Beyond the credit gap:
quantity and price of risk indicators for macropru

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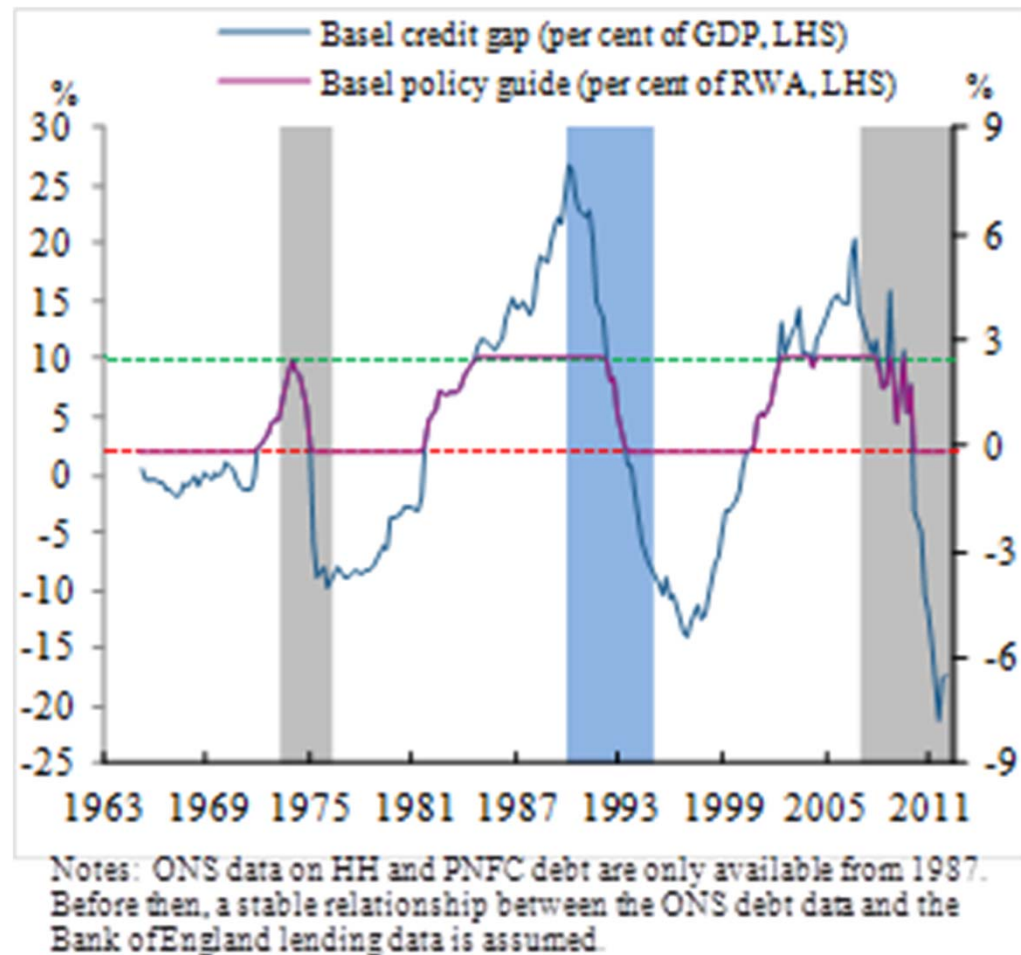joint with Oliver Bush (BoE) and Hanno Stremmel (WHU)

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Summary

- Policy ahead of theory: *de facto* political consensus on need for macroprudential policy, particularly counter-cyclical capital, but no consensus on theory or even how to measure systemic risk

- Focus on credit-to-GDP gap (BCBS 2010) reflects success in existing empirical work explaining international banking crisis. Theory suggests many other indicators have the potential to be useful in measuring systemic risk

- Credit gap poor for release phase

- In line with intuition, we find that a simple proxy for "price of risk" seems just as useful and robust as credit gap (or other credit cycle proxies), and contributes to timing of cycles

- Some evidence for leverage and liquidity measures, but less robust

Beyond Credit Gap

- Credit gap has been shown to be useful in signalling tightening phases for counter-cyclical capital buffers …

- BUT would have led to very long lags in the release phase (partly defeating purpose)

- Price of risk indicators can potentially help identify the release phase in more timely fashion

Notes: ONS data on HH and PNFC debt are only available from 1987. Before then, a stable relationship between the ONS debt data and the Bank of England lending data is assumed.

Price vs Quantity of risk

- Quantity of risk indicators: a measure of imbalance, source of higher fragility to shocks. Typically based on quantity variables but can also be based on price variables (e.g. mispricing proxies such as real exchange rate misalignment, price-to-rent ratio)

- Price of risk indicators: a measure of current assessment of risks, ideally would use risk premia (required excess return per unit of quantity of risk) but need models

- Price of risk is believed to be highly counter-cyclical and jump variable (forward looking)

- Quantity of risk is typically pro-cyclical and more sticky (past decisions)

Price vs Quantity of risk

Conjecture

(follows from rationale for counter-cyclical macropru?)

A. CCMP buffers should be raised when price of risk is low (cost of buying insurance/raising finance is low) and indicators of quantity of risk are high or increasing

B. CCMP buffers should never be raised when risks have materialized and strong bias to release (use insurance bought, not buy more when event has happened). At most, it might not be the time to release until full scale is assessed (prudential buffers vs actual capital level)

Outline

- Motivation – what indicators to use for macroprudential policy?

- Identifying factors in a "data rich" case - UK indicators for macropru

- Data – construction of international panel with additional variables

- Results – going beyond the credit gap in predicting banking crisis
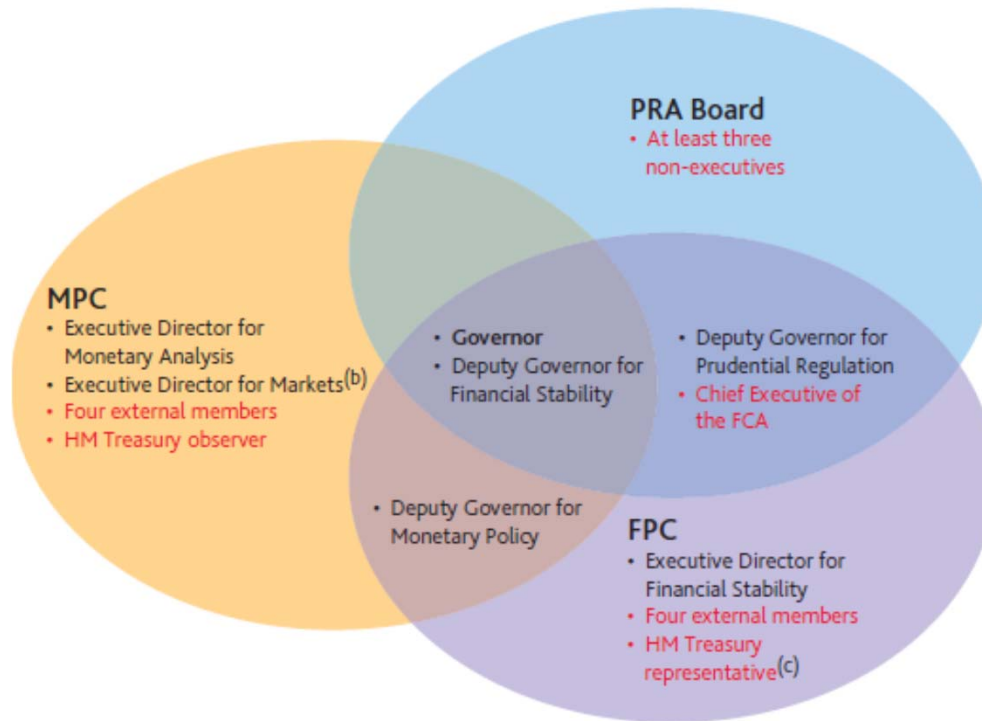
- Robustness and next steps

- Conclusion

I. MOTIVATION

Motivation

- New macroprudential framework, with new tools and mandates, but many unknowns

- Theory at early stages, similar to MP half a century ago, some learning-by-doing inevitable for calibration

- Many practical questions need to be answered, including *what set of indicators to monitor/base decisions?*

- UK FPC draft policy statement includes 38 indicators for macropru

- Trade off between benefits of small set of indicators (communication, accountability) and risk of missing vulnerabilities

Figure 3 Membership of Bank of England statutory decision-making bodies(a)

PRA Board
· At least three non-executives

MPC
· Executive Director for Monetary Analysis
· Executive Director for Markets(b)
· Four external members
· HM Treasury observer

· Governor
· Deputy Governor for Financial Stability

· Deputy Governor for Prudential Regulation
· Chief Executive of the FCA

· Deputy Governor for Monetary Policy

FPC
· Executive Director for Financial Stability
· Four external members
· HM Treasury representative(c)

(a) Members shown in red are not part of the Bank's Executive Team.
(b) The Executive Director for Markets will also routinely attend FPC meetings.
(c) Non-voting member of the FPC.

PRA created in 2013, FPC created in interim form 2011, statutory 2013
(See Murphy & Senior "Changes to the Bank of England", Quarterly Bulletin 2013 Q1)

Macropru: new and evolving framework

- Legal framework: PRA, FPC with statutory powers (April 2013) and European legislation (CRD IV)

- FPC powers: power to issue recommendations and direction powers over two counter-cyclical macro-prudential (CCMP) tool
  – countercyclical capital buffer and sectoral capital requirements (**for now**)

- FPC communication: Jan 2013 draft policy statement* contains list of core indicators
  – Internally: Starting point for analysis, consistency
  – Externally: Transparency, accountability, predictability

*http://www.bankofengland.co.uk/financialstability/Pages/fpc/coreindicators.aspx

Table C Core indicator set for the countercyclical capital buffer[1]

Indicator	Average, 1987–2006[2]	Average 2006[3]	Maximum since 1987[2]	Minimum since 1987[2]	Latest value
Bank balance sheet stretch[4]					
1 Core Tier 1 capital ratio[5]	6.6%	6.3%	10.8%	6.1%	10.8% (2012 H1)
2 Leverage ratio[6]					
Simple	4.7%	4.1%	5.4%	2.9%	5.1% (2011)
Basel III	n.a.	n.a.	n.a.	n.a.	4.2% (Oct. 2012)
7 Bank debt measures					
CDS premia[11]	12 bps	8 bps	298 bps	6 bps	168 bps (Nov. 2012)
Subordinated spreads[12]	29 bps	10 bps	967 bps	4 bps	354 bps (Nov. 2012)
8 Bank equity measures					
Price to book ratio[13]	2.14	1.97	2.83	0.52	0.76 (Nov. 2012)
Market-based leverage ratio[14]	9.6%	7.8%	14.8%	1.9%	3.9% (Nov. 2012)
Non-bank balance sheet stretch					
9 Credit-to-GDP[15]					
Ratio	131.8%	179.1%	198.4%	93.8%	183.7% (2012 Q2)
Gap	4.2%	13.0%	21.4%	-16.3%	-13.3% (2012 Q2)
10 Private non-financial sector credit growth[16]	10.8%	10.1%	25.6%	-4.7%	0.4% (2012 Q2)
Conditions and terms in markets					
14 Long-term real interest rate[20]	3.09%	1.25%	5.14%	0.02%	0.04% (Nov. 2012)
15 VIX[21]	19.1	12.8	65.4	10.6	16.7 (Nov. 2012)
16 Global spreads[22]					
Corporate bond spreads[23]	115 bps	87 bps	486 bps	52 bps	139 bps (Nov. 2012)
Collateralised and securitised debt spreads[24]	50 bps	46 bps	257 bps	15 bps	63 bps (Nov. 2012)
17 Spreads on new UK lending					
Mortgage lending[25]	81 bps	56 bps	368 bps	42 bps	351 bps (Oct. 2012)
Corporate lending[26]	103 bps	98 bps	389 bps	93 bps	332 bps (2012 Q3)

Guiding Principles (wish list)

- <u>expectation dynamics</u>: enhance stability rather than introduce potentially unstable expectation dynamics

- <u>feasibility and credibility</u>: cannot be based on "holy Grail" (forecasting and predicting the unpredictable or detecting bubbles in real time)

- <u>clarity and time-consistency</u>: lack of clarity or doubts on feasibility would cancel some of the benefits → effectiveness depends on policy being 'predictable'

- <u>clear countercyclical gains</u>: based on measurable gains/outcomes and not purely on counter-factual predictions

Crisis Literature

- Kaminsky and Reinhart (1999), Demirgüç-Kunt and Detragiache (1998, 2000): general determinants of crises

- Borio and Lowe (2002), Borio and White (2004), Schularick and Taylor (2012), Drehmann et al (2011), Drehmann & Juselius (2013): BIS-driven emphasis on credit cycle

- Barrell et al (2010), Kato et al (2010) : attempt to incorporate leverage, poor data

- Giese et al (2013): predictors of UK crises

Theory

- Cochrane (2011) – consensus that most of the cyclical variation in asset prices reflects time-varying risk premia, with very different cyclical/frequency properties from quantity of risk variables

- Adrian and Boyarchenko (2012), Brunnermeier and Sannikov (2012), He and Krishnamurthy (2012), Danielsson, Shin & Zigrand (2012) – endogenous risk creation and transmission of risk through choice of leverage and link to risk premia/volatility

- Corporate finance/Int'l Finance – many other variables related to debt, imbalances, and mismatches that should be good proxies for quantity of risk ("embarrassment of riches")

Empirical Strategy

- Not attempting to forecast, but forecasting regressions useful to establish stylised facts on "significant conditional correlations"

- Because there are few systemic crisis events for any country, we need to explore the cross-section to increase crisis observations

- …but data collection for wide panel of countries is very costly

- Proceed in two steps: first explore informational content in pre-selected list for UK to guide efforts on which variables more likely to be useful and contain independent information, in second step check usefulness in panel forecasting regressions

# II. IDENTIFYING FACTORS IN A "DATA RICH" CASE - UK INDICATORS FOR MACROPRU

2-step Strategy

- Proceed in 2 steps: 1st we estimate PCs from the set of time series indicators in Giese *et al* (2013), to capture each of the three episodes of banking sector distress in the UK in the last 50 years (1973, 1990 and 2007). Factor structure suggests which variables to focus

- 2nd examine how well PCs explain the variation in the FPC's indicators (7 are only available from 1987 onwards; 16 from the 1990s or later; 8 are available only on an annual basis)

Giese *et al* (2013) Indicators	
1	Broad HH and PNFC credit gap
2	Narrow HH and PNFC credit gap
3	Broad HH, PNFC and OFC credit gap
4	Narrow HH, PNFC and OFC credit gap
5	Nominal broad HH and PNFC credit growth
6	Nominal narrow HH and PNFC credit growth
7	Nominal broad HH, PNFC and OFC credit growth
8	Nominal narrow HH, PNFC and OFC credit growth
9	Real broad HH and PNFC credit growth
10	Real narrow HH and PNFC credit growth
11	Real broad HH, PNFC and OFC credit growth
12	Real narrow HH, PNFC and OFC credit growth
13	HH debt-to-income gap
14	PNFC debt-to-profit gap
15	OFC credit-to-GDP gap
16	Current account deficit
17	Loan to deposit ratio gap
18	Leverage ratio
19	Real house price gap
20	Real commercial property price gap
21	Real equity price gap
22	Corporate bond spread

PCA: Synthesising the indicators

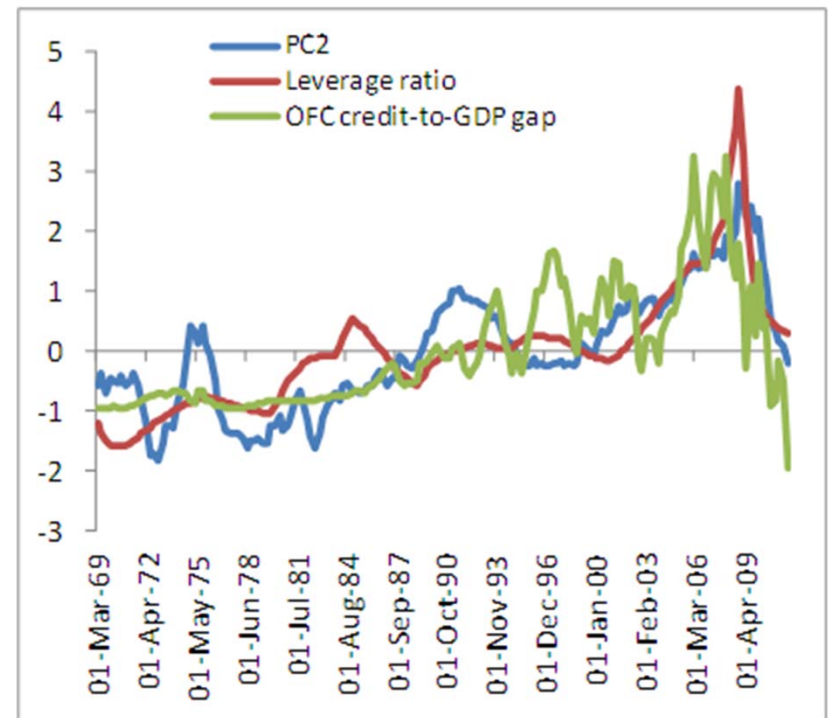| Percentage of Variance Explained by Principal Components					
	PC1	PC2	PC3	PC4	PC5	PC6
Individual	44	22	12	7	4	3
Cumulative	44	66	78	84	88	91
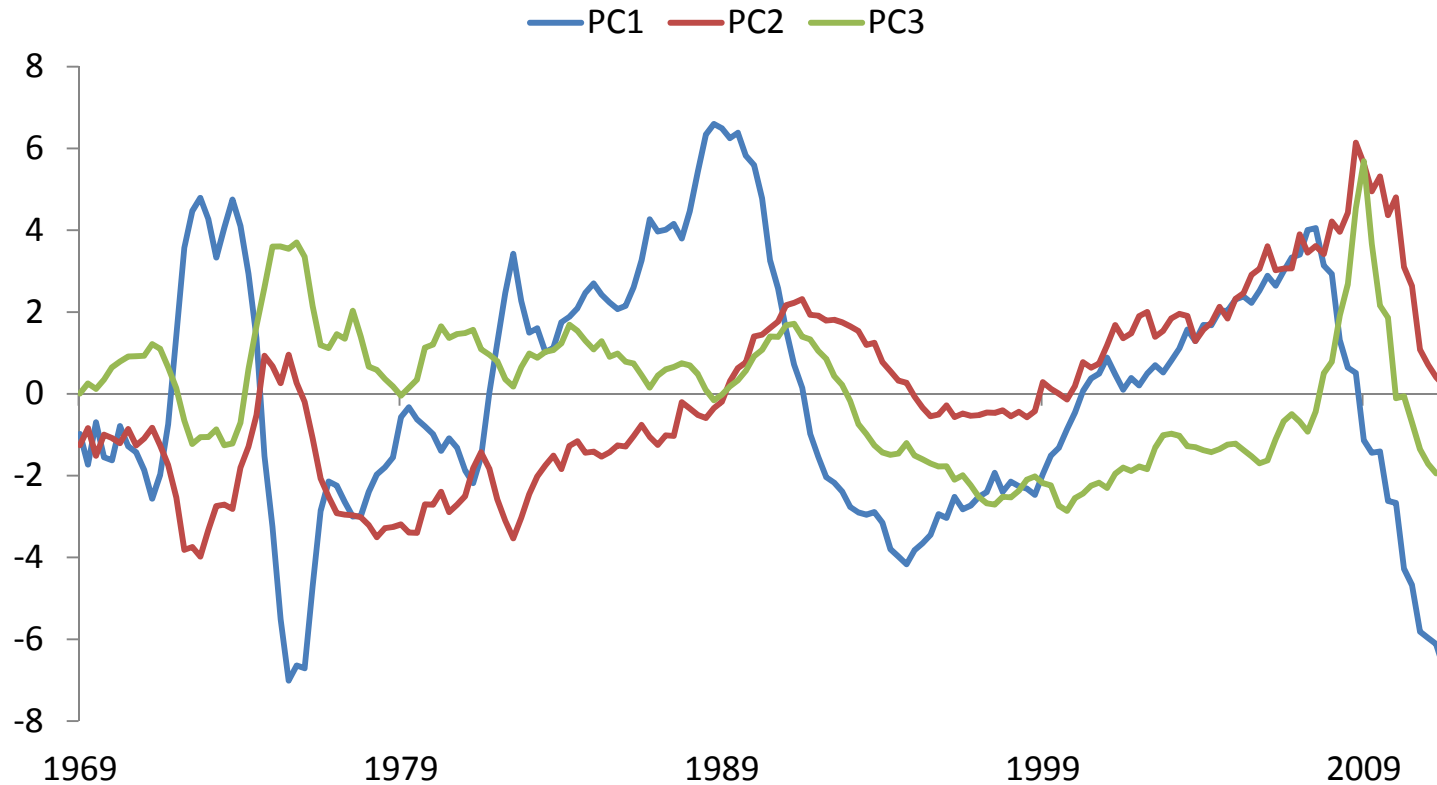
Interpreting PCs

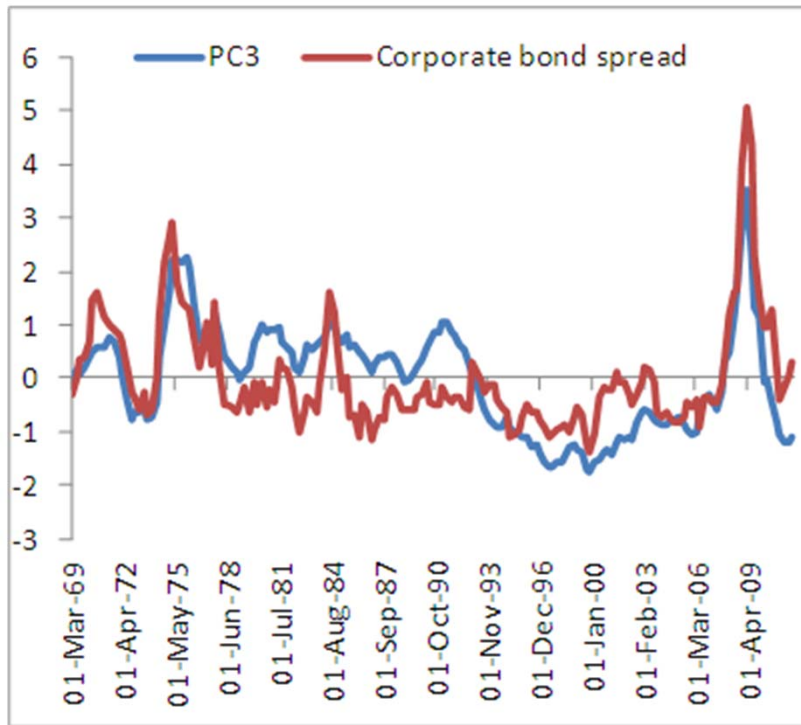•PC1 is highly correlated with credit gap measures (>0.8) and house price gap (~0.8)
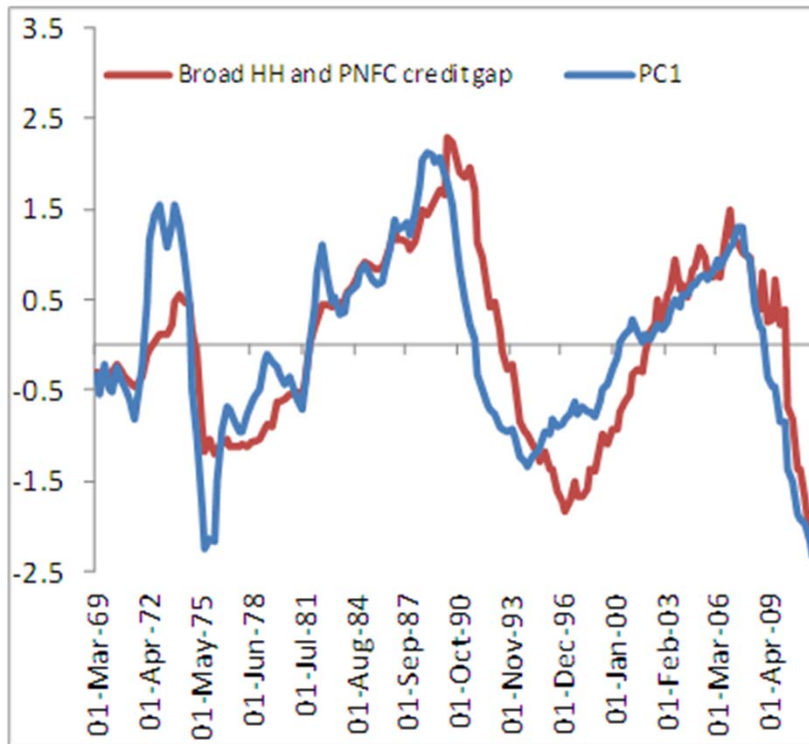
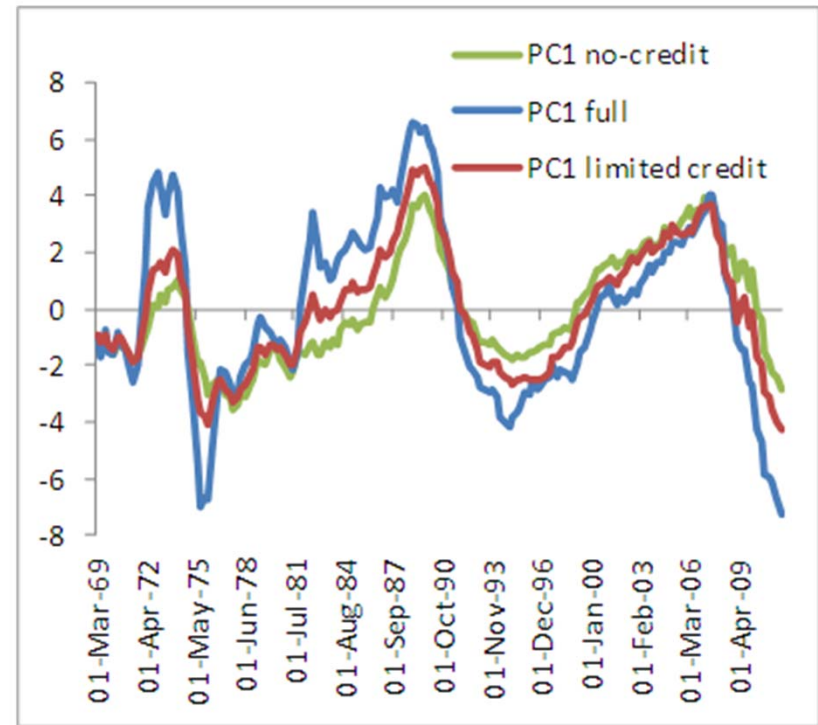•PC2 is highly correlated with leverage (0.8) and OFC credit gap (0.7)

Interpreting PCs (ctd)

•PC3 is highly correlated with credit spreads (>0.7) and spread between the narrow and broad measures of credit growth (i.e., credit provided by non-banks) (~0.7)

•PC4 and PC5 seem to capture equity cycle and liquidity

•Estimates of PCs are robust to different choice of variables

Summary PCA implications

- PCs explain similar percentage of variation in FPC indicators (average R2 of 80%)

- Indicators of quantity (credit cycle – non-bank balance sheet stretch - and leverage – bank balance sheet stretch) and "price of risk"

- Suggests adding a proxy for price of risk could be useful for conduct of macropru (different cyclical properties could help with tightening/release phases)

- Importance of Leverage also in line with recent theory

III. INTERNATIONAL PANEL DATA

Data Construction

- Credit data from BIS/IFS; GDP data from IMF/OECD; **leverage data from Worldscope/Datastream**; VIX proxy constructed from stock market indices from Datastream;

- Crisis indicators (L&V and R&R) adjusted for post crisis bias identified by Bussière and Fratzscher (2006)

- Benchmark: 27 countries (mixture of AEs and EMEs), annual data from 1980 to 2010, 541 Total observations, with 22 crises

- Additional variables (robustness) from IMF, World Bank, OECD, IFS and others (e.g. fin reform, openess/freedom)

Country	Non-Crisis	Crisis	Total
Australia	29	0	29
Austria	15	1	16
Belgium	19	1	20
Canada	30	0	30
Denmark	21	1	22
Finland	8	1	9
France	25	1	26
Germany	17	1	18
Greece	16	1	17
Hong Kong	15	0	15
India	12	0	12
Ireland	23	1	24
Italy	19	1	20
Japan	22	1	23
Korea	20	1	21
Netherlands	25	1	26
Norway	23	1	24
Poland	12	0	12
Portugal	17	1	18
Singapore	17	0	17
South Africa	29	0	29
Spain	14	1	15
Sweden	17	2	19
Switzerland	25	1	26
Turkey	12	1	13
United Kingdom	16	1	17
United States	21	2	23
Total	*519*	*22*	*541*
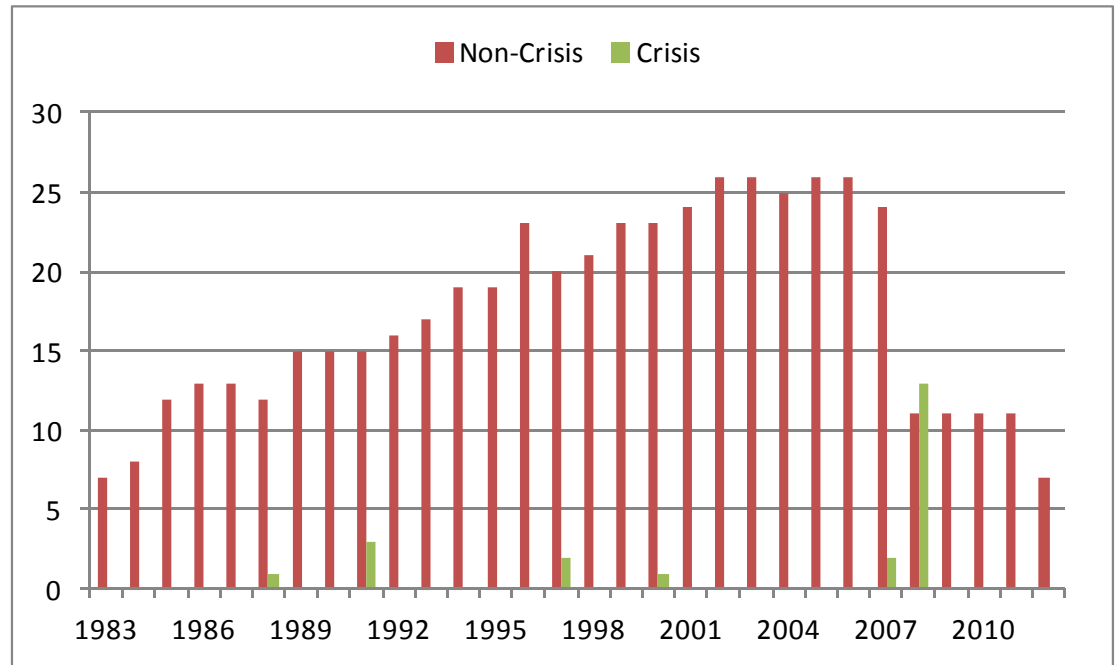
Crises Overview

1988	United States
1991	Finland, Norway, Sweden
1997	Japan, Korea
2000	Turkey
2007	United Kingdom, United States
2008	Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, Spain, Switzerland

Data

Event Window of Banking Crisis
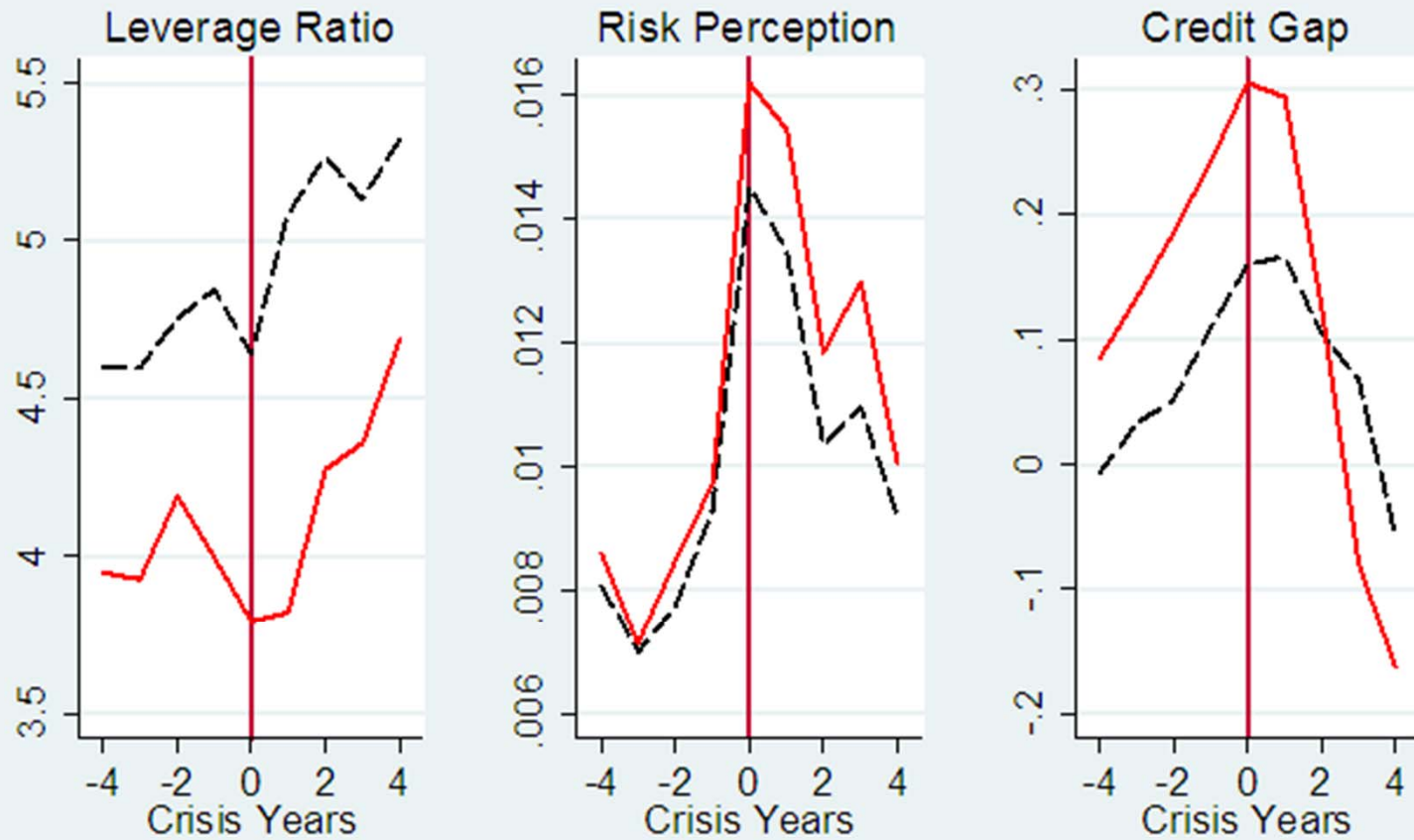
In Total 24 Crisis : 1988 (US), 1991 (FI,NW,SE), 1997 (JP,KO),2000 (TR), 2007 (UK,US),
2008 (AT,BG,CH,DE,DK,ES,FR,GR,IR,IT,NL,PT,SE)

IV. EMPIRICAL ANALYSIS

Methodology

- Macropru has long lags: implementation/compliance and (unknown) transmission

- We consider as benchmark 3 year lags in the indicators

- Use pooled Logit, with country fixed effects and time (decades) fixed effects

- Some robustness checks to lag selection, model, inclusion of country and time effects, sample of countries and additional variables

Benchmark Model Results

	Logit with t-3 regressors
Credit-to-GDP GAP	4.85***
	(1.52)
VIX	-9.30***
	(1.92)
Acc. Leverage	-2.00***
	(0.59)
Obs	397
LogLikelihoodRatio	235.12
BIC	-42.76
* p<0.10, ** p<0.05, *** p<0.01"	

ROC (type I and II error trade-off)
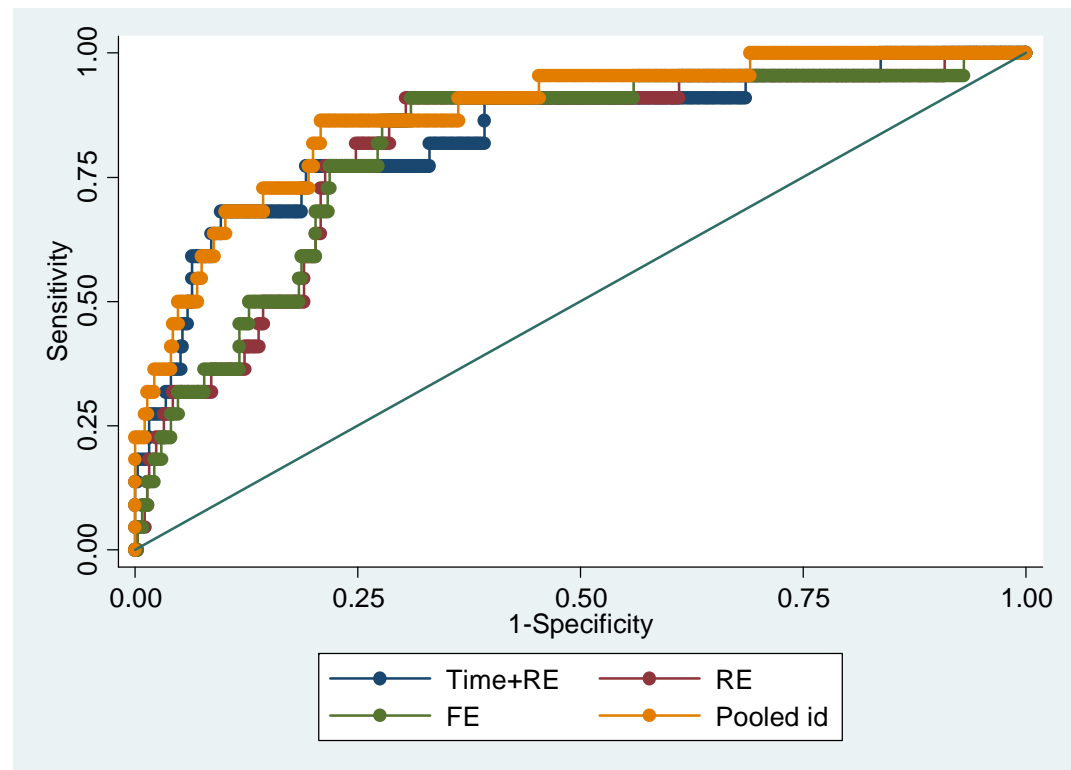
Selection of lags

	Lag of independent variables						
	0	1	2	3	4	5	6
Credit-to-GDP GAP	2.43***	2.44***	2.82***	4.85***	3.41***	2.63**	4.95***
	(0.91)	(0.83)	(0.94)	(1.52)	(1.14)	(1.12)	(1.58)
VIX	6.52***	0.17	-2.22***	-9.30***	-3.67***	0.34	2.62068**
	(1.30)	(0.79)	(0.86)	(1.92)	(0.94)	(0.85)	(1.05)
Acc. Leverage	-0.65*	0.11	-0.25	-2.00***	-0.82**	-0.27	-0.34
	(0.38)	(0.30)	(0.34')	(0.59)	(0.36)	(0.30)	(0.33)
Obs	397	394	394	397	372	340	322
LogLikelihoodRatio	243.34	296.68	286.94	235.12	278.34	279.97	258.42
BIC	-46.87	-73.64	-68.76	-42.76	-65.18	-70.04	-59.91

* $p<0.10$ ** $p<0.05$ *** $p<0.01$"

- AUROC for benchmark is 0.945 (0.84 for just credit gap)

Selection of lags - AUROC
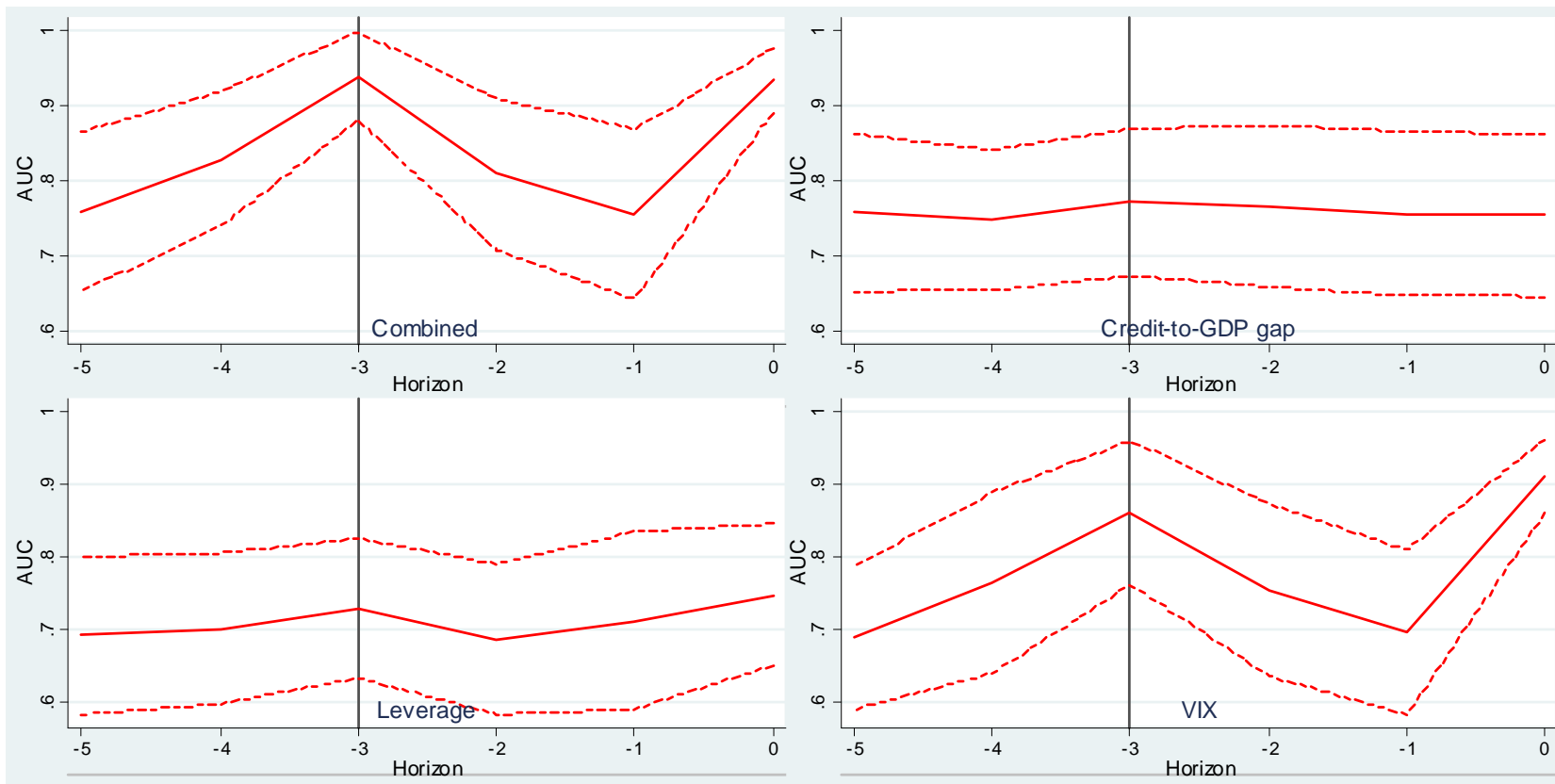
V. ROBUSTNESS AND NEXT STEPS

Preliminary Robustness Results

- Credit gap and equity vol are robust to
    - different methods (panel logit/probit and pooled logit/probit)
    - inclusion of fixed effects and time dummies
    - 15 additional variables
    - sample of countries
    - limited sample period (cannot exclude recent crisis)

- Leverage is marginally significant, not robust to all the above
    - Significant with pooled logit & country dummies
    - Significant for OECD without US (accounting regimes)
    - or when liquidity ratio is included

- Further robustness checks would require longer sample period and correct for accounting differences

Preliminary – adding liquidity

			Lag of independent variables				
	0	1	2	3	4	5	6
Credit-to-	1.10553**	1.13971**	1.55344***	2.23224***	1.34959**	1.15108**	1.24028**
	(0.55879)	(0.53497)	(0.59795)	(0.72051)	(0.63916)	(0.55280)	(0.53981)
VIX	4.40328***	0.40882	-1.09346	-3.24791***	-0.86642	1.40496**	2.44342***
	(0.84035)	(0.68047)	(0.71389)	(0.86239)	(0.68783)	(0.67424)	(0.71494)
Acc. Lever	-2.77362***	-0.94491	-0.96550	-1.79564**	-1.18415	-0.66821	-0.54479
	(1.01115)	(0.83694)	(0.82139)	(0.83244)	(0.76227)	(0.75538)	(0.76503)
Liquidity	-23.21218***	-14.50269***	-12.26380***	-13.18320***	-12.35641***	-11.28555***	-11.88818***
	(7.54190)	(4.97655)	(4.56354)	(4.64233)	(4.39838)	(4.20786)	(4.29234)
Obs	450.00	456.00	460.00	464.00	452.00	439.00	423.00
LogLikelih	127.41	175.92	174.64	159.48	176.49	172.14	160.50
BIC	-48.43	-72.65	-71.99	-64.39	-72.96	-70.86	-65.13

* $p<0.10$ ** $p<0.05$ *** $p<0.01$"

Next steps

- Price of risk and quantity of risk indicator distinction can be very useful to implement countercyclical buffers

- Analogy to MP in the 60s-70s: forecast in non-intervention period useful to establish stylized facts, dangerous as basis of active intervention policy communication/implementation

- Many systemic risk indicators, based on asset prices, are proxies for price of risk rather than quantity of risk

- Does the analogy to MP stretch further: can we devise a simple rule (as the Taylor rule) for CCB?

Conclusion

- Still work in progress, but we have found evidence that more indicators then just credit gap are useful for explaining crises, even at long horizons (Drehmann & Juselius (2013) find DSR works for short horizon)

- Additional indicators (balance sheet - leverage, liquidity - and price of risk) are consistent with intuition from theory
    - price of risk (and liquidity) seem very robust

- The price of risk has different cyclical properties to quantity of risk, which includes strong counter-cyclical variation in risk premia, can help with different phases of counter-cyclical macropru policy implementation