

House prices, equity prices, investment and credit – what do they tell us about banking crises? A historical analysis based on Norwegian data

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In recent years, many countries have experienced a sharp rise in house prices and household credit. Many have expressed concern that this development is not sustainable over time and that it may lead to financial imbalances. In this article, we will consider whether historical indicators can predict banking crises through the last 150 years. Using a Hodrick-Prescott filter, we calculate the gap between actual observations and trend for real house prices, real equity prices, gross fixed investment and credit on the basis of Norwegian data back to 1819. We find that all gap indicators are useful in predicting earlier banking crises in Norway. With few exceptions, the indicators show a common pattern – the gaps widen from one to six years prior to the banking crises and subsequently fall. As a rule, at least two of the gap indicators have high values prior to the banking crises, indicating that combinations of indicators may increase the strength of the analysis. We also find that indicator values that can be associated with a banking crisis, i.e. the threshold values, may be somewhat higher in Norway than in comparable international studies.

1 Introduction

In recent years, many countries have experienced strong increases in house prices and household credit. Many have expressed concern that this development is not sustainable over time and that the “borrowing bubble” may burst. A number of studies have presented economic indicators that can predict banking crises. In this article, we look at some of these indicators for Norway. Using data that go back to 1819, we try to reveal whether there are recurring relationships between some economic variables and banking crises in Norway.

This article is organised as follows: Section 2 discusses the relationship between credit, asset prices and banking crises and provides a brief summary of international studies. Section 3 presents different indicators for Norway and considers the relationship between these indicators and banking crises as far back as the 1800s. Section 4 summarises our findings.

2 The relationship between credit, asset prices and financial stability

One hypothesis about the causes of banking crises is the hypothesis of financial fragility, which is investigated in a number of studies, including those conducted by Minsky (1977) and Kindleberger (1978, 2000). According to this hypothesis, considerable optimism in periods of economic expansion can push up both asset prices and investment and result in high credit growth. This may contribute to the build-up of financial imbalances. In the event of disturbances in the economy, optimism will wane. Asset prices and investment will fall.

The quality of banks’ portfolios will be put to the test and the value of banks’ collateral will diminish. Servicing debt will become a problem and banks’ loan losses will increase.

Recent studies focus on equity prices as an indicator of impending banking crises. These studies show that equity prices rise sharply and then fall for up to a year before a banking crisis.¹

A large portion of the literature is devoted to the importance of credit for banking crises.² The main conclusion is that strong growth in domestic credit increases the probability of financial instability. Most studies concerning credit place emphasis on growth during a limited time period. For example, they consider the implications of high credit growth for a period of one year. Consequently, stock variables and cumulative processes are virtually disregarded. Meanwhile, the vulnerability of the non-financial sector (non-financial enterprises, households and municipalities) will not only depend on debt growth, but also on the level of debt. Strong credit growth for a period of some years, from an initially low level, will not necessarily represent a threat to debt-servicing capacity.

History shows that a number of factors and events have usually played a part in triggering financial instability. The studies generally reveal relationships between developments in asset prices and credit on the one hand and financial distress on the other. However, they provide few numerical indicators which may be used by central banks and government authorities to assess whether or not financial stability is at risk.

Borio and Lowe (2002) discuss these problems. In

* I wish to thank Knut Sandal for suggesting the project and Arild J. Lund, Thea Birkeland-Kloster, Bent Vale and Karsten R. Gerdrup for their useful comments.

¹ Hutchison and McDill (1999), Kaminsky and Reinhart (1999).

² Borio and Lowe (2002) provide some references.

their study, they look at real asset prices, credit to the private sector and investment. They focus on cumulative processes. To capture such effects, they analyse developments in credit and investment as a percentage of GDP instead of looking at growth rates over a shorter time period. The indicator for credit as a percentage of GDP is hereafter referred to as the credit gap. This is compared with an indicator for growth in inflation-adjusted credit in order to examine the predictive powers of indicators linked to level compared with pure growth indicators.

The primary objective is to construct indicators that can predict banking crises. The idea, which is based on Kaminsky and Reinhart (1999), is to find a threshold value for each of the indicators which can signal financial problems. The method involves calculating a gap for the variables concerned, defined as the deviation between actual observations and a trend. The gaps are calculated as a per cent of the trend with the exception of the credit gap, which is measured in percentage points.

Borio and Lowe (2002) examine both single indicators and combinations of indicators. They also look at multiple horizons and consider the usefulness of indicators in predicting banking crises within one, two and three years. They use data from 34 countries with a total of 38 banking crises during the period 1960-1999.

Of the four indicators examined, the credit gap provides the best results. A gap of 4 percentage points predicts nearly 80 per cent of the banking crises within one year and gives false signals in only 18 per cent of the cases. The credit gap is clearly a better indicator than the gap in credit growth. The predictive powers of the gaps in real equity prices and investment as a percentage of GDP are lower than that of the credit gap. In addition, these two gap indicators are fairly noisy. Another finding from the study is that expanding the time horizon improves the predictive powers of the indicators, in particular the indicators for real equity prices and credit.

Borio and Lowe (2002) experiment with various combinations of indicators and find that this improves the predictive properties. They conclude that the combination of a credit gap with a threshold value of 4 percentage points and a real equity price gap with a threshold value of 40 per cent provides the best results. Including the investment gap does not increase the predictive powers of the indicators. Expanding the time horizon from

one to three years improves the indicators' predictive powers.

In Borio and Lowe (2004), the analysis is expanded by using quarterly data and extending the time horizon to three-to-five years. The predictive powers of the indicators improve compared with the authors' previous study.

3 House prices, equity prices, investment and credit in Norway

3.1 Calculating gap indicators for Norway

We have used the method described in Borio and Lowe (2002) to test the hypothesis of financial fragility on historical data for Norway. We have calculated the gap in real house prices, real equity prices, investment as a percentage of GDP and credit as a percentage of GDP. The gaps are measured as percentage deviations from the trend, with the exception of the credit gap, which is measured as a percentage of GDP, and here we use the difference in percentage points from the trend. We, like Borio and Lowe (2002), calculate the trend using a Hodrick-Prescott filter (HP filter)³ and a recursive method.⁴ This means that only data up to the beginning of each year is included in the calculation of the trend value for this year. This implies that we analyse the same information that was in principle available to decision-makers at any given time.⁵

We use data from as far back as 1819 from Norges Bank's historical monetary statistics.⁶ We include an indicator for house prices.⁷ House prices have rarely been used in similar studies because it has been difficult to find adequately long time series for property prices (house prices and prices for commercial property) which are comparable across countries. The close relationship between house prices and household credit⁸ and the importance of house prices for banks' collateral make it very interesting to include them in the analysis. Our method for finding the indicators' threshold values differs somewhat from the method used by Borio and Lowe (2002). Since our study involves only one country, we use the peaks in the gaps to establish the threshold values, whereas Borio and Lowe have panel data and weigh the number of predicted crises against the noise-to-signal ratio.⁹

³ See Bjørnland, Brubakk and Jore (2004) for a description of the Hodrick-Prescott filter.

⁴ In line with Borio and Lowe (2002), we use a somewhat untraditional value for λ in calculating trend. Normal practice is to use $\lambda = 400$ for annual data, whereas they use 1600. The idea is to place greater emphasis on the past and achieve a smoother trend. The result is more fluctuations, implying that a larger portion of the fluctuations in the variables can be explained by temporary disturbances. This choice is justified on the grounds that cumulative processes, which figure prominently in building up financial unrest, take a long time while the actual crises seldom materialise.

⁵ When using the recursive method, developments in the variable after the year being analysed are not taken into account. Normally, the variables fall after the outbreak of a banking crisis. Therefore, when the recursive method is used, the gaps prior to the banking crises may be underestimated as compared with when the normal method is used.

⁶ Eitheim, Klovland and Qvigstad (ed.) (2004)

⁷ In an international context, the long time series for house prices in Norway is unique. Other long historical time series include a property index for the Herengracht Canal in Amsterdam for the period 1628-1973 with a two-year frequency (see Eichholtz (1997)), and an annual house price index for Paris for the period 1840-1999 (see reference in Eitheim and Erlandsen (2004)).

⁸ Jacobsen and Naug (2004)

⁹ The noise-to-signal ratio is defined as "the ratio of size of Type II errors (i.e. the percentage of non-crisis periods in which a crisis is incorrectly signalled) to one minus the size of Type I errors (i.e. the percentage of crises that are not correctly predicted)".

3.2 Historical developments in the gap indicators

The gaps in real house prices, real equity prices and investment as a percentage of GDP and credit as a percentage of GDP are shown in Charts 1-5.¹⁰ The banking crises in 1857, 1864, 1880-1890, 1899-1905, 1920-1928 and 1988-1992 are marked in grey. To date these crises, we have used Rygg (1954), Gerdrup (2003)¹¹ and Moe, Solheim and Vale (2004).

The real house price gap

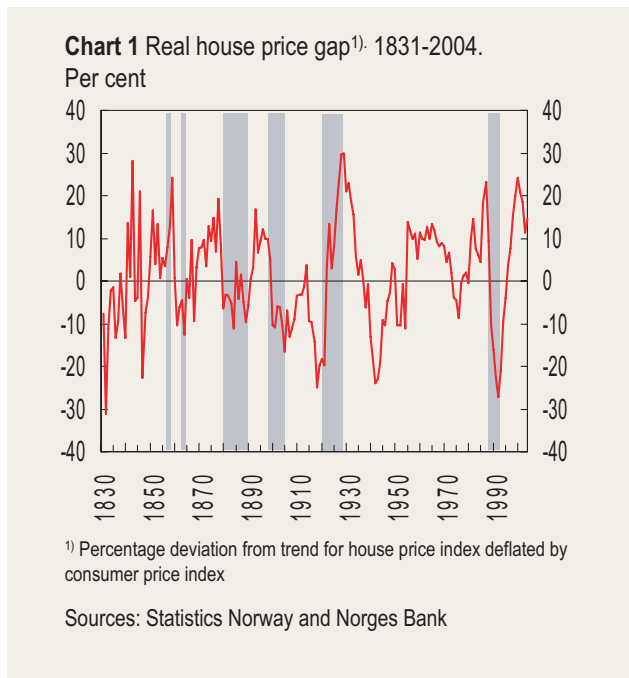
Chart 1 indicates that the real house price gap had relatively clear peaks before the banking crises. In most cases, the gap peaked from one to six years before the onset of the banking crisis, and was narrowing at the beginning of the banking crisis. The gap has generally been negative during the banking crises, with a trough near the end of the crises.

The house price gap showed wide fluctuations in the period 1831-1859 compared with the rest of the period. This may be the result of too few observations. Until 1840, the house price index is based solely on figures for housing turnover and house prices in Bergen, whereas the figures for Oslo are included from 1841.

The house price gap is relatively narrow in 1853 prior to the banking crisis in 1857. This indicates that house prices have not made a particularly large contribution to the crisis in 1857.¹² In addition, the crisis is considered to be fairly mild. According to Rygg (1954), there are not so many bankruptcies, but the effects of the crisis can be seen in a general deterioration of economic activity in the 1860s.

Another interesting observation is that the house price gap continues to widen following the crisis in 1857, in contrast to what is the normal course of developments. It appears that the house price gap captures another crisis which is more local, i.e. the Bergen crisis in 1859.¹³ One reason for this may be that Bergen is heavily represented in the house price series during this period. However, the investment gap also appears to capture the Bergen crisis (see Chart 2). It narrows and reaches a trough in 1859.

The crisis in the period 1920-1928 represents an exception to the usual path for the house price gap. The peak in 1914 is very low compared with the peaks during earlier banking crises.¹⁴ Developments in real house prices were sluggish after the high level of housing starts in the 1890s and the housing crash in 1899. In addition, as a result of the great migration from Norway at the beginning of the 1900s, many houses stood



empty.¹⁵ At that time, the housing market consisted primarily of rentals. In Kristiania (now Oslo), for example, only 5 per cent of dwellings were owner-occupied.¹⁶ To understand developments in house prices, we must therefore consider the interests of the property owner. In 1910, house rents were about 10 per cent lower than at the turn of the century.¹⁷ Property owners had considerable problems with high vacancy rates and low house rents. Therefore, investing in dwellings was not particularly profitable. In 1915, the Storting (Norwegian parliament) adopted the Act on the regulation of house rents. This may have further reduced the interest in investing in property for rental purposes. Hanisch and Ryggvik (1992) point out that a consequence of the Act was that extensive construction of apartment buildings for rental purposes did not occur until the end of the 1920s and beginning of the 1930s.

Another feature is that the house price gap widens during the crisis in 1920-1928 in contrast to during other crises. This may be explained by the fact that the deflationary policy at this time pushed down the general price level more than nominal house prices. Therefore, real house prices increased.

The low house price gap preceding the crisis in 1920-1928 indicates that real house prices were not one of the causes of the banking crisis. Nor do we find any reference in the historical studies that might indicate that developments in the housing market were considered to be a problem.

The house price gap reaches a new top level before the

¹⁰ The gaps are based on annual data back to 1819 for house prices, 1830 for gross fixed capital formation and GDP, 1914 for equity prices and 1899 for credit.

¹¹ Gerdrup (2003) differentiates between banking crises/banking problems and systemic crises in the banking sector. Only the crises in 1899-1905, 1920-1928 and 1988-1992 are characterised as systemic crises.

¹² Rygg (1954), pp. 16-19 stresses the importance of foreign credit for the banking crisis in 1857.

¹³ Rygg (1954), p. 25

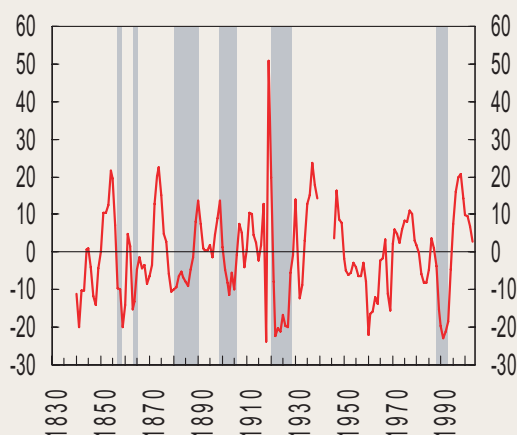
¹⁴ Developments should be interpreted in the light of the considerable uncertainty associated with the calculation of historical house price indices.

¹⁵ About 10 per cent of the dwellings in Kristiania were vacant at the beginning of the 1900s (see Hanisch and Ryggvik (1992) and Rygg (1954).

¹⁶ Gulbrandsen (1980), p. 43.

¹⁷ Gulbrandsen (1980), p. 68

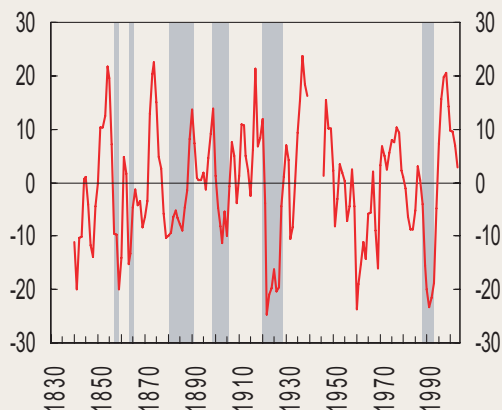
Chart 2 Investment gap¹⁾, 1840-2003. Per cent



¹⁾ Percentage deviation from trend for total gross fixed capital formation measured as a percentage of gross GDP. From 1970, mainland gross fixed capital formation as a percentage of mainland GDP (basis value). No data available for 1940-1945.

Sources: Statistics Norway and Norges Bank

Chart 3 Investment gap for investment excl. changes in stocks and statistical discrepancies¹⁾, 1840-2003. Per cent



¹⁾ Percentage deviation from trend for total gross fixed capital formation excl. changes in inventories/statistical deviations measured as a percentage of gross GDP. From 1970, mainland gross fixed capital formation as a percentage of mainland GDP (basis value). No data available for 1940-1945.

Sources: Statistics Norway and Norges Bank

banking crisis in 1888-1902. The maximum value is in 1887, i.e. one year before the crisis. It is higher than the peaks before the crises in the 1880s and in 1899-1905. The high value of the gap in 1887 is related to the deregulation of the credit and housing market at the beginning of the 1880s, the low interest rate policy and the combination of full tax deductions for interest expenses and high marginal tax rates. This encouraged high levels of household borrowing and a rise in prices for dwellings and commercial property.

The investment gap

The investment gap shows a pattern similar to that of the house price gap - an increase before the banking crises and subsequently a fall (see Chart 2). Compared with the house price gap, there are fewer fluctuations, especially in the 1800s.

The pattern before the crisis in 1899-1905 may in part be characterised as a deviation. The investment gap peaked in 1899, but the peak is lower than prior to earlier banking crises. At the same time, Klovland (1989) describes the years after 1895: "From then on, a long period of expansion set in, creating a spirit of enterprise not experienced since the 1870s." He characterises these years as a period of unusually strong economic activity. With this in mind, we would expect the investment gap to be wider.

Another exception is the investment gap before the crisis in 1920-1928. The investment gap is extremely wide in 1919, twice as wide as at any other peak during the entire period from 1840 to 2003. We do not find evidence in the historical literature that supports such large investments in 1919. There was a very brief upswing

after World War I in 1919, but there is no mention of extraordinary investment in any business sector. Goods imports were very high, however, after import restrictions were lifted (see Rygg (1954)). Scarcity of goods combined with the fact that some individuals had made quite a profit during the war, led to a sharp increase in the import of both necessities and luxuries. The importers filled the empty warehouses. The figures used so far in the calculation of the investment gap are figures for total gross fixed capital formation. If we exclude inventory changes and statistical deviations from these figures,¹⁸ the path of the investment gap will change (see Chart 3).¹⁹ This investment gap reaches its maximum level in 1917 and the value is more in line with the peaks in the rest of the period. Since we are more interested in gross fixed capital formation as an indication of economic activity, we use the investment gap in Chart 3 as the basis for our analysis here.

The credit gap

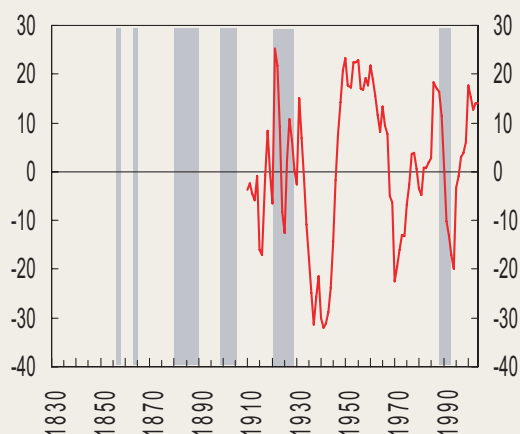
The period with available data for credit is relatively short and only includes two banking crises. This can, in isolation, lead to uncertain results. Nevertheless, the credit gap can be said to conform to the typical pattern of the other gaps, with an increase prior to the banking crises (see Chart 4). At the same time, the path of the credit gap is somewhat peculiar. While the other gaps tend to narrow prior to a banking crisis, the credit gap is positive for a longer period during the crisis. This may be because credit adjusts to developments in house prices and investment with a lag,²⁰ and because reducing debt takes some time. At the same time, GDP levels off rapidly or declines during a crisis. As a result, the

¹⁸ Figures from Statistics Norway: (1965), (1972) and (1995)

¹⁹ If we look at the period 1909-2003, the period where figures for inventory changes are available, inventory changes and statistical deviations as a percentage of total gross fixed capital formation are highest in 1919. The year 1919 is special in that respect.

²⁰ Jacobsen and Naug (2004) find that household credit in Norway adjusts slowly to developments in house prices.

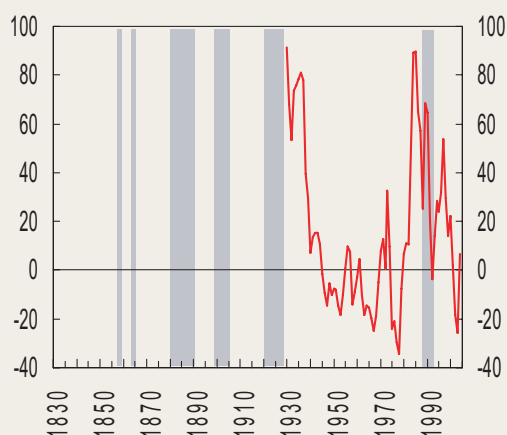
Chart 4 Credit gap¹⁾. 1910-2004. Percentage points



¹⁾ Deviation from trend for total credit to municipalities, non-financial enterprises and households measured as a percentage of gross GDP. From 1995, total credit to mainland Norway as a percentage of GDP (basis value). GDP data for 1940-1945 is not available.

Sources: Statistics Norway and Norges Bank

Chart 5 Real equity price gap 1930-2004¹⁾. Per cent



¹⁾ Percentage deviation from trend for equity price index deflated by consumer price index. Break in 2001 in connection with change from OSEAX (all-share index) to OSEBX (benchmark index)

Sources: Statistics Norway and Norges Bank

credit to GDP ratio increases at the beginning of the crisis and thus may take the form of a positive credit gap. It is also worth mentioning that Borio and Lowe (2004) observe a similar effect in that the noise-to-signal ratio for the credit gap does not fall as fast as for the equity price gap as the horizon is lengthened, a factor that is related to the slow adjustment in credit.

The path of the credit gap before and during the banking crisis in 1920-1928 deserves more attention. It is surprising that the credit gap is negative for the entire period from 1910 to 1917 in the light of historical references to strong credit expansion. One possible reason for this may be problems with the data. The data only cover a short period prior to the banking crisis. However, they cover all the years where there was credit expansion. It is conceivable that this artificially increases the trend, resulting in a credit gap which is too narrow. Another explanation may be that the companies financed investment by means of new share issues in addition to taking up bank loans. During these years, equity prices rose at a particularly sharp pace. Knutsen (1991) points out, for example, that investment in shipping and manufacturing during the war was largely financed by issuing new shares.

The credit gap peaks in 1921. First, this is strange in the light of the low level of activity in 1921. This is probably because banks attempted to rescue enterprises that experienced difficulties after the war by renewing their credit (see Rygg (1954)). Moreover, it is striking that the credit gap did not peak until one year after the banking crisis materialised instead of before the crisis. This can probably be explained by the decline in GDP in nominal prices, (see above). In addition, this banking

crisis had two phases. The first banking difficulties arose in the years 1920-1923, but few banks went bankrupt. Nordvik (1992) describes this as the first phase of the crisis. The serious banking crisis began, on the other hand, in 1923. In the years that followed, 67 banks were placed under public administration and 55 banks were liquidated.²¹ Therefore, the peak in the credit gap in 1921 may be regarded as a signal of the build-up phase before the serious crisis materialises in 1923.

Real equity price gap

The period with equity price data is the shortest of the four indicators used in this article and only covers one banking crisis, the crisis in 1988-1992. This makes it difficult to evaluate the size of this gap (see Chart 5). There is no doubt, however, that the real equity price gap is high before the crisis in 1988-1992. The only observation of a similar gap is at the end of the 1930s.

The historical references²² indicate a stock market boom in two other periods, but we lack data for these periods. The one period is from the middle of the 1890s before the crisis in 1899-1905. Both stock market turnover and equity prices rose. Stock market trading was driven by strong economic conditions and the many new enterprises in need of financing as well as the conversion of enterprises to limited companies.

The second period was during World War I, before the banking crisis in 1920-1928. High demand for freight services and fish in the warring countries had a positive effect on Norway's shipping and fishing industries. Equity prices rose, especially in shipping and whaling, and speculation surged. This was a highly speculative period. There was a sharp rise in the number of new share

²¹ See Rygg (1950), p. 144.

²² Rygg (1954)

Table 1. Banking crises in Norway

Crisis	Observed gap	Maximum value (peak) of gap in period prior to banking crisis	Year of peak	Number of years before banking crisis****	Data unavailable
1857	House price gap	13	1853	4	Credit gap
	Investment gap*	22	1854	3	Equity price gap
(1859)**	Investment gap*	24	1859	0	Credit gap
	Investment gap***	(22)	(1854)	(5)	Equity price gap
1864	House price gap	No peak			Credit gap
	Investment gap	5	1861	3	Equity price gap
1880-1890	House price gap	19	1878	2	Credit gap
	Investment gap	23	1874	6	Equity price gap
1899-1905	House price gap	17	1893	6	Credit gap
	Investment gap	14	1899	0	Equity price gap
1920-1928	House price gap	4	1914	6	Equity price gap
	Investment gap	21	1917	3	
	Credit gap	25	1921	One year after crisis was triggered	
1988-1992	House price gap	23	1987	1	
	Investment gap	4	1988	0	
	Credit gap	18	1986	2	
	Equity price gap	90	1985	3	

* The investment gap is based on figures for gross fixed capital formation less inventory changes and statistical deviations.

** It appears that the house price gap may capture the banking crisis in Bergen in 1859.

*** Same peak as before the banking crisis in 1857

**** The number of years before the peak of the banking crisis is probably a more relevant measure. The peak of the crisis in 1988-1992 is reached in 1991-1992 (see Vale (2004)). There is no information, however, about when the peaks of the other crises are reached. The peak for the period 1880-1890 is probably reached during the crisis in Arendal in 1886.

issues, both in connection with the formation of new companies and capital increases in existing companies.

3.3 Other periods with wide gaps

There are two other periods that stand out with high values for some of the gap indicators at times when there was no banking crisis. The one is 1936-1937 when both the investment gap and the equity price gap peak. The house price gap is narrow and the credit gap is negative. This is right before World War II. From a historical perspective, the war represents a shock when normal economic relationships break down. This combined with a lack of data for macroeconomic variables during the war years makes the analysis difficult. Therefore, we have made no attempt to look more closely at this period.

The second period is the 1950s and 1960s. At this time, the situation is reversed, with wide credit and house price gaps and low and largely negative investment and equity price gaps. Why wasn't there a banking crisis then? First, the housing and credit markets were regulated at this time. Internationally, there were few banking crises in this period, which may be because financial markets were regulated.²³ Banking crises are typical for the 1980s and 1990s after the liberalisation of the financial system. Second, the 1950s and 1960s are marked by stable macroeconomic developments (see Steigum (2004)). In addition, the house price gap in the

1950s and 1960s is somewhat narrower than the level we associate with earlier crises. A wide credit gap does not necessarily lead to banking problems if house prices do not rise sharply. Finally, interest rates on household borrowing are low at this time. It was the government's objective to keep interest rates low. Low interest rates allow households to service debt without defaulting.

4 What do the gap indicators say?

The results of the analysis are summarised in Table 1. Generally, we find all the gap indicators to be useful for signalling the build-up of imbalances and banking crises. The series for the house price gap and the investment gap extend furthest back in our sample, and both usually give positive signals prior to banking crises. Borio and Lowe (2002), on the other hand, do not find the investment gap useful for predicting banking crises. However, their conclusion may be due to the relatively short period considered (1960-1999). Nor are the values for the investment gap high in the Norwegian data for the 1980s. It is possible that the banking crises in the 1980s and 1990s differed from earlier crises and that a narrow investment gap was a special feature of the crises at that time.

The credit gap and the equity price gap are also important sources of information in the analysis of banking

²³ Kaminsky and Reinhart (1999)

crises. Our data on credit and equity prices do not cover all banking crises, unfortunately. As a result, we can neither confirm nor dismiss the findings of Borio and Lowe (2002) that the combination of the credit gap and the equity price gap is best for predicting banking crises.

The historical references indicate that the credit and equity price gaps may have been wide prior to some of the banking crises, but there is no data available. Our conclusions must therefore be viewed in the light of the somewhat limited data. We must also bear in mind the uncertainty associated with such long historical time series.

Borio and Lowe (2002) find certain threshold values, or critical values, for the gap indicators that predict banking crises. As we have data for only one country, we have not used their method to find the critical values. If we start our analysis by looking at the peaks in the gap indicators prior to the banking crises,²⁴ it appears as though an investment gap of more than 20 per cent, a house price gap approaching 16-17 per cent and a credit gap of close to 18 percentage points can be associated with a banking crisis.²⁵ These values are higher than those found by Borio and Lowe (2002) in their analysis.²⁶

Imbalances develop over time. When there is a disturbance, usually in the form of higher interest rates, the financial system is put to the test. The system's ability to withstand the pressure depends, among other things, on the quality of banks' portfolios and on banks' capital adequacy. However, indicators of the robustness of banks are not included in the analysis. The gap indicators in our analysis show the fragility of the economy in general. The gap indicator analysis must therefore be supplemented by an analysis of the robustness of the banking sector.

It is also possible that the critical values of the gap indicators are not constant. First, they may depend on the number of indicators that react. If there is a relatively narrow gap compared with the critical values, the probability of a crisis may nevertheless have increased if there are gaps in a number of indicators. For example, the investment gap prior to the crisis in 1899-1905 was relatively narrow. At the same time, there was a wide gap in both house prices and very probably in credit and equity prices (we lack data for the last two, but the his-

torical references indicate gaps). Second, the critical values of the gap indicators depend on the financial strength of the banking sector. Narrow gaps can lead to banking crises if the banking system is not very sound, just as wide gaps can do when the banking system is more robust. The crisis in 1920-1928 is an example. The house price gap was narrow, but there were weaknesses in the banking sector, with extensive short-term financing, large exposures, inadequate assessment of creditworthiness and insufficient guarantees for loans. Minor disturbances were enough to trigger the subsequent banking crisis.

The data we have studied cover several monetary policy regimes.²⁷ These different regimes have probably had an impact on the build-up of imbalances and the underlying causes of the banking crises. Nevertheless, the gap indicators have been relatively stable. It is possible that economic agents behave differently under a monetary policy regime with a flexible inflation target, which Norway has had since 2001. However, gap indicators are still relevant as expressions of the fragility of the economy. Whether the robustness of the financial system is greater under the new regime remains to be seen.

5 Conclusion

In this article, we have studied real house prices, real equity prices, investment as a percentage of GDP and total credit to the non-financial sector as a percentage of GDP over a long historical period. Using gap indicators, we have attempted to identify common features in the build-up of financial imbalances and banking crises. In general, the indicators tally with historical references from other studies, in particular concerning developments in the real economy. With few exceptions, the indicators show a common pattern - an increase in the gaps from one to six years prior to the banking crises, and subsequently a fall. As a rule, at least two of the gap indicators have high values prior to the banking crises, indicating that the strength of the analysis may be increased by combining indicators. The conclusions are conditioned by the uncertainty associated with long historical time series, and lack of data for some of the gap indicators in certain periods.

²⁴ Borio and Lowe (2002) define the critical values on the basis of the percentage of crises predicted by the indicators, and the noise-to-signal ratio, because they use panel data. Their method is therefore different from the one used here, which is based on the indicator's maximum value prior to a banking crisis.

²⁵ The critical values depend on the length of the calculation period. Consequently, they must be seen in relation to the periods used in this analysis.

²⁶ The deviation is not only due to the difference between the period analysed by the author and by Borio and Lowe (2002). An estimate of the gap indicators based on Norwegian data for the period 1960-2003 shows that the conclusion still applies.

²⁷ For an analysis, see Gerdrup (2003).

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Appendix

Developments in real house prices, real equity prices, investment and credit, the last two as a percentage of GDP, are shown in Charts 6-9. The banking crises are marked in grey. The house price index has been calculated by means of the repeated-sales method and is based on housing turnover figures for Bergen, Oslo, Trondheim and Kristiansand.²⁸ Since 1986, the index has been extended using figures from the Norwegian Association of Real Estate Agent's house price index.

For equity prices, we have calculated the annual average in the OSEAX (Oslo Stock Exchange all-share index) using monthly figures for the period 1914-2000.²⁹ From 2001 on, we have added figures from the OSEBX (Oslo Stock Exchange benchmark index), which represents a break in the time series.

To deflate house and equity prices, we used the consumer price index.³⁰ It may be of interest to investigate developments in nominal variables, particularly house prices and their importance for credit. At the same time, real variables are decisive for the choices facing economic agents. From a historical perspective, where nominal prices vary substantially, partly due to inflation, it is particularly important to eliminate the inflation effect. Using real variables, it is possible to analyse comparable indicators over time and identify features that are common to different banking crises.

Gross fixed capital formation and GDP are taken from historical monetary statistics.³¹ In order to isolate the effect of the build-up of the petroleum sector, we have used mainland gross fixed capital formation and mainland GDP (basis value) since 1970. The revision of the national accounts results in a further break in these series in 1970.

Figures for credit are based on total credit to the public (municipalities, non-financial enterprises and households) in the period 1899-1994. It would have been desirable to use mainland credit from 1970 for the reasons mentioned above. However, it is not possible to construct such data so far back in time. Therefore, mainland credit is only used from 1995 onwards, which means a break in the data. Credit figures are also available before 1899. However, they are only reported at ten-year intervals in the period 1830-1899. Since this makes it difficult to estimate a credit trend reliably, we have concentrated on data from 1899 onwards.

Figures for gross fixed capital formation and GDP are not available for the years 1940-1945. We have constructed these through interpolation and used them to estimate the trend. However, we have not specified figures for the investment gap indicator in the years 1940-1945. For the credit gap, where only one of the series included in the estimation has been obtained through interpolation, i.e. GDP, we have specified values for the gap indicator in the period in question despite the uncertainty.

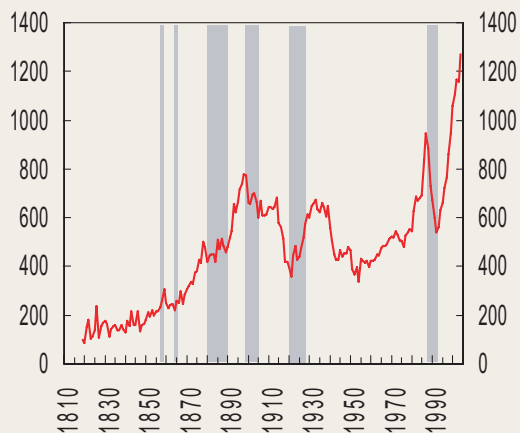
²⁸ Eitrheim and Erlandsen (2004)

²⁹ Klovland (2004)

³⁰ Grytten (2004)

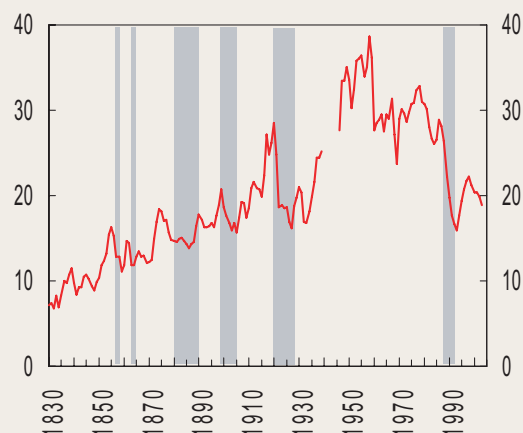
³¹ Grytten (2004)

Chart 6 Real house prices. Index 1819=100



Sources: Statistics Norway and Norges Bank

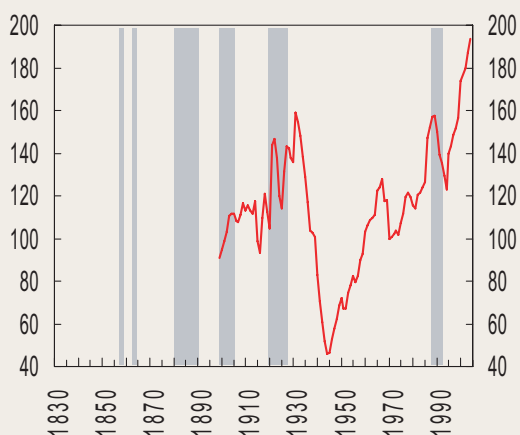
Chart 7 Total gross fixed capital formation as a percentage of GDP. 1830-2003¹⁾



¹⁾From 1970, mainland gross fixed capital formation as a percentage of mainland GDP (basis value). No data available for 1940-1945.

Sources: Statistics Norway and Norges Bank

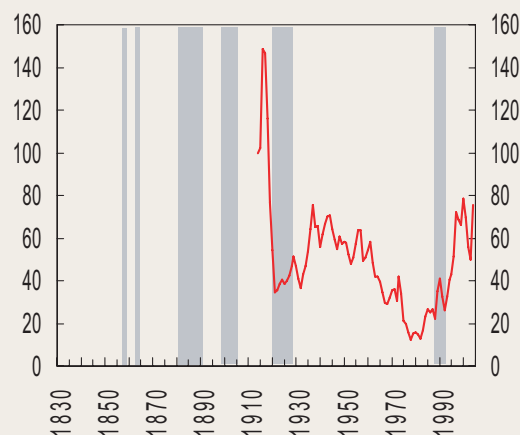
Chart 8 Total credit to municipalities, non-financial enterprises and households as a percentage of GDP. 1899-2004¹⁾



¹⁾Total credit to municipalities, non-financial enterprises and households as a percentage of gross GDP. From 1995, total credit to mainland Norway as a percentage of mainland GDP (basis value). GDP data for 1940-1945 is not available.

Sources: Statistics Norway and Norges Bank

Chart 9 Real equity prices. 1914-2004¹⁾. Index 1914=100



¹⁾Break in 2001 in connection with change from OSEAX (all-share index) to OSEBX (benchmark index)

Sources: Statistics Norway and Norges Bank

We have used the first 10 to 16 years in the time series to estimate the trend. The aim has been to have a sufficient number of observations to estimate a meaningful trend at the outset. At the same time, our desire to obtain gap indicators as early as possible before the outbreak of a banking crisis has placed some constraints on the length of this period.