When to lean against the wind

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Credit booms: two sides of the same coin

Credit deepening is associated with...

- ...improvements in financial intermediation and economic growth (King and Levine 1993; Rousseau and Wachtel 1998)

as well as

- ...higher risk of experiencing a financial crisis (Schularick and Taylor 2012).

Macroprudential policy

Monetary policy or macropru to deal with booms?

- Large set of macroprudential policies to deal with booms (Cerutti et al. 2015).
- Effects of policies still debated (Svensson (2016), Adrian and Liang (2016)).
- New evidence on real economic effects of macropru: Richter, Schularick, Shim (2017).

One step back: before taking action can we tell if a credit boom is good or bad?

Good booms and bad booms - mixed evidence

Are bad credit booms detectable?

- Mendoza and Terrones (2012): credit growth and capital inflows more pronounced for crisis observations.
- Gorton and Ordonez (2016): dynamics of productivity matter.
- In general Dell'Arricia et al. (2016): difficult to tell crisis and non-crisis booms apart.

What we do

- We use a sample of 17 countries from 1870 to 2013,
- Use new and promising procedure for detrending proposed by Hamilton (2017)
- Apply country-specific thresholds to identify credit booms
- Identify 112 credit booms of which 29 are followed by a financial crisis (bad)
- Analyze whether there are observable differences between the two types of credit booms.

What we find

- **There are clear markers of good and bad booms.**
- Bad booms are characterized by:
  - House price booms
  - Rising loan-to-deposit ratios in the banking sector
  - Deteriorating current account balances
- These characteristics have high predictive ability.
- **And central banks can detect them in REAL TIME.**

Detrending procedure

We use a detrending procedure recently proposed by Hamilton (2017).

Intuition: The credit cycle is the component in credit that could not be predicted $h = 3$ years ago.

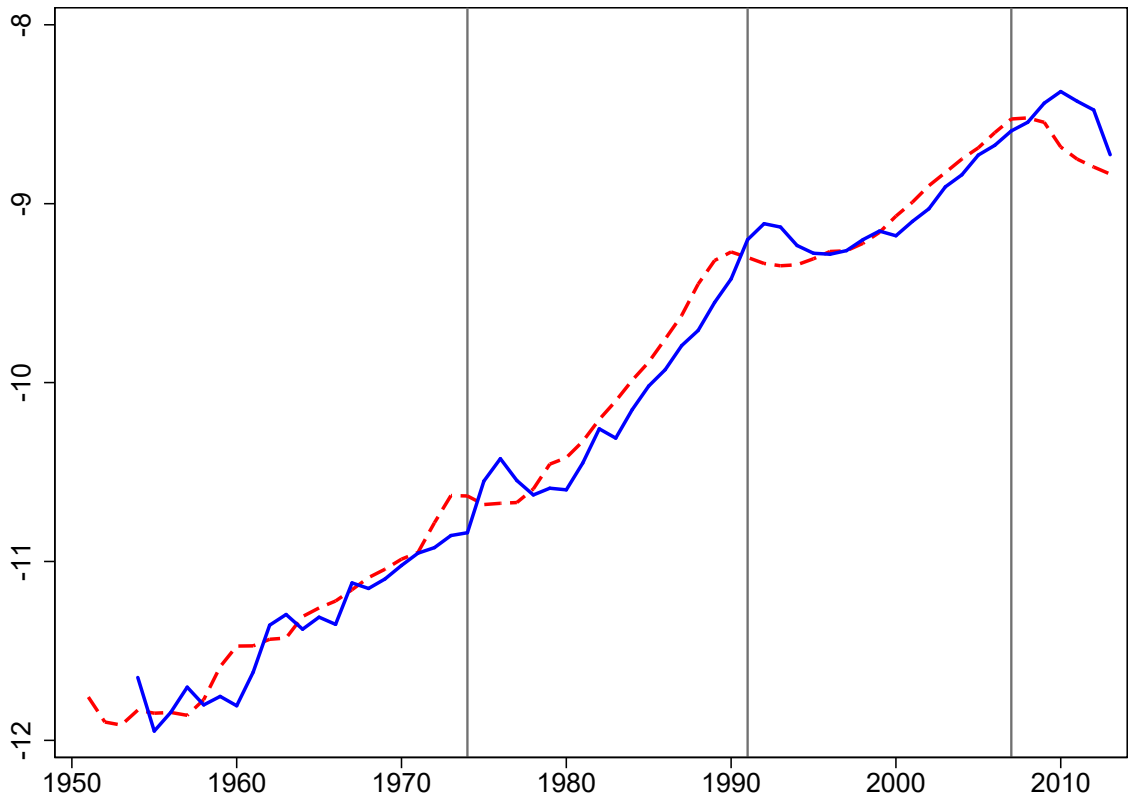
Formally: We estimate a regression of credit (y) at time t on the 4 most recent values at time $t - h$.

$$y_t = \beta_0 + \beta_1 y_{t-h} + \beta_2 y_{t-h-1} + \beta_3 y_{t-h-2} + \beta_4 y_{t-h-3} + v_t$$

Detrended credit c_t is the residual $\hat{v}_t$ of this regression.

Example UK

Figure: Raw data (red) and trend (blue) of log real private credit per capita in the United Kingdom



Boom definitions

To identify booms we apply the following procedure:

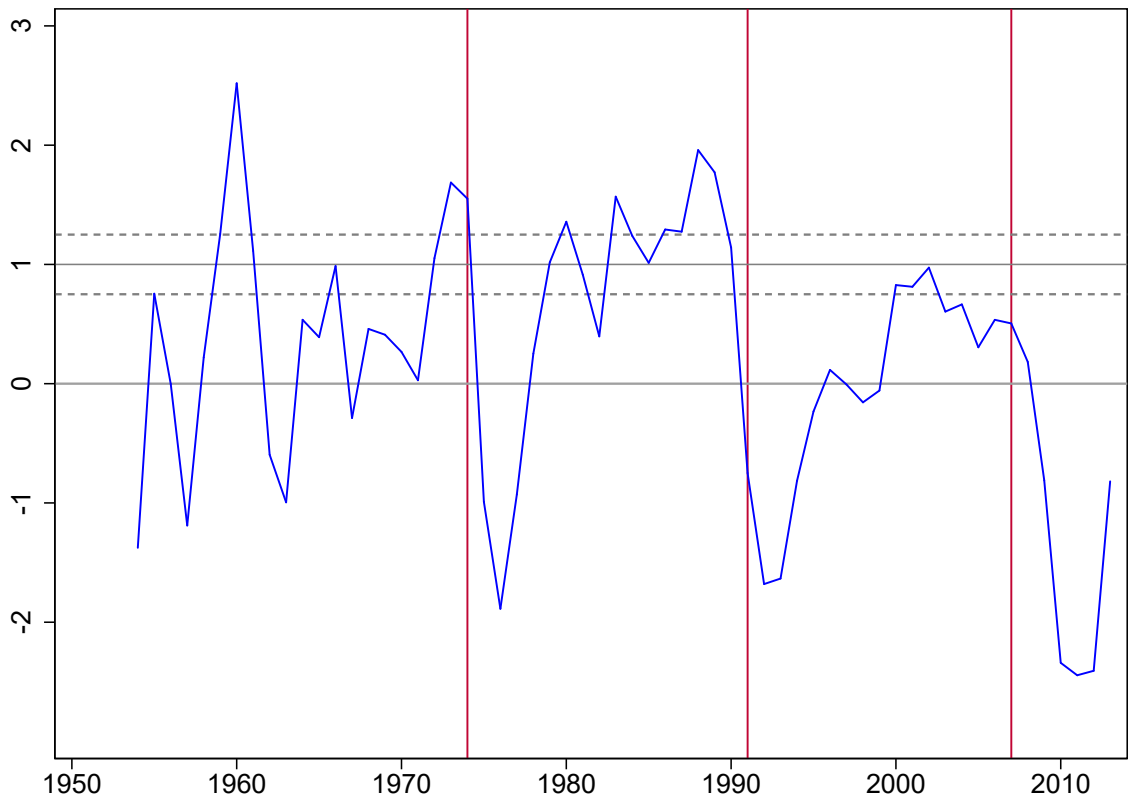
- Normalize detrended credit ($c_{i,t}$) by country specific standard deviation to identify fic unusually large deviations.
- A country-year observation is a boom observation if normalized measure is larger than 1, i.e., $c_{i,t}$ greater $\sigma(c_i)$:

$$\text{Credit Boom}_{i,t} = I(c_{i,t} > \text{standard deviation of c in country i})$$

- Subsequent boom observations are combined into one boom episode.
- Country-year observations that are preceeded and followed by a boom are integrated into the boom episode.

Identifying booms

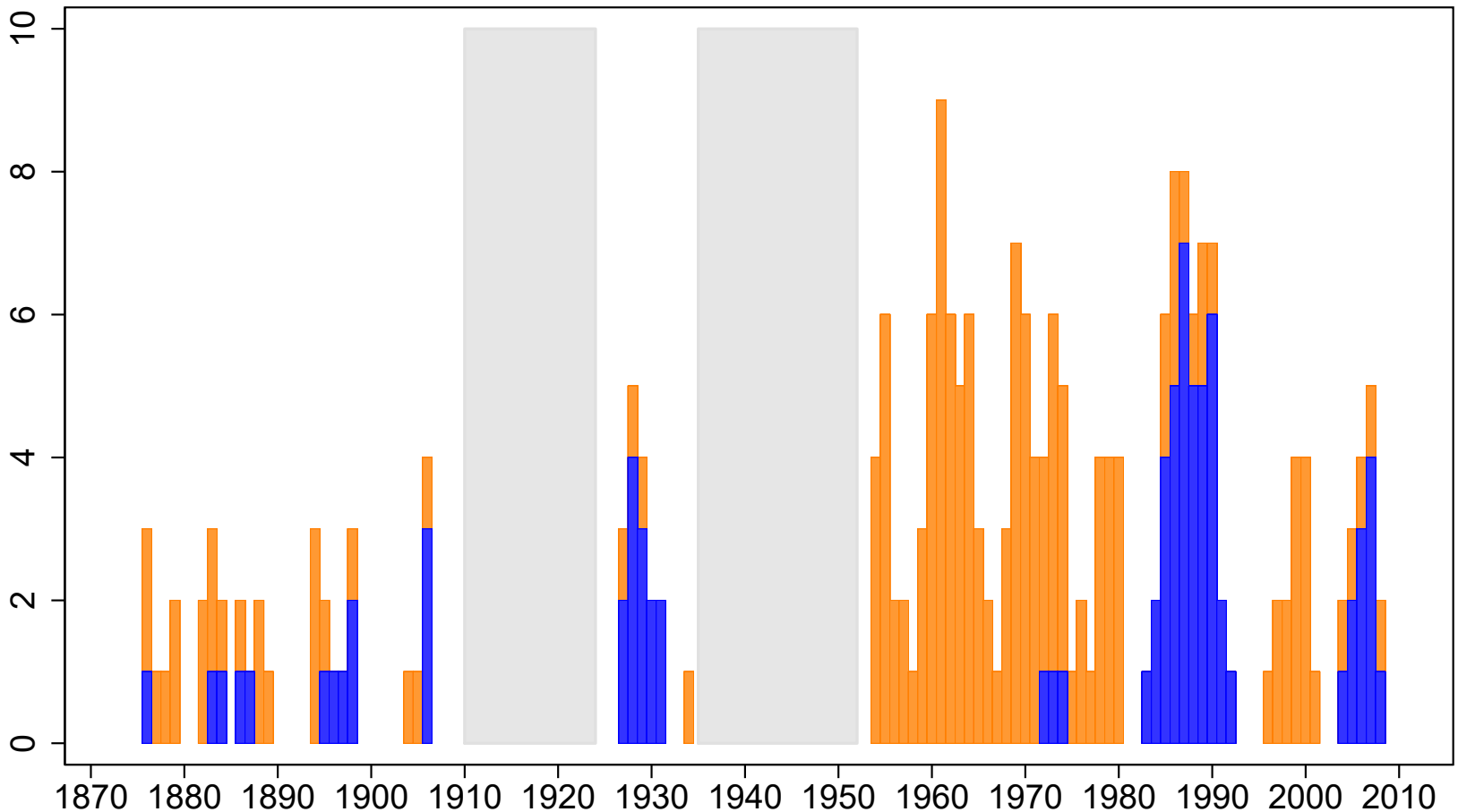
Figure: Detrended credit in the United Kingdom



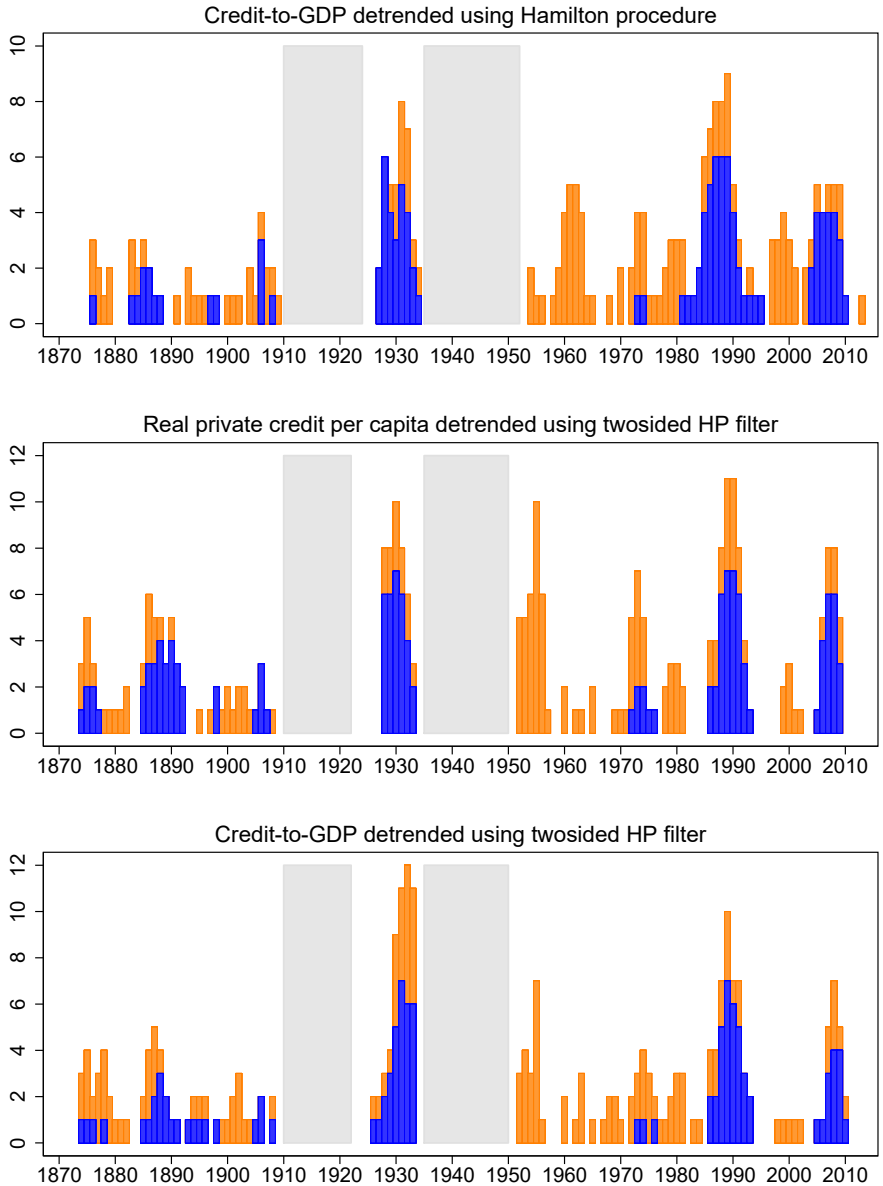
Notes: This figure presents the normalized cyclical component of real private credit per capita in the UK. Red vertical lines indicate dates of systemic financial distress defined in Jordà et al. (2016).

Credit booms: 1870-2013

Figure: Number of ongoing credit booms by year



Alternative boom definitions



Booms and crises

	All years	All years	Pre-WW2	Pre-WW2	Post-WW2	Post-WW2
Detrended credit	0.61***		0.70***		0.86***	
	(0.15)		(0.18)		(0.23)	
Credit boom		1.27***		1.61***		1.54***
		(0.30)		(0.52)		(0.42)
Pseudo R^2	0.054	0.054	0.082	0.078	0.080	0.072
AUC	0.69	0.68	0.72	0.69	0.73	0.69
s.e.	0.04	0.04	0.05	0.05	0.06	0.07
Observations	1517	1517	516	516	942	942

Notes: Detrended credit is standardized at the country level, see text. Credit boom is a dummy that is 1 if detrended credit exceeds the boom threshold, 0 otherwise. Both variables are included as first lag. Country fixed effects are included. Clustered standard errors reported in parentheses. AUC is the area under the receiver operating curve (see text for explanation), and s.e. is its standard error.

Boom characteristics

- **Peak** refers to the observation with the highest value of detrended credit within a boom episode.
- **Duration** refers to the number of years until the peak is reached.
- **Size** refers to the average of detrended credit in the years until the peak is reached.
- A boom is characterized as **bad** if there is a financial crisis during the boom or in the 3 years after the peak.
- **Other variables** are detrended and normalized using the same procedure as for credit.

Do good and bad booms differ?

	Coefficient	t-stat
Boom with crisis	1.00	.
Size	0.26*	2.40
Duration	0.76*	2.49
Duration to peak	0.38	1.86
GDP	-0.06	-0.33
Consumption	0.06	0.32
Current Account	-0.51*	-2.49
Investment	0.19	0.92
Short term rate	-0.05	-0.20
Long term rate	-0.05	-0.22
Credit-to-GDP	0.25	1.77
Capital ratio	0.15	0.62
Noncore	0.01	0.05
Loans-to-Deposits	0.87***	3.73
House price index	0.96***	4.05
Stock price index	0.28	1.08
Observations	112	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Good and bad booms

We first run logit models for a boom ending in a financial crisis (badly).

The observation is a boom episode b in country i, characterized by $Z_{i,b}$ which includes size and duration of the boom as well as additional observables.

$$log\left(\frac{Pr[B_{i,b}=1|Z_{i,b}]}{Pr[B_{i,b}=0|Z_{i,b}]}\right)=\alpha+\beta Z_{i,b}+\epsilon_{i,b}$$

Variables included

1. Baseline specification: Duration of the credit boom and size.
2. Real economic fundamentals: Detrended and normalized GDP, consumption, investment, the current account balance and interest rates.
3. Bank balance sheets: Credit-to-GDP in levels, detrended and normalized capital, wholesale funding, and loan-to-deposit ratios.
4. Asset prices: Detrended and normalized stock and house prices.

Boom characteristics: baseline

	Size (1)	Duration (2)	Both (3)
Panel A: Full sample			
Size of boom	1.38**		1.26**
	(0.62)		(0.63)
Duration to peak		0.38*	0.30
		(0.20)	(0.21)
Pseudo R^2	0.047	0.025	0.062
AUC	0.68	0.56	0.68
s.e.	0.06	0.06	0.06
Observations	112	112	112
Panel B: Reduced sample —including country fixed effects			
Size of boom	2.28**		2.09*
	(1.12)		(1.15)
Duration to peak		0.49**	0.33
		(0.24)	(0.24)
Pseudo R^2	0.149	0.100	0.162
AUC	0.76	0.70	0.78
s.e.	0.06	0.06	0.06
Observations	98	98	98

Adding economic fundamentals

	Base	GDP	Cons.	Invest.	Current account	Short-rate	Long-rate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Full sample							
Size of boom	1.12	1.12	1.14	1.03	1.25	1.05	1.08
	(0.82)	(0.81)	(0.84)	(0.89)	(0.91)	(0.76)	(0.76)
Duration to peak	0.35	0.35	0.37*	0.31	0.35	0.36	0.35
	(0.22)	(0.22)	(0.22)	(0.23)	(0.22)	(0.23)	(0.22)
Real variable (see column header)		-0.04	-0.13	0.52**	-0.76**	-0.21	-0.14
		(0.27)	(0.32)	(0.26)	(0.31)	(0.40)	(0.30)
Pseudo R^2	0.063	0.063	0.064	0.081	0.144	0.067	0.066
AUC	0.68	0.68	0.69	0.71	0.76	0.69	0.67
s.e.	0.07	0.07	0.06	0.06	0.06	0.06	0.06
Observations	90	90	90	90	90	90	90
Panel B: Reduced sample							
Size of boom	2.03	2.05	2.14	1.96	2.51	1.73	1.88
	(1.40)	(1.35)	(1.39)	(1.45)	(1.56)	(1.41)	(1.29)
Duration to peak	0.42	0.50*	0.56*	0.40	0.60*	0.46	0.43
	(0.30)	(0.30)	(0.29)	(0.31)	(0.36)	(0.34)	(0.30)
Real variable (see column header)		-0.36	-0.59	0.26	-1.25***	-0.35	-0.18
		(0.42)	(0.54)	(0.27)	(0.40)	(0.65)	(0.35)
Pseudo R^2	0.162	0.169	0.178	0.165	0.299	0.169	0.165
AUC	0.77	0.77	0.77	0.77	0.83	0.76	0.76
s.e.	0.07	0.07	0.06	0.07	0.05	0.06	0.07
Observations	72	72	72	72	72	72	72

Adding bank variables

	Base (1)	Credit-to-GDP (2)	Cap. Ratio (3)	Noncore (4)	Loan-to-Dep. (5)
Panel A: Full sample					
Size of boom	1.19	1.22	1.26*	1.19	1.31*
	(0.73)	(0.75)	(0.74)	(0.73)	(0.71)
Duration to peak	0.31	0.26	0.30*	0.30	0.07
	(0.19)	(0.20)	(0.18)	(0.20)	(0.26)
Banking variable (see column header)		0.49	0.35	0.02	0.66***
		(0.57)	(0.31)	(0.18)	(0.22)
Pseudo R^2	0.060	0.070	0.082	0.060	0.116
AUC	0.68	0.67	0.68	0.68	0.74
s.e.	0.06	0.07	0.07	0.06	0.06
Observations	101	101	101	101	101
Panel B: Reduced sample					
Size of boom	2.07	2.04	2.11	2.07	2.16
	(1.45)	(1.44)	(1.44)	(1.47)	(1.47)
Duration to peak	0.41	0.37	0.38	0.37	0.16
	(0.28)	(0.28)	(0.27)	(0.26)	(0.33)
Banking variable (see column header)		0.30	0.23	0.08	0.65**
		(0.71)	(0.34)	(0.21)	(0.26)
Pseudo R^2	0.169	0.172	0.179	0.170	0.208
AUC	0.78	0.79	0.79	0.78	0.80
s.e.	0.06	0.06	0.06	0.06	0.06
Observations	86	86	86	86	86

Adding asset prices

	Baseline (1)	House prices (2)	Stock prices (3)	Both (4)
Panel A: Full sample				
Size of boom	1.61	1.61	1.81*	2.00*
	(0.99)	(1.13)	(0.98)	(1.15)
Duration to peak	0.49**	0.42	0.51**	0.47
	(0.23)	(0.28)	(0.24)	(0.31)
House Price Index		0.84**		0.91**
		(0.38)		(0.38)
Stock Price Index			-0.20	-0.40
			(0.28)	(0.34)
Pseudo R^2	0.111	0.207	0.116	0.223
AUC	0.72	0.82	0.73	0.82
s.e.	0.07	0.05	0.07	0.05
Observations	85	85	85	85
Panel B: Reduced sample				
Size of boom	2.36	2.59	3.73**	6.12**
	(1.75)	(1.66)	(1.79)	(2.46)
Duration to peak	0.75**	0.71	0.91**	0.97
	(0.35)	(0.46)	(0.40)	(0.68)
House Price Index		1.43**		2.14***
		(0.57)		(0.65)
Stock Price Index			-0.95**	-1.86***
			(0.41)	(0.68)
Pseudo R^2	0.232	0.380	0.283	0.499
AUC	0.81	0.89	0.84	0.92
s.e.	0.07	0.04	0.06	0.03
Observations	64	64	64	64

All

	Baseline	House prices	LtD ratio	Full	Full (lower threshold)
	(1)	(2)	(3)	(4)	(5)
Panel A: Full sample					
Size of boom	1.42	1.27	1.18	1.48	1.56**
	(1.00)	(1.08)	(1.10)	(1.11)	(0.66)
Duration to peak	0.43*	0.39	0.15	0.18	0.05
	(0.22)	(0.27)	(0.33)	(0.30)	(0.19)
House Price Index		0.86**	0.80**	0.83**	0.93**
		(0.39)	(0.39)	(0.42)	(0.42)
Loan-to-Deposits			0.72**	0.61*	0.44
			(0.30)	(0.34)	(0.37)
Current Account				-0.81**	-0.87**
				(0.39)	(0.36)
Pseudo R^2	0.089	0.185	0.242	0.287	0.263
AUC	0.70	0.80	0.85	0.87	0.86
s.e.	0.07	0.05	0.05	0.04	0.05
Observations	86	86	86	86	102

Can we spot the danger in real time?

So far: data used at peak of credit boom.

Problem: policy-maker does not know whether the peak of a credit boom has already been reached.

Real time information:

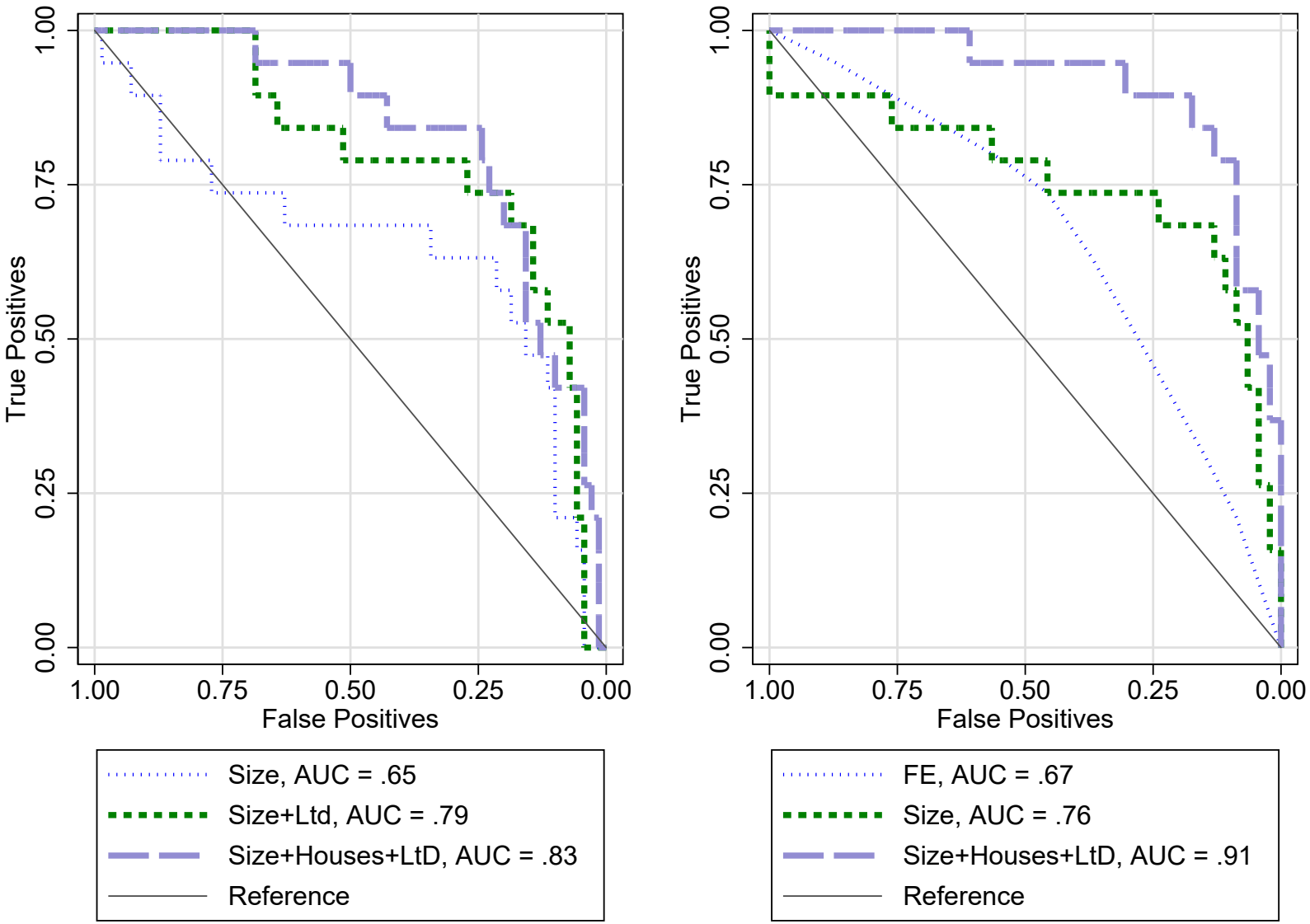
- Use information at the time when the credit boom threshold is first reached (observable in real time)
- Drop booms that turn into a financial crisis in the first year of the boom
- The loan-to-deposit and house prices contain again valuable information.

Real time

	(1)	(2)	(3)	(4)
Panel A: Full sample				
Initial size of boom	2.02*	2.04	1.89	1.96
	(1.21)	(1.31)	(1.19)	(1.33)
House price index		0.57		0.56
		(0.36)		(0.43)
Loan-to-Deposits			1.16***	1.17***
			(0.33)	(0.35)
Pseudo R^2	0.059	0.101	0.188	0.224
AUC	0.65	0.74	0.79	0.83
s.e.	0.09	0.07	0.06	0.05
Observations	89	89	89	89
Panel B: Reduced sample				
Initial size of boom	2.81	3.99**	2.38	3.79**
	(1.82)	(1.93)	(1.67)	(1.72)
House price index		1.53*		1.35
		(0.88)		(0.84)
Loan-to-Deposits			1.78***	1.91**
			(0.54)	(0.89)
Pseudo R^2	0.149	0.300	0.337	0.442
AUC	0.76	0.85	0.87	0.91
s.e.	0.08	0.05	0.05	0.04
Observations	65	65	65	65

Can bad booms be identified in real time?

Figure: Correct classification frontiers.



Second exercise

Booms in the 2000s: can we predict out of sample?

- Run logit model on data until 1999
- Use coefficients to calculate probabilities for booms after 2000 to end badly
- NB: based on data in the year of the boom start, i.e., in real time!
- The model attaches low probabilities to good booms and high probabilities to bad booms

Booms after 1999

	Start	Outcome	Initial Size (1)	Size + House Prices (2)	Full (3)
Denmark	2005	bad	0.206	0.684	0.744
Spain	2005	bad	0.195	0.508	0.572
Sweden	2005	bad	0.151	0.563	0.538
USA	2004	bad	0.159	0.533	0.533
Italy	2007	bad	0.162	0.345	0.472
Norway	2005	good	0.175	0.355	0.434
UK	2000	good	0.145	0.217	0.253
Denmark	2002	good	0.152	0.208	0.249
Finland	2003	good	0.153	0.178	0.197
Finland	2000	good	0.155	0.163	0.186
Australia	2004	good	0.161	0.914	0.914

Notes: This table presents predicted probabilities of a boom after the year 2000 being bad based on information available in the first year of the boom. Probabilities are based on coefficients from logit classification models estimated using available data until 1999. Models are including the size of the boom (1) and adding house prices (2) and additionally loan-to-deposits (3).

Robustness

Results are robust to varying...

- The credit measure to identify a boom: credit-to-GDP instead of real credit per capita;
- The detrending procedure: two-sided HP filter instead of the Hamilton (2017) method;
- The credit boom threshold: 0.75 or 1.25 country specific standard deviations as a threshold;
- The sample period: post-WW2 data only.

Conclusions

- Policy-makers can distinguish between good and bad booms and can do so in real time.
- Most important markers of bad credit booms are house price booms and elevated loan-to-deposit ratios.