

Supplementary information

THE INTERCONNECTEDNESS OF STOCK PRICES, MONEY, AND CREDIT ACROSS TIME AND FREQUENCY FROM 1970 TO 2016

Maciej RYCZKOWSKI , Marek ZINECKER 

Technological and Economic Development of Economy

<https://doi.org/10.3846/tede.2022.16779>

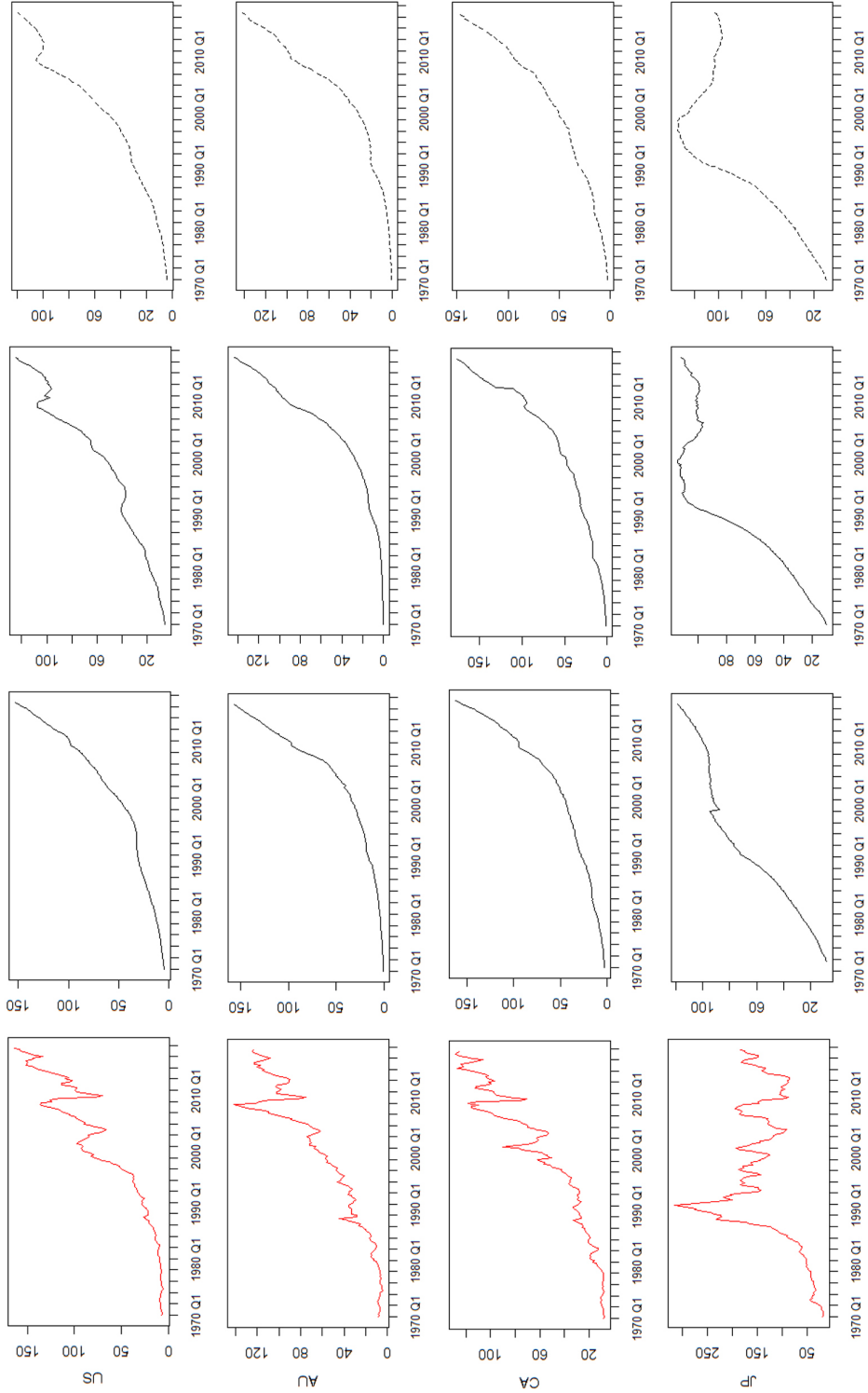


Figure A1 (To be Continued)

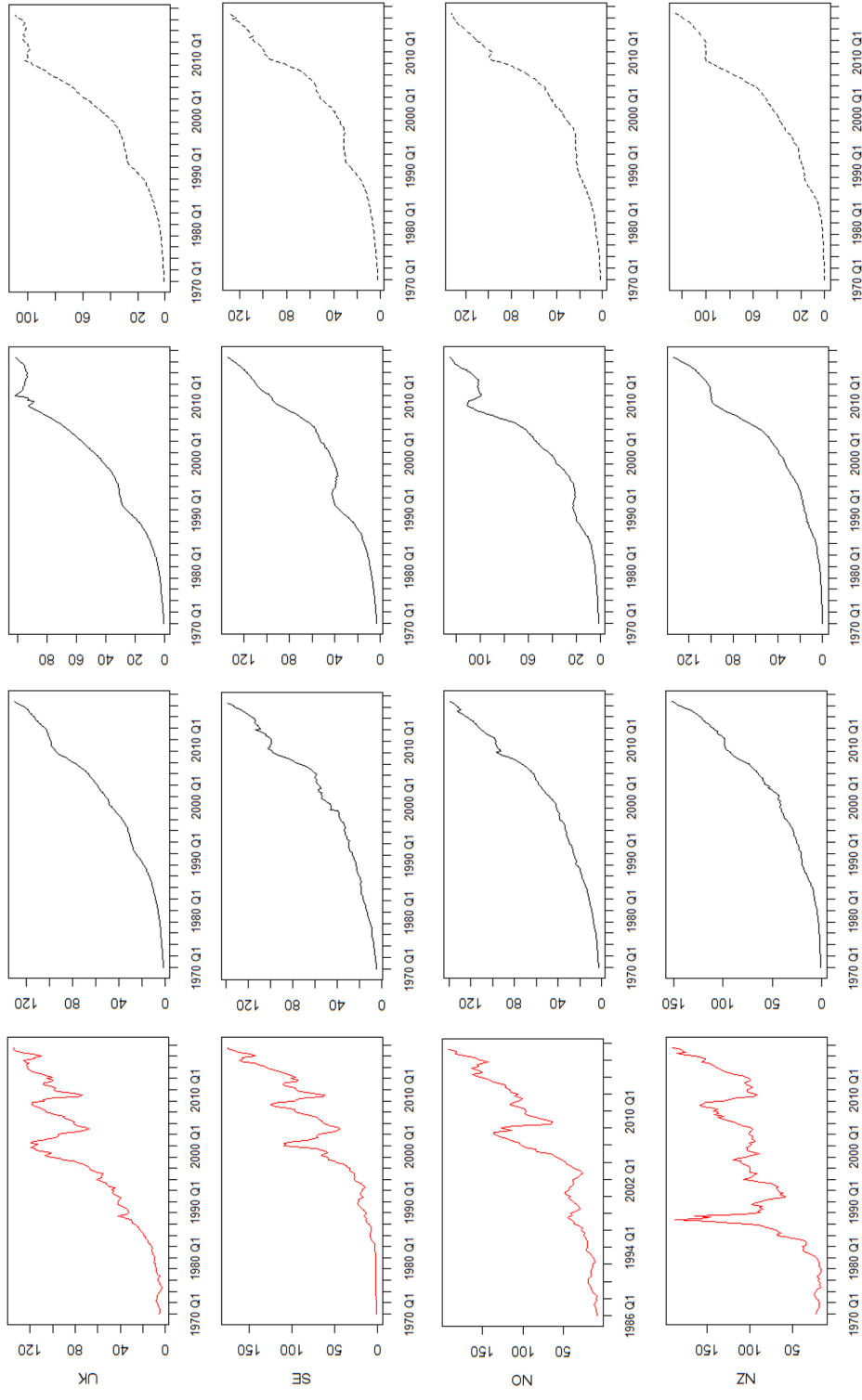


Figure A1 (To be Continued)

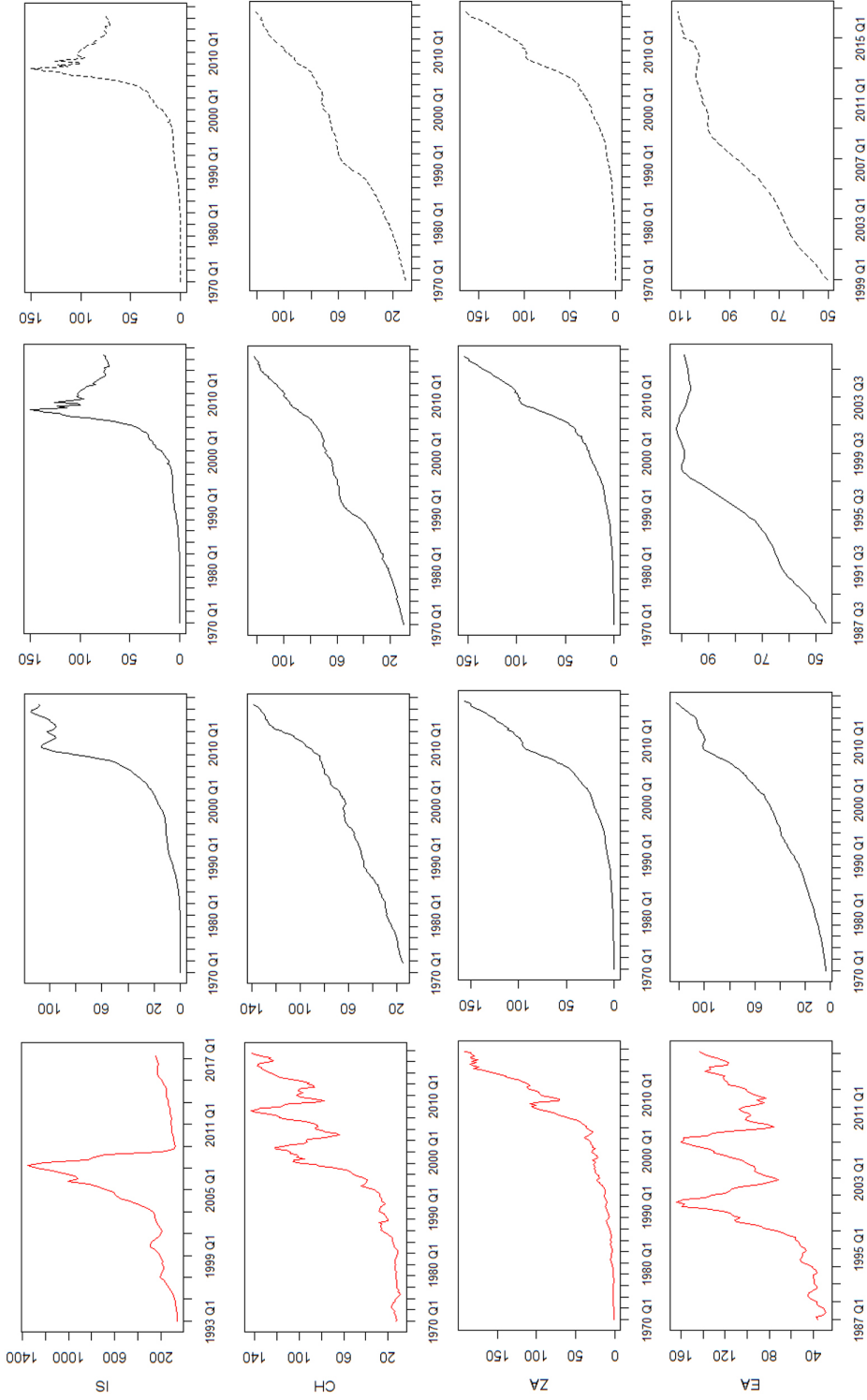
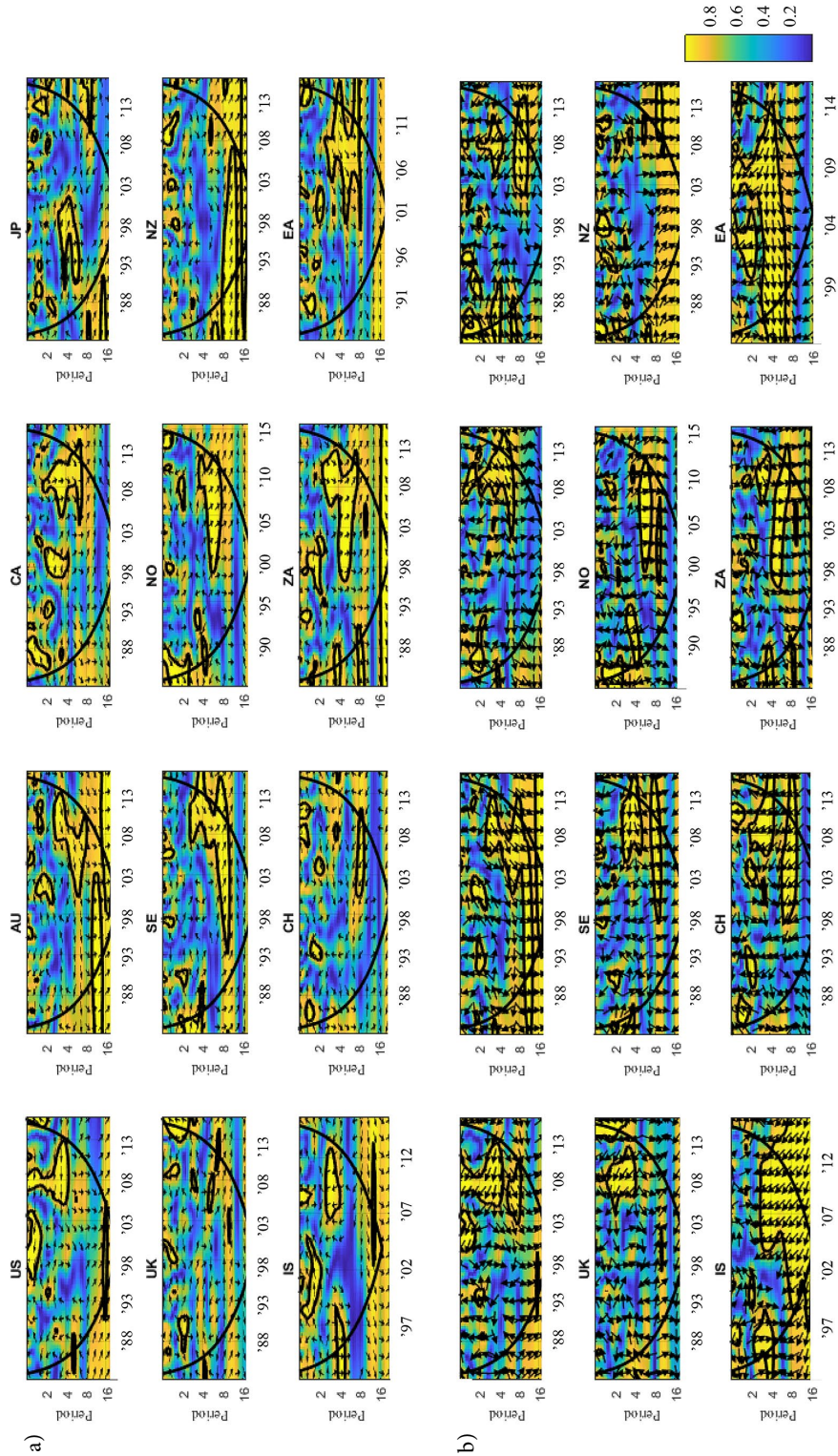
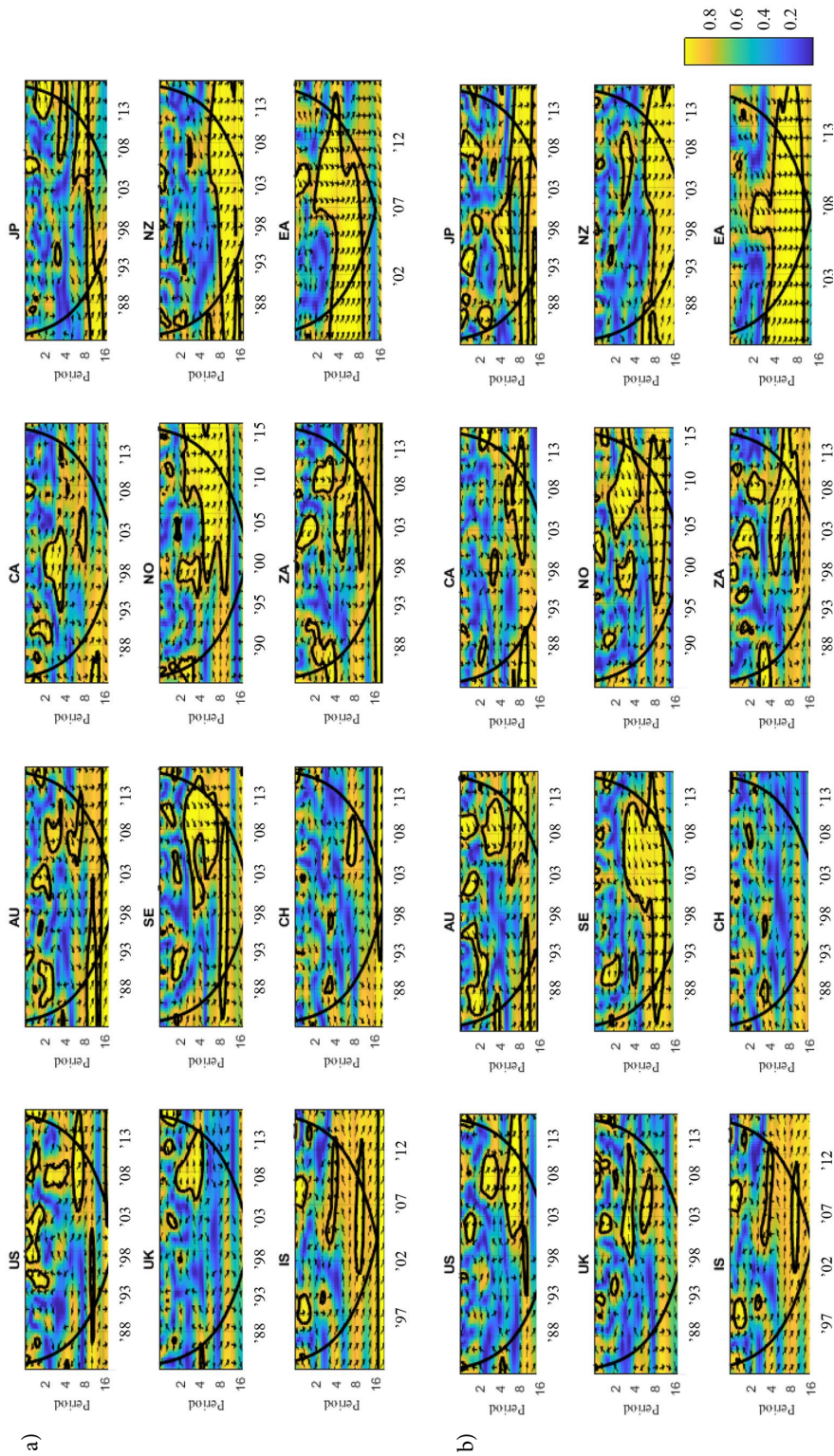


Figure A1. Time domain representation of stock prices (red), M3 bank credit, credit from all sectors (dashed line) respectively from 1Q 1970 to 4Q 2016, I indexes (2010 = 100), seasonally adjusted (source: own work)



Note: Plot *b* concerns M3 growth corrected for the real GDP growth. Plots *a*, *b*: Iceland since 1Q 1993, Norway since 1Q 1986. Data for the EA start from 1Q 1987 (*a*) and from 1Q 1995 (*b*). See notes to Figure 1.

Figure A2. Wavelet coherency between M3 and share prices from 1Q 1984 to 4Q 2016 (source: own work)



Note: Plot *a* concerns credit to private non-financial sector from banks at market value. Plot *b* concerns credit to private non-financial sector from all sectors at market value. Plots *a*, *b*: Iceland since 2Q 1993, Norway since 2Q 1986. Data for the EA start from 3Q 1987 (*a*) and from 1Q 1999 (*b*). See notes to Figure 1.

Figure A3. Wavelet coherency between credit and share prices from 1Q 1984 to 4Q 2016 (source: own work)

Table A1. Episodes of real stock price booms (1970–2016)

Australia	2Q 2009 – 4Q 2009
Canada	2Q 1978 – 1Q 1979; 4Q 1982 – 2Q 1983
Iceland	4Q 1995 – 4Q 1996; 3Q 2003 – 3Q 2004
Japan	1Q 1972 – 4Q 1972; 2Q 1986 – 2Q 1987; 2Q 1999 – 4Q 1999
New Zealand	3Q 1973 – 1Q 1973; 2Q 1983 – 1Q 1984; 1Q 1986 – 4Q 1986; 3Q 1993 – 1Q 1994; 3Q 2012 – 1Q 2013
Norway	2Q 2009 – 4Q 2009
South Africa	1Q 1972 – 4Q 1972
Sweden	4Q 1983 – 2Q 1983; 4Q 1985 – 2Q 1986; 2Q 2009 – 4Q 2009
Switzerland	1Q 1972 – 3Q 1972; 1Q 1985 – 4Q 1985; 1Q 1997 – 3Q 1997; 3Q 2005 – 1Q 2006
the United Kingdom	1Q 1987 – 3Q 1987
the United States	4Q 1970 – 2Q 1971; 4Q 1982 – 2Q 1983; 2Q 2003 – 1Q 2004; 2Q 2009 – 4Q 2009
Euro area	2Q 2009 – 4Q 2009

Note: data for Iceland since 4Q 1993, Norway since 4Q 1986, Euro Area since 4 Q 1990. We define a boom as a period of at least three consecutive quarters in which the real value of the index exceeds the recursive trend plus 1.75 times the recursive standard deviation of the series (the latter being calculated with a very slowly adjusting Hodrick-Prescott filter, with $\lambda = 100,000$). Boom for Japan 2Q 1986 – 2Q 1987 does not meet the afore-mentioned criteria but was included due to its severe long-lasting economic consequences.

Table A2. Episodes of real stock price busts (1970–2016)

Australia	1Q 1974 – 3Q 1975; 2Q 1982 – 1Q 1983; 3Q 1988; 4Q 2008 – 3Q 2009
Canada	4Q 1974 – 3Q 1975; 2Q 1982 – 1Q 1983; 4Q 2001 – 1Q 2002; 2Q 2009 – 3Q 2009
Iceland	3Q 2001 – 1Q 2002; 3Q 2008 – 2Q 2010
Japan	2Q 1974 – 3Q 1975; 1Q 1991 – 3Q 1991; 3Q 1992 – 1Q 1993; 4Q 2001 – 2Q 2002; 3Q 2008 – 4 Q 2009
New Zealand	4Q 1974 – 4Q 1975; 4Q 1977 – 2Q 1978; 1Q 1983; 1Q 1988 – 2Q 1989; 4Q 1990 – 3Q 1991; 4Q 2008 – 3Q 2009
Norway	4Q 1991; 2Q 1999; 1Q 2003 – 2Q 2003, 4Q 2008 – 3Q 2009
South Africa	3Q 1975 – 3Q 1977; 4Q 1981 – 4Q 1982; 3Q 1988 – 1Q 1989; 2Q 1999; 3Q 2003; 1Q 2009 – 3Q 2009
Sweden	3Q 1977 – 2Q 1978; 1Q 1991 – 3Q 1991; 3Q 2001 – 3Q 2003; 3Q 2008 – 3Q 2009
Switzerland	1Q 1974 – 3Q 1975; 3Q 1988; 1Q 2003 – 3Q 2003; 4Q 2008 – 3Q 2009
the United Kingdom	4Q 1973 – 3Q 1975; 1Q 2003 – 2Q 2003; 1Q 2009 – 3Q 2009
the United States*	2Q 1974 – 2Q 1975; 4Q 2008 – 3Q 2009
Euro area	4Q 2001 – 3Q 2003; 4Q 2008 – 4Q 2009

Note: data for Iceland since 1Q 1994, Norway since 4Q 1986, Euro Area since 4Q 1990. We define busts as periods when the fourquarter trailing moving average of the annual growth rate of stock prices, in real terms, falls below a 20% threshold. *In the United States we have not detected the Dot-com bubble burst between 2000 and 2002. As the Dot-com crisis was an important event in the stock market

history, in order to resolve any doubts related to the dates of stock price busts, we comment on why the Dot.com crisis was not detected in Table A2 in the United States. In fact, we evidenced a fall in the fourquarter trailing moving average of the annual growth rate of stock prices, in real terms, from 5% in 3Q 2001 up to maximum of 19% in 2Q 2003 (this date is slightly later than the burst of the Dot-com bubble since we analyze the fourquarter trailing moving). Nevertheless, according to the 20% threshold, we did not detect the stock price bust in the United States (although we were really close to do so). We suppose that a reasonable explanation could be that, although stock price falls concerned the whole stock market, they were predominantly related to the technology-dominated Nasdaq, and to a lesser extent to other stocks. Therefore, since we use the OECD share prices index (the share price index covers all listed companies on the world's largest stock market, namely the New York Stock Exchange), the impact of the Dot.com crisis was less severe on the general stock index that we use.

Table A3. Episodes of high and low cost real house price booms between 1970 and 2016 (source: own work)

Australia	3Q 1973 – 2Q 1976 (0.7;1.17)[12] ;
Canada	4Q 1973 – 4Q 1977 (2.12;2.80)[17]; 1Q 1988 – 3Q 1991 (2.96;0.39)[15];
Denmark	2Q 1977 – 1Q 1980 (-1.00;0.69)[12]; 2Q 1985 – 4Q 1988 (0.98;2.90)[15]; 2Q 2005 – 4Q 2008 (0.88;0.57)[15];
Euro area	1Q 2005 – 1Q 2009 (0.62;0.11)[17];
Japan	3Q 1989 – 1Q 1993 (2.06;3.09)[15];
New Zealand	3Q 1973 – 2Q 1977 (5.48;5.35)[16]; 1Q 2004 – 2Q 2008 (2.96;3.62)[18];
Norway	4Q 1985 – 2Q 1989 (4.66;3.17)[15];
South Africa	1Q 1981 – 3Q 1985 (3.79;2.35)[19]; 3Q 2004 – 1Q 2009 (-0.21;0.84)[19];
Sweden	2Q 1976 – 4Q 1980 (1.17;0.22)[19]; 3Q 1988 – 2Q 1992 (1.72;0.37)[16];
Switzerland	3Q 1987 – 2Q 1992 (-0.12;1.50)[20];
the United Kingdom	3Q 1987 – 3Q 1991 (2.57;1.54)[17]; 4Q 2002 – 3Q 2008 (0.42;1.84)[24];
the United States	4Q 1977 – 4Q 1980 (1.64;2.27)[13]; 3Q 1987 – 3Q 1990 (0.28;1.08)[13]; 2Q 2003 – 1Q 2008 (-1.48;1.34)[20];

Note: A boom is defined as a consecutive positive deviation of real house prices from a smooth Hodrick-Prescott trend (smoothing parameter = 100,000) of more than 5% lasting at least 12 quarters. *Data for euro area since 1Q 1990. Figures in squared parentheses refer to the number of quarters of the particular boom. High cost booms are bolded. If the annual average real GDP growth in the three years following the boom minus the annual average growth during the boom (reported as a first number in round brackets in percentage points) is greater by at least 2.4 p.p., the boom is classified as a high cost boom. Otherwise it is classified as a low cost one. I use some additional conditions for the classification in order to avoid unreasonable results. The 1989–1993 boom in Japan and the 2003–2008 boom in the U.S., although not reflected in the relative growth condition, were ultimately followed by a period of prolonged low or negative real growth. Therefore, we classify them as high-cost booms. Additionally, we report the difference between the annual average real GDP growth in the three years following the boom and the annual average growth in the three years after the boom (reported as a second number in round brackets, after the semicolon).

Table A4. Episodes of real house price busts (1970–2016)

Australia	4Q 1982 – 3Q 1983; 2Q 1987 – 3Q 1987; 4Q 1990 – 1Q 1991; 4Q 2011 – 2Q 2012
Canada	2Q 1982 – 2Q 1983; 4Q 1990 – 2Q 1991; 4Q 1995 – 1Q 1996;
Iceland	4Q 2008 – 4Q 2010
Japan	4Q 1974 – 2Q 1977; 4Q 1992 – 4Q 1993; 2Q 2003 – 3Q 2005
New Zealand	1Q 1976 – 4Q 1981; 2Q 1987; 4Q 2008 – 3Q 2009
Norway	1Q 1974 – 3Q 1974; 1Q 1976 – 4Q 1976; 4Q 1988 – 2Q 1993; 1Q 2009 – 3Q 2009
South Africa	1Q 1975 – 3Q 1975; 4Q 1976 – 1Q 1979; 1Q 1985 – 4Q 1987; 3Q 1992 – 3Q 1993; 4Q 2008 – 1Q 2010
Sweden	3Q 1980 – 3Q 1984; 2Q 1992 – 2Q 1994
Switzerland	3Q 1974 – 3Q 1976; 1Q 1991 – 1Q 1994; 4Q 1995 – 3Q 1997
the United Kingdom	4Q 1974 – 1Q 1978; 4Q 1981 – 4Q 1982; 3Q 1990 – 3Q 1993; 4Q 2008 – 4Q 2009; 4Q 2011 – 1Q 2012
the United States	2Q 1991 – 4Q 1991; 3Q 2007 – 1Q 2010; 2Q 2011 – 4Q 2011
Euro area	–

Note: IS since 4Q 2001, EA since 4Q 1991. We define busts as periods when the fourquarter trailing moving average of the annual growth rate of stock prices, in real terms, falls below a 5% threshold.