that are not designated to be boom periods, the interest rate deviation and the inflation deviation variables have significant coefficients. For the interest rate deviation, the results are mixed, in that while the coefficient on the current value of the interest rate deviation is negative and highly significant, the coefficient on the first lag of the interest rate deviation is equally large and positive. In fact, the sum of the two estimates is slightly positive. The same qualitative result also occurs for the inflation deviation, but this time the sum of the two estimates is negative. For the normal period, at least, "easy" credit does not appear to be associated with increases in stock prices.

As in the case of house prices there is evidence of nonlinearity in the results, in that there are significant coefficients on the interaction terms. In fact, the coefficient on the lag of the interest rate deviation is very negative and significant. Given that the regular coefficients on the interest rate deviation "wash out," there only appears to be a relationship between "loose" monetary policy and higher stock prices

Table 5A. Panel Regression Results for Real Stock Prices
(Taylor Rule)[a]

Dependent Variable: Deviation of log Real Stock Prices from long–run trend (HP trend)

Regressors	*(1)*	*(2)*	*(3)*	*(4)*
$(p - \bar{p})_{t-1}$	0.32*** (0.00)	0.27*** (0.00)	0.25*** (0.00)	0.30*** (0.00)
$(r^s - r^{Taylor})_t$	-2.02*** (0.00)	-1.94*** (0.00)	-1.76*** (0.01)	-1.99*** (0.01)
$(r^s - r^{Taylor})_{t-1}$	2.33*** (0.00)	2.29*** (0.00)	2.14*** (0.00)	2.22*** (0.01)
$(\pi - \bar{\pi})_t$	-3.45*** (0.00)	-3.08*** (0.00)	-2.90*** (0.01)	-3.59*** (0.01)
$(\pi - \bar{\pi})_{t-1}$	2.48*** (0.00)	2.49*** (0.00)	2.60** (0.03)	3.16** (0.03)
$(L/Y - \overline{L/Y})_t$	0.14 (0.47)	0.25 (0.24)	0.40 (0.22)	0.52 (0.14)
$(L/Y - \overline{L/Y})_{t-1}$	-0.20 (0.29)	-0.29 (0.16)	-0.26 (0.37)	-0.30 (0.35)
$D^*(p - \bar{p})_{t-1}$	0.35*** (0.00)	0.38*** (0.00)	0.43*** (0.00)	0.31*** (0.01)
$D^*(r^s - r^{Taylor})_t$	0.61 (0.44)	0.92 (0.27)	0.80 (0.46)	1.31 (0.28)
$D^*(r^s - r^{Taylor})_{t-1}$	-1.45** (0.06)	-1.74** (0.03)	-1.49 (0.17)	-1.54 (0.19)
$D^*(\pi - \bar{\pi})_t$	-0.36 (0.77)	-0.10 (0.94)	0.05 (0.98)	1.01 (0.62)
$D^*(\pi - \bar{\pi})_{t-1}$	-2.19 (0.11)	-2.49* (0.08)	-3.04 (0.13)	-4.72* (0.04)
$D^*(L/Y - \overline{L/Y})_t$	0.65** (0.03)	0.44 (0.16)	0.39 (0.38)	0.12 (0.79)
$D^*(L/Y - \overline{L/Y})_{t-1}$	-0.30 (0.30)	-0.13 (0.67)	-0.30 (0.48)	-0.11 (0.81)
GDP growth		0.01*** (0.01)	0.01* (0.06)	0.01* (0.06)
Current account			0.02** (0.04)	0.01* (0.08)
Change in financial innovation				0.00 (0.89)
R^2	0.38	0.38	0.39	0.39
$\bar{R}^2$	0.35	0.35	0.34	0.33

Source: Authors' calculations.
a. Fixed effects included in regression but not reported. Numbers in parentheses are *p*-values.

during the identified boom periods. The initial impact of the interest rate being one percentage point below the optimal rate is between 1.5% and 1.75% on stock prices. This negative and significant result is not consistent across all specifications. Once the current account variable is added, the significance disappears, but we must be careful to point out that the data for the current account variable is limited, and only goes back to the 1950's. Because of these data's limitations, not all the stock market booms before World War II are included in regression (3) or (4).

For the inflation variable, there is some evidence of an extra kick during the booms. The impact is quite large—to the order of +2.5% in the case of regression (2)—but the significance is marginal. As for the credit variable—except for regression (1), where the coefficient is significant and positive for the interaction term—there is little evidence that "easy" credit has any impact on stock price booms.

Overall, there is, again, evidence that "loose" monetary policy and low inflation acts to boost stock prices and that this boost was heightened during the identified boom periods.

Next we re-estimate our model using the other measure of monetary policy; namely, the deviation of the growth rate of M2 from the Friedman 3% rule. The results are reported in table 5B. The results are qualitatively similar to the ones reported in table 5A. The monetary variable has inconsistent signs during "normal" periods, but it is large and, in this case, positive during the boom periods. This, again, suggests a relationship between "loose" monetary policy and increases in stock prices, especially during boom periods.

Interestingly, just as in the house price regressions, the impact of low inflation is only significant during the "normal" periods and there is no added "boost" during the boom periods. What is different however is that credit is not significant and positive. As in the case with the inflation variable, this positive impact on prices from "easy" credit—a value of the loans to GDP ratio that is above trend—is only evident during the "normal" periods. Again, there is no heightened effect during the booms.

This is an interesting result and one conjecture could be that the results, when we use the money growth variable, are being driven by the early periods where it is more likely that there is a strong relationship between credit conditions and the growth rate of money (Schularick and Taylor, 2012). It may be that the low inflation and credit story is more relevant during the latter part of twentieth century than in the early part.

Table 5B. Panel Regression Results for Real Stock Prices
(Money Growth Rate Rule)[a]

Dependent Variable: Deviation of log Real House Prices from long–run trend (HP trend)

Regressors	*(1)*	*(2)*	*(3)*	*(4)*
$(p - \bar{p})_{t-1}$	0.36*** (0.00)	0.32*** (0.00)	0.25*** (0.00)	0.30*** (0.00)
$(\Delta\log(m) - 0.03)_t$	0.28* (0.06)	0.42** (0.05)	0.46 (0.16)	0.20 (0.58)
$(\Delta\log(m) - 0.03)_{t-1}$	-0.34** (0.02)	-0.66*** (0.00)	-1.01*** (0.00)	-0.75** (0.03)
$(\pi - \bar{\pi})_t$	-0.66* (0.06)	-0.43 (0.25)	-1.21* (0.09)	-1.78 (0.07)
$(\pi - \bar{\pi})_{t-1}$	-0.73** (0.04)	-0.60 (0.11)	-0.40 (0.58)	0.22 (0.82)
$(L/Y - \overline{L/Y})_t$	0.30* (0.06)	0.48*** (0.01)	0.59* (0.06)	0.61* (0.08)
$(L/Y - \overline{L/Y})_{t-1}$	-0.23 (0.16)	-0.39 (0.03)	-0.32 (0.27)	-0.33 (0.31)
$D^*(p - \bar{p})_{t-1}$	0.32*** (0.00)	0.35*** (0.00)	0.42*** (0.00)	0.29*** (0.01)
$D^*(\Delta\log(m) - 0.03)_t$	1.07*** (0.00)	1.02*** (0.00)	0.22 (0.66)	0.27 (0.64)
$D^*(\Delta\log(m) - 0.03)_{t-1}$	-0.38 (0.17)	-0.32 (0.35)	0.22 (0.67)	-0.14 (0.80)
$D^*(\pi - \bar{\pi})_t$	-0.58 (0.29)	-0.80 (0.18)	-0.29 (0.81)	0.14 (0.92)
$D^*(\pi - \bar{\pi})_{t-1}$	-0.17 (0.75)	-0.14 (0.80)	-1.01 (0.41)	-2.80 (0.06)
$D^*(L/Y - \overline{L/Y})_t$	0.23 (0.36)	-0.01 (0.96)	0.09 (0.83)	-0.05 (0.92)
$D^*(L/Y - \overline{L/Y})_{t-1}$	0.00 (1.00)	0.25 (0.35)	-0.07 (0.87)	0.08 (0.86)
GDP growth		0.01*** (0.00)	0.01** (0.03)	0.01** (0.04)
Current account			0.02** (0.03)	0.02* (0.06)
Change in financial innovation				0.00 (0.74)
R^2	0.37	0.39	0.39	0.39
$\bar{R}^2$	0.35	0.36	0.35	0.33

Source: Authors' calculations.
a. Fixed effects included in regression but not reported. Numbers in parentheses are p-values.

4.3 Real Commodity Prices

Tables 6A and 6B report our estimated results for real commodity prices. Because of the global nature of the commodity price market, in lieu of global monetary policy measures, we use U.S. data in these regressions. This means that we are unable to use a panel for this estimation; therefore, the number of observations available to us for these regressions is quite small.

For the interest rate deviation there are mixed results for the "normal" period in that the coefficient on the current period is significant and positive, while the coefficient on the first lag is negative and significant. Thus, during normal periods, the cumulative impact of a sustained decrease in the interest rate below the Taylor-rule rate would have a positive—but small—impact on commodity prices. However, during the boom periods, the impact of the interest rate deviation is significant and negative. Again, there appears to be a heightened impact on commodity prices of "loose" monetary policy during boom periods.

There is some evidence that low inflation also has a positive impact on commodity prices, but there is no "boost" during the boom periods, while there is no evidence that "easy" credit has a positive impact on commodity prices.

Table 6A. Panel Regression Results for Real Commodity Prices (Taylor Rule)[a]

Dependent Variable: Deviation of log Real Commodity Prices from long—run trend (HP trend)

Regressors	*(1)*	*(2)*	*(3)*	*(4)*
$(p - \bar{p})_{t-1}$	0.71*** (0.00)	0.66*** (0.00)	0.38*** (0.27)	0.35*** (0.53)
$(r^s - r^{Taylor})_t$	5.40** (0.02)	7.78*** (0.00)	6.15 (0.35)	7.01 (0.64)
$(r^s - r^{Taylor})_{t-1}$	-6.36* (0.07)	-7.94** (0.02)	-5.49 (0.51)	-5.74 (0.62)
$(r^s - r^{Taylor})_{t-2}$	2.30 (0.28)	1.64 (0.42)	-0.08 (0.99)	-0.46 (0.96)
$(\pi - \bar{\pi})_t$	4.62* (0.07)	6.32*** (0.01)	10.02* (0.09)	10.66 (0.45)
$(\pi - \bar{\pi})_{t-1}$	-7.68** (0.02)	-7.21** (0.02)	-6.25 (0.52)	-6.10 (0.67)

Table 6A. (continued)

Regressors	*(1)*	*(2)*	*(3)*	*(4)*
$(\pi - \overline{\pi})_{t-2}$	2.07 (0.52)	0.26 (0.93)	-1.03 (0.89)	-2.14 (0.90)
$(L/Y - \overline{L/Y})_t$	-0.72 (0.47)	-1.11 (0.24)	-0.62 (0.75)	-1.33 (0.78)
$(L/Y - \overline{L/Y})_{t-1}$	0.88 (0.35)	0.86 (0.32)	1.46 (0.44)	1.64 (0.67)
$(L/Y - \overline{L/Y})_{t-2}$	-0.73 (0.49)	-0.14 (0.89)	-2.57 (0.27)	-2.27 (0.46)
$D^*(p - \overline{p})_{t-1}$	-0.22 (0.42)	-0.28 (0.28)	-0.44 (0.31)	-0.53 (0.52)
$D^*(r^s - r^{Taylor})_t$	-5.64* (0.10)	-7.05** (0.03)	-7.19 (0.37)	-10.12 (0.55)
$D^*(r^s - r^{Taylor})_{t-1}$	6.95 (0.16)	7.80 (0.09)	16.52 (0.14)	22.90 (0.26)
$D^*(r^s - r^{Taylor})_{t-2}$	-4.31 (0.15)	-3.30 (0.25)	-12.08 (0.11)	-16.41 (0.43)
$D^*(\pi - \overline{\pi})_t$	-3.21 (0.43)	-2.52 (0.51)	-10.08 (0.14)	-14.06 (0.34)
$D^*(\pi - \overline{\pi})_{t-1}$	6.50 (0.32)	5.70 (0.35)	16.67 (0.20)	24.70 (0.30)
$D^*(\pi - \overline{\pi})_{t-2}$	-4.53 (0.38)	-2.28 (0.64)	-15.81 (0.14)	-20.25 (0.52)
$D^*(L/Y - \overline{L/Y})_t$	1.40 (0.33)	2.13 (0.13)	2.99 (0.30)	4.57 (0.48)
$D^*(L/Y - \overline{L/Y})_{t-1}$	-1.08 (0.54)	-1.51 (0.36)	-5.12 (0.15)	-6.44 (0.27)
$D^*(L/Y - \overline{L/Y})_{t-2}$	0.49 (0.73)	0.22 (0.87)	5.46 (0.07)	5.67 (0.17)
GDP growth		0.02** (0.02)	0.03 (0.22)	0.03 (0.53)
Current account			0.08 (0.17)	0.05 (0.64)
Change in financial innovation				0.02 (0.75)
R^2	0.70	0.74	0.84	0.81
$\bar{R}^2$	0.53	0.59	0.60	0.28

Source: Authors' calculations.
a. Numbers in parentheses are p-values

Table 6B reports the results for the regression when money growth rate deviations are used in place of interest rate deviations, but for this case, the results are poor. Almost all coefficients are insignificant, and except for the "credit" impact during booms, there is no difference between "normal" periods and "boom" periods.

Table 6B. Panel Regression Results for Real Commodity Prices (Money growth rate rule)[a]

Dependent Variable: Deviation of log Real House Prices from long–run trend (HP trend)

Regressors	*(1)*	*(2)*	*(3)*	*(4)*
$(p - \bar{p})_{t-1}$	0.62*** (0.00)	0.66*** (0.00)	0.68** (0.03)	1.07 (0.17)
$(\Delta\log(m) - 0.03)_t$	-0.72 (0.45)	-0.64 (0.50)	-0.88 (0.54)	-0.71 (0.76)
$(\Delta\log(m) - 0.03)_{t-1}$	-1.84 (0.22)	-2.22 (0.14)	-2.82 (0.23)	-5.90 (0.24)
$(\Delta\log(m) - 0.03)_{t-2}$	0.31 (0.76)	0.80 (0.46)	1.33 (0.39)	4.29 (0.44)
$(\pi - \bar{\pi})_t$	-0.36 (0.89)	0.38 (0.88)	6.15 (0.22)	11.13 (0.36)
$(\pi - \bar{\pi})_{t-1}$	-2.35 (0.36)	-1.79 (0.48)	-0.11 (0.98)	-5.31 (0.57)
$(\pi - \bar{\pi})_{t-2}$	0.90 (0.56)	1.02 (0.50)	2.50 (0.37)	4.76 (0.34)
$(L/Y - \overline{L/Y})_t$	0.55 (0.54)	0.39 (0.66)	0.14 (0.92)	-1.48 (0.64)
$(L/Y - \overline{L/Y})_{t-1}$	0.22 (0.76)	-0.07 (0.92)	1.24 (0.34)	2.49 (0.38)
$(L/Y - \overline{L/Y})_{t-2}$	-0.54 (0.55)	-0.31 (0.74)	-4.13 (0.07)	-5.55 (0.26)
$D^*(p - \bar{p})_{t-1}$	-0.13 (0.57)	-0.23 (0.34)	-0.36 (0.30)	-0.66 (0.43)
$D^*(\Delta\log(m) - 0.03)_t$	1.69 (0.18)	1.52 (0.22)	2.32 (0.23)	2.25 (0.48)
$D^*(\Delta\log(m) - 0.03)_{t-1}$	1.24 (0.46)	1.45 (0.39)	0.70 (0.79)	3.34 (0.50)
$D^*(\Delta\log(m) - 0.03)_{t-2}$	-0.10 (0.93)	-0.37 (0.76)	-0.86 (0.64)	-3.68 (0.51)
$D^*(\pi - \bar{\pi})_t$	3.96 (0.17)	3.61 (0.20)	-0.37 (0.95)	-6.05 (0.62)
$D^*(\pi - \bar{\pi})_{t-1}$	-0.27 (0.92)	-0.04 (0.99)	-2.74 (0.64)	2.34 (0.81)

Table 6B. (continued)

Regressors	*(1)*	*(2)*	*(3)*	*(4)*
$D^*(\pi - \overline{\pi})_{t-2}$	-0.21 (0.91)	-0.19 (0.92)	-1.45 (0.72)	-3.94 (0.62)
$D^*(L/Y - \overline{L/Y})_t$	0.50 (0.67)	0.81 (0.49)	1.76 (0.41)	3.46 (0.49)
$D^*(L/Y - \overline{L/Y})_{t-1}$	-1.34 (0.31)	-1.06 (0.42)	-3.34 (0.18)	-5.32 (0.19)
$D^*(L/Y - \overline{L/Y})_{t-2}$	0.64 (0.59)	0.38 (0.74)	5.32** (0.05)	7.35 (0.16)
GDP growth		0.01 (0.12)	0.04** (0.05)	0.03 (0.38)
Current account			0.03 (0.46)	0.01 (0.88)
Change in financial innovation				0.04 (0.58)
R^2				
$\bar{R}^2$				

Source: Authors' calculations.
a. Fixed effects included in regression but not reported. Numbers in parentheses are *p*-values.

4.4 Discussion

The results presented above show that "loose" monetary policy, that is, having an interest rate below the target rate or having a growth rate of money above the target growth rate positively impacts asset prices, and this correspondence is heightened during periods when asset prices grew quickly and then subsequently suffered a significant correction. This result was robust across multiple asset prices and different specifications and was present even when we controlled for other alternative explanations, such as low inflation or "easy" credit. The initial impacts are relatively small, especially when you consider that the run-up of asset prices in the boom periods are almost all greater than 5% per year, with some much higher than that.

It should also be noted that in alternative specifications not reported here, for reasons of brevity but available upon request, the result that "loose" monetary policy is associated with increases in asset prices was found in different sub-periods of the data and when the first difference of the variables was used instead of the deviations from trend. The size and significance of the estimates were very similar across all specifications.

We also found that low inflation and, to a lesser degree, "easy" credit are also associated with increases in asset prices. There does not appear to be one variable that is associated with increases in asset prices more than another. The monetary variable was consistently important during the boom periods; whereas, the other two controls were not always important. Again, the initial impacts were quite small relative to the sizes of the overall price increases during the booms.

Before moving to our policy lessons that we draw from this exercise, we must note the limitations of the empirical exercise we undertook. The regression model that we estimated is not a structural model, and so we cannot draw any conclusions about causality from these results. In fact, we try very hard to only say that we found associations between asset prices and the three control variables we use. The model, because of its atheoretical nature, does not have any explicit statement of the channel with which the three control variables impact asset prices. We do find evidence of nonlinear effects, but that is as far as we go. We also do not model the feedback of each of the three variables upon each other. This is obviously very important if we were to try to contrast the magnitudes of the effects these three controls had on asset prices during the identified boom periods. This last point is an important consideration and it is part of our ongoing and future research on this topic.

5. Policy Lessons

Our evidence that loose monetary policy (along with low inflation and credit expansion) does contribute significantly to booms in house prices, stock prices and commodity prices, leads to the question about what central banks should do about it. Should they use their policy tools to target housing prices, stock prices or commodity prices directly? Or, should they give important weight to asset prices when setting their policy instruments as a possible contingency to depart from their central goals (high employment) of low inflation? This subject received considerable attention during the tech boom of the late 1990s and again during the housing boom in the mid-2000s (Bordo and Wheelock, 2009). Since periods of explosive growth in asset prices have often preceded financial crises and contractions in economic activity, some economists have argued that by defusing asset price booms, monetary policy can limit the adverse impact of financial instability on economic activity.

However, the likelihood of a price collapse and subsequent macroeconomic decline might depend on why asset prices are rising in the first place. Many analysts believe that asset booms do not pose a threat to economic activity or the outlook for inflation, as long as they can be justified by realistic prospects of future earnings growth, in the case of stock prices; or reflect real fundamentals such as population growth, in the case of housing booms; or real side shocks or changing conditions of supply, like natural disasters or demand (like the growth of China), in the case of commodity price booms.

On the other hand, if rising stock prices reflect "irrational exuberance," or rising house prices reflect a bubble, they may pose a threat to economic stability and justify a monetary policy response to encourage market participants to revalue equities more realistically or to deter speculation in real estate. In the case of commodity prices, to the extent a boom does not reflect fundamentals, policy tightening could defuse the real effects of a sudden bust.

The traditional view holds that monetary policy should react to asset price movements only to the extent that they provide information about future inflation. This view holds that monetary policy will contribute to financial stability by maintaining stability of the price level (Bordo et al., 2002, 2003; Schwartz, 1995), and that financial imbalances or crises should be dealt with separately by regulatory policies or lenders of last resort policies (Schwartz, 2002). Bernanke and Gertler (1999, 2001) presented the traditional view in the context of a Taylor rule.

Many economists do not accept the traditional view, at least not entirely. Smets (1997), for example, argued that monetary policy tightening is optimal in response to "irrational exuberance' in financial markets. Similarly, Cecchetti et al. (2000) contended that monetary policy should react when asset prices become misaligned with fundamentals. Bernanke and Gertler (2001) expressed doubts that policymakers can judge reliably whether asset prices are being driven by "irrational exuberance," or if an asset price collapse is imminent. However, Cecchetti (2003) replied that asset price misalignments are no more difficult to identify than other components of the Taylor rule, such as potential output.[15]

Bordo and Jeanne (2002a, 2002b) offered a different argument in support of a monetary policy response to asset price booms. They

15. For the debate within the FOMC over the 1990s stock market boom, see Bordo and Wheelock (2004).

argued that preemptive actions to defuse an asset price boom can be regarded as insurance against the high cost of lost output should a bust occur. They contended that policy makers should attempt to contain asset price misalignments when the risk of a bust (or the consequences of a bust) is large, or when the cost of defusing a boom is low in terms of foregone output. Bordo and Jeanne showed that a tension exists between these two conditions. As investors become more exuberant, the risks associated with a reversal in market sentiment increases; however, leaning into the wind of investor optimism requires more costly monetary actions. Thus, the monetary authorities must evaluate both the probability of a costly crisis and the extent to which they can reduce this probability.

Since this earlier debate, where the warnings of Bordo and Jeanne and others were not largely heeded, the housing bust of 2006 in the U.S. and the subsequent financial crisis and Great Recession led many policy makers to decide that financial stability should be an important goal of central banks along with low inflation (and overall macro stability). The new view argued that central banks should be closely monitoring asset price developments and the state of the financial system (including non-banks and banks) and be willing to use policy to defuse threatening imbalances. This became known as the case for macro prudential regulation, which promoted the use of policy tools such as countercyclical capital requirements and liquidity ratios (Kashyap, Rajan and Stein, 2008). This case, fostered by the BIS and many others, has led to important changes in the central banking and financial regulatory landscape, including the 2010 Dodd Frank Bill in the U.S., which has given the Federal Reserve greatly expanded powers over the financial system as a whole, and in the U.K. where the Bank of England has taken over some of the responsibilities of the Financial Stability Authority.

The question arises if the new financial stability powers of central banks will work to prevent the next crisis, also whether or not the new impetus has gone too far in encroaching on the traditional role of central banks to maintain price stability, acting as lenders of last resort to the banking system and protectors of the integrity of the payments system. The history of financial regulation after big financial crises (e.g. the Great Depression) suggests that the government often overreacts and, in the name of safety, suppresses financial development and the price discovery mechanism of financial markets. The regime of the 1930s through the 1970s gave us financial stability at the expense of unworkable firewalls between complementary financial functions (Glass-Steagall) and price controls and ceilings like regulation Q in the U.S. and the prohibition of the payment of interest on demand deposits. Similar regulations were put in place across the world. These regulations and controls broke down in the face of the Great Inflation, financial market arbitrage, and financial innovation. In addition, in this immediate post World War II period, central banks lost their independence to the fiscal authorities that had other politically driven objectives in mind. It would not be surprising if that happened again.

More fundamentally, many of the recent institutional changes pose threats to the independence of central banks and their ability to perform their core mission, which is to maintain the value of money (Bordo, 2010; Svennson, 2010). Central banks were also supposed to act as lenders of last resort to provide emergency liquidity to the banking system. They were not responsible for the solvency of banks or any other entities, or the financing of government deficits (except in wartime) (Bordo, 2012).

The bottom line is that asset price booms (stock market and housing market) are important and potentially dangerous to the real economy and should be closely monitored and possibly defused. However, the policy tools to do this should not be the traditional tools of monetary policy. Other tools, such as margin requirements for stock prices, minimum down payments for housing, and risk and bank-size weighted capital requirements for banks could be used. Authorities other than central banks could perform these tasks to prevent central banks from being diverted from their main functions.

To the extent that asset price booms—including commodity price booms—do not reflect real fundamentals, they should also be viewed as harbingers of future inflation, and as part of the normal transmission mechanism of monetary policy as has occurred in earlier historical episodes. In this case, they serve as a signal for tighter monetary policy.

Finally, our evidence—for the close to a century, for many countries, and for three types of asset booms—that expansionary monetary policy is a significant trigger, makes the case that central banks should follow stable monetary policies. These should be based on well understood and credible monetary rules.

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Appendix A

Identified Boom/Busts

Figure A1. Identified Housing Price Booms

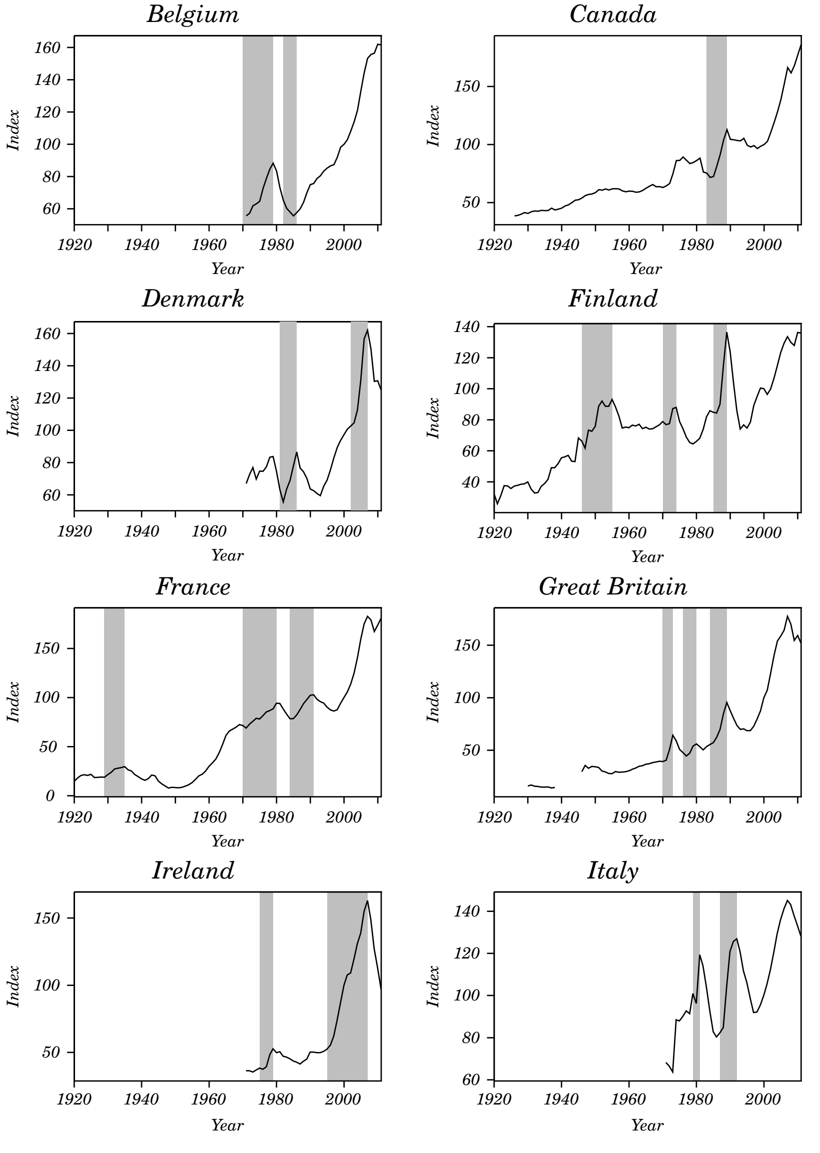
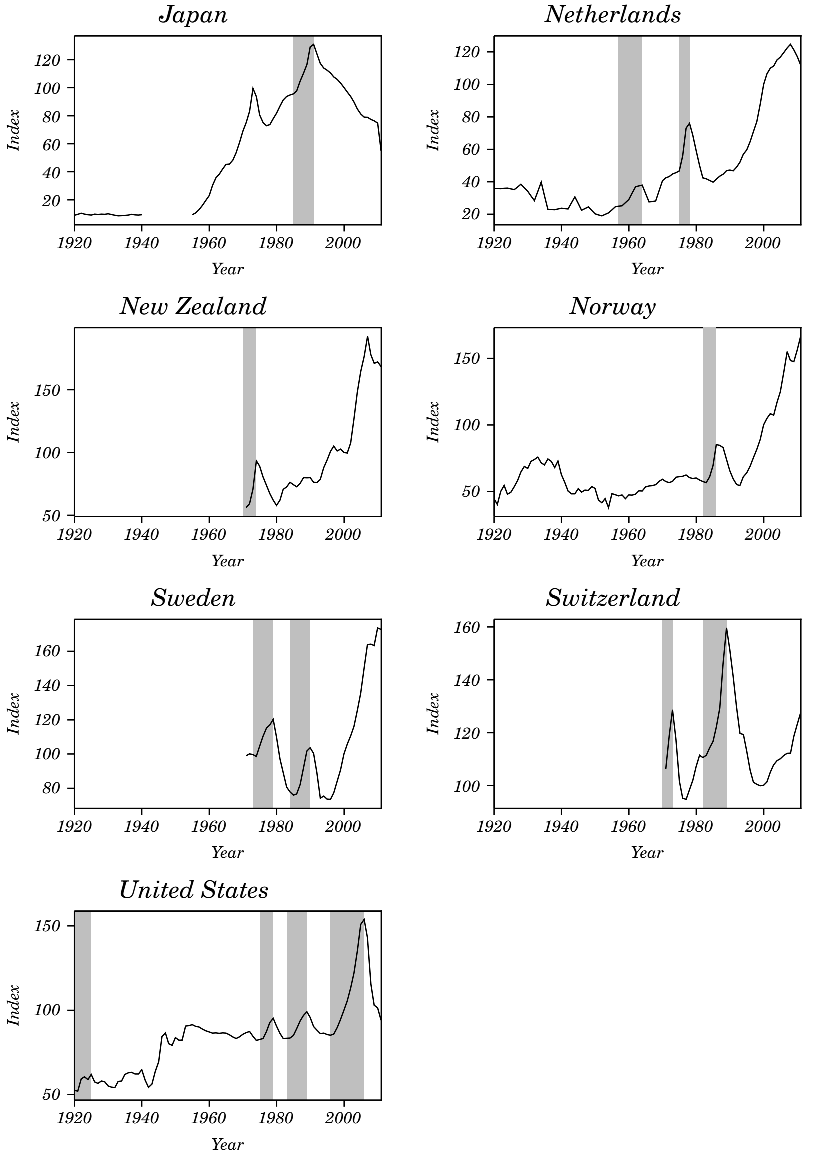


Figure A1. (continued)



Source: Authors' elaboration.

Figure A2. Identified Stock Price Booms

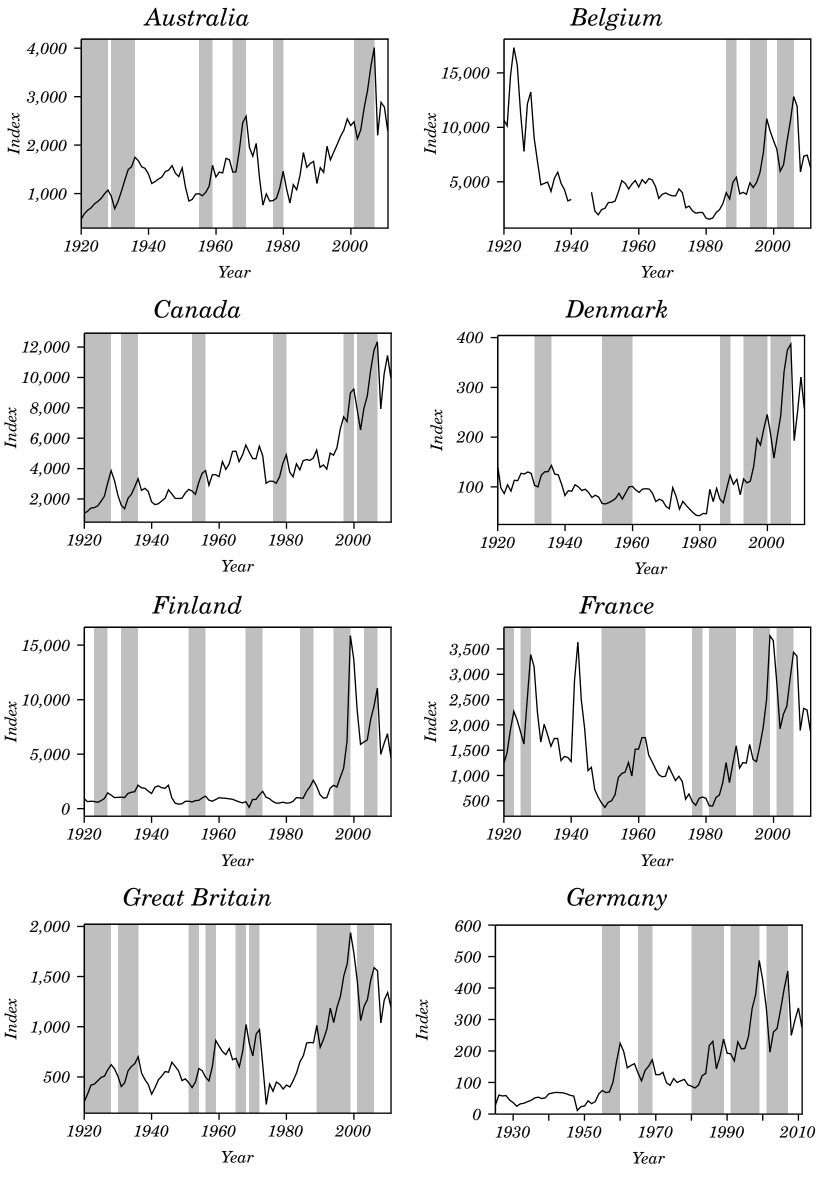


Figure A2. (continued)

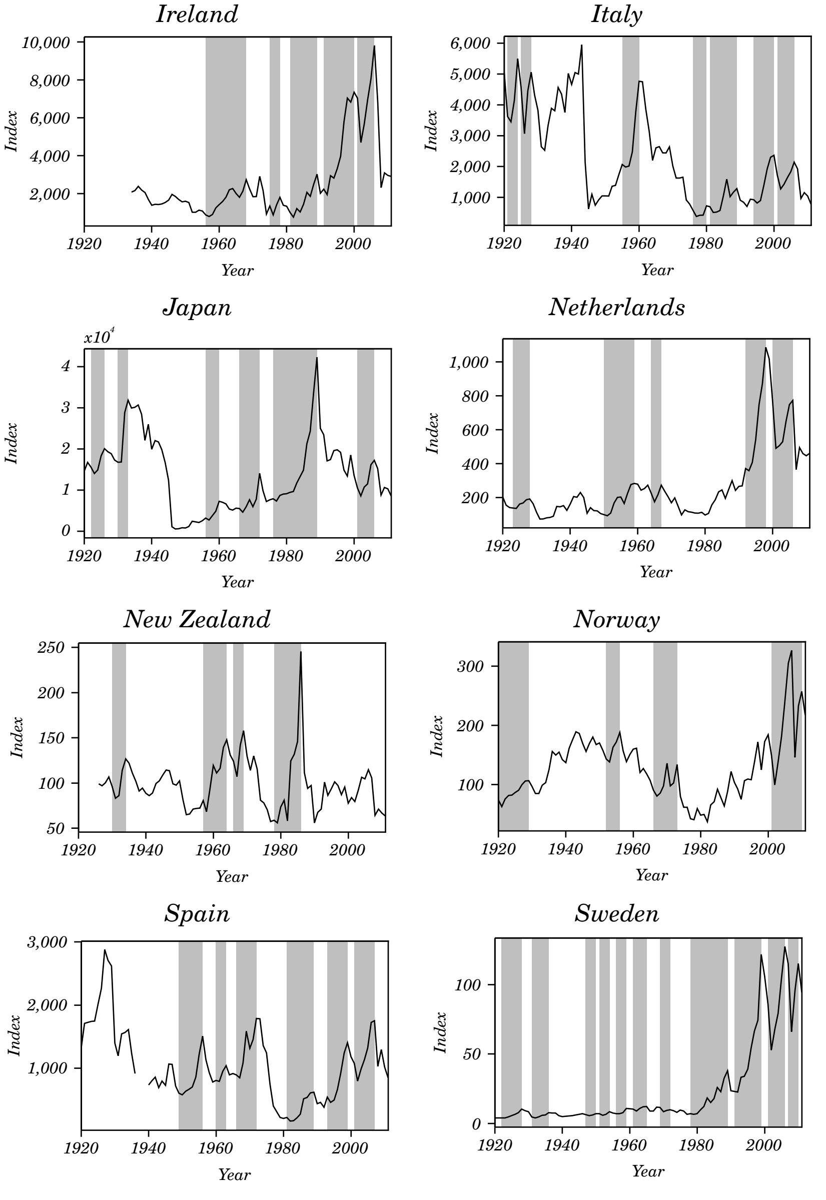
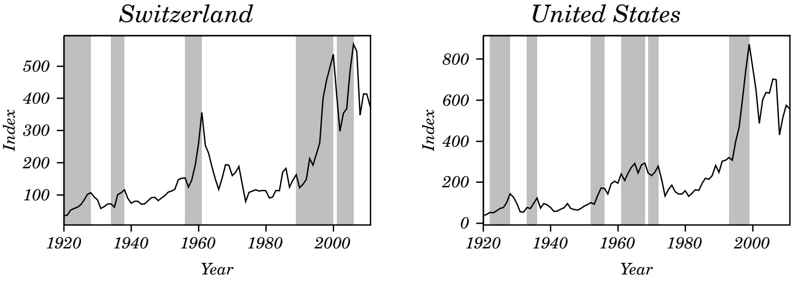
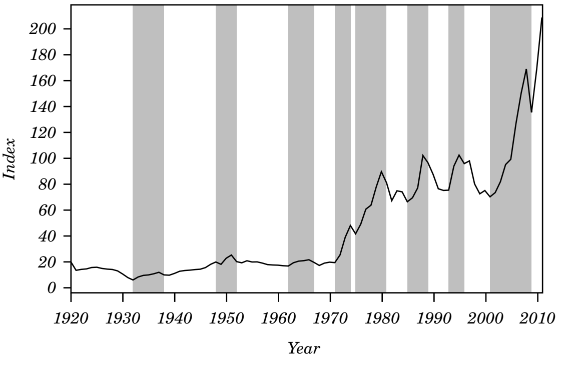


Figure A2. (continued)



Source: Authors' elaboration.

Figure A3. Identified Commodity Price Booms



Source: Authors' elaboration.

Appendix B

Data Sources

Real GDP:

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

Real house price index, 2000=100:

Detailed description: U.S. [*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," 349-376 Chapter 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*], U.K. [*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, Sept. 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

Money:

M2 or M3 – depending on the country. Source: Moritz Schularick and Alan M. Taylor. "Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870–2008" American Economic Review 2012, 102(2): 1029–1061

Stock market index (close, end of December):

The source is Global Financial Data.com

Real commodity prices:

The Economist All-Commodity Dollar Index (close, end of December). The source is Global Financial Data.com

Financial liberalization index, 0 to 21:

Sum of seven components [creditcontrols, intratecontrols, entrybarriers, bankingsuperv, privatization, intlcapital, securitymarkets]. Abdul Abiad, Enrica Detragiache, and Thierry Tressel "A New Database of Financial Reforms" IMF WP/08/275

Credit:

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

Current account:

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