Credit risk in commercial real estate: the role of idiosyncratic versus macro-economic factors

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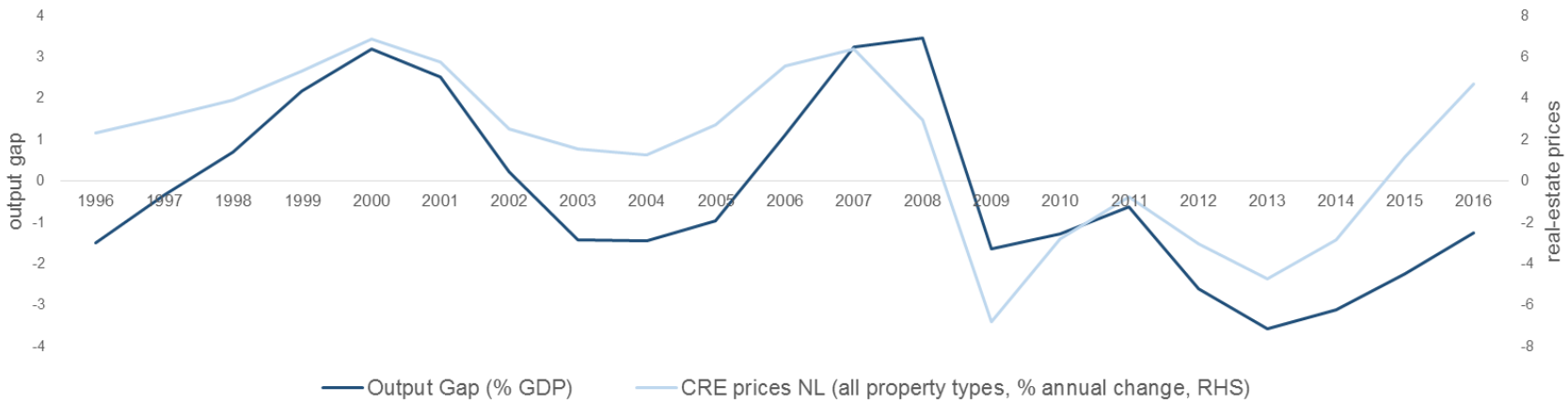
Section 1

Introduction and research question

Motivation

- The Commercial Real Estate (CRE) market has shown strong evidence of pro-cyclicality (Davis and Zhu, 2011).
- Example for the Netherlands:



- Macro factors affect the health of individual firms, but the health of firms also affects the macroeconomic environment.
  - There is interaction and feedback between corporate defaults and financial stability (Jacobson, 2005).
  - Thus, we should understand the link between macro factors and CRE defaults.

Main research questions

- What are the main drivers of default for bank loans to the commercial real estate (CRE) sector?
- What is the relevance of macroeconomic factors versus individual loan characteristics?

Section 2

Default channels

Drivers of corporate default

- Theory:
  - Firms take on debt to conduct investments with uncertain future returns.
  - Debt default occurs when the net value of the firm turns negative (net worth covenant) or when the cash flow cannot cover debt service (flow based covenant); see Merton (1974) and Leland and Toft (1996). $\rightarrow$ **LTV and cash flow matter.**
  - However, default can also happen for positive net worth or even when cash flow is sufficient: **strategic default**. This may depend on associated costs: forgoing tax benefits, legal costs, accounting fees, opportunity/reputation costs (Haugen 1979).

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- Empirical work:
  - **Balance sheet and market information** are useful in probabilistic models of firm default (Ohlson 1980, Altman 1977, Shumway 2001).
  - Consensus: liquid balance sheet, strong equity base and less volatile earnings are associated with lower defaults.
  - Bank loan risk and the role of collateral are, however, **less well documented** (Altman 2000).

Are commercial real estate firms different?

- **Industry effects** are important to improve default models (Chava 2004; Maksimovic and Phillips 1997, Opler and Titman 1994, Acharya 2003, Bruneau et al. 2012,) $\rightarrow$ CRE is likely different.

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- Real estate loans are sensitive to **property value drops** and cash flow shocks (An and Sanders, 2010; Chen and Deng, 2012).

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- **Feedback effects** occur between bank lending and CRE up- and downswings (Davis and Zhu, 2011)
- **CRE different from RRE**: home-owners need to live in their house $\rightarrow$ less reason to default. Still, also RRE default risk increases with LTV (LaCour-Little, 2004, Archer and Smith, 2013).

Section 3

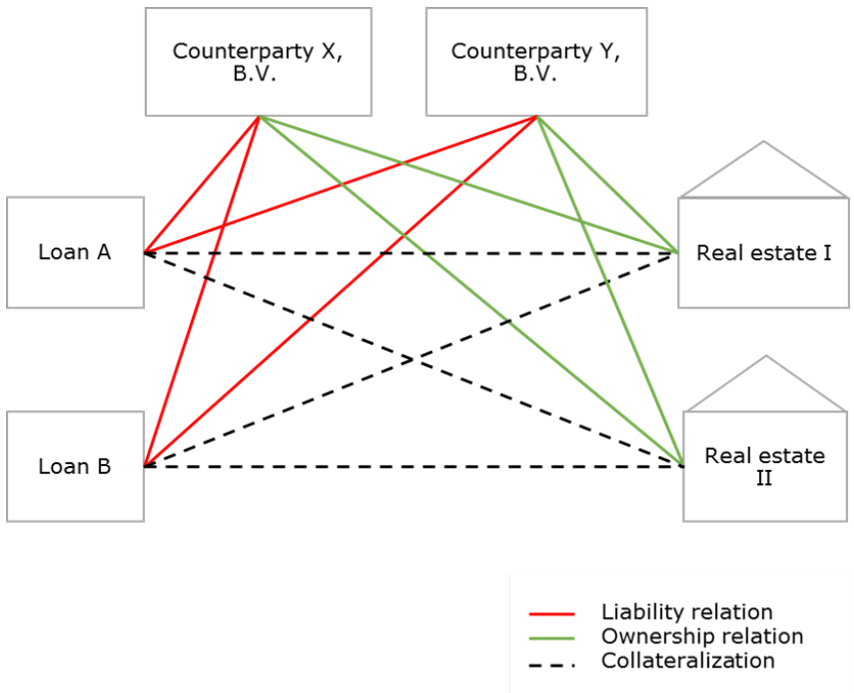
Data and stylized facts

Data

- As of end-2015, De Nederlandsche Bank (DNB) collects semi-annual data on the CRE exposures of the largest Dutch banks:
  - CRE is defined as income producing real estate (cf. ESRB Recommendation).
  - Data are collected at loan level.
  - We collect over 70 variables for counterparty, loan and collateral characteristics.
  - As of 2017H1: 33,014 counterparties, 65,572 loans, 225,288 collateral items, total outstanding around €77 bln.
- At the moment only a cross-section of the loan book can be used for the analysis: no time series (yet). Here, we use 2017H1 data.
- We add macroeconomic variables: (regional) GDP, the ECB Bank Lending Survey index and a CRE price index.

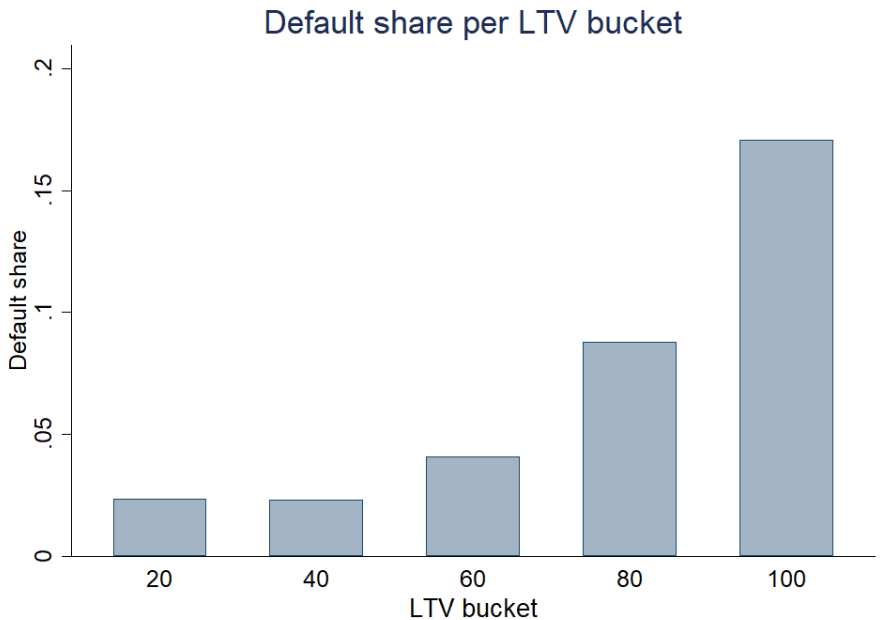
Portfolio structure

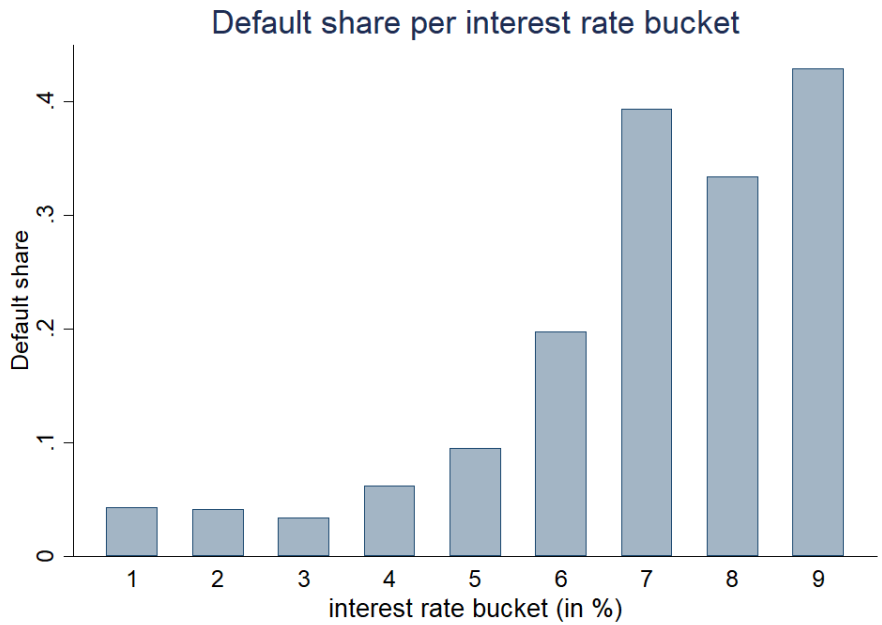
- Joint-liability and cross-collateralization (see figure) complicate default modelling: correlation between counterparties.
- Solution: model default at the joint-liability level!
- This means that the joint-liability level is one counterparty, eliminating correlation of default.



Stylized facts: Idiosyncratic factors

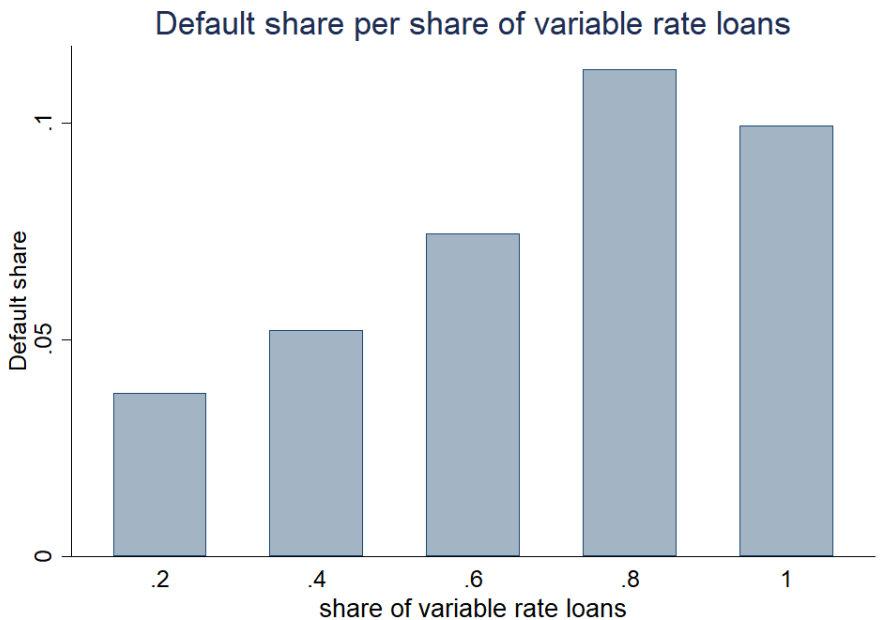
- Higher current interest rate and current LTV buckets are associated with higher default rate.

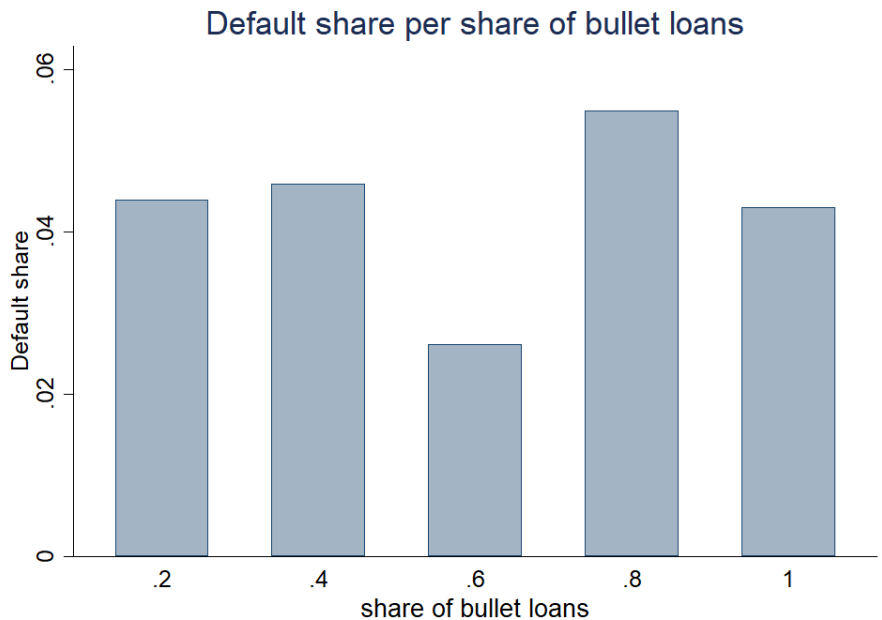




Stylized facts: Idiosyncratic factors - 2

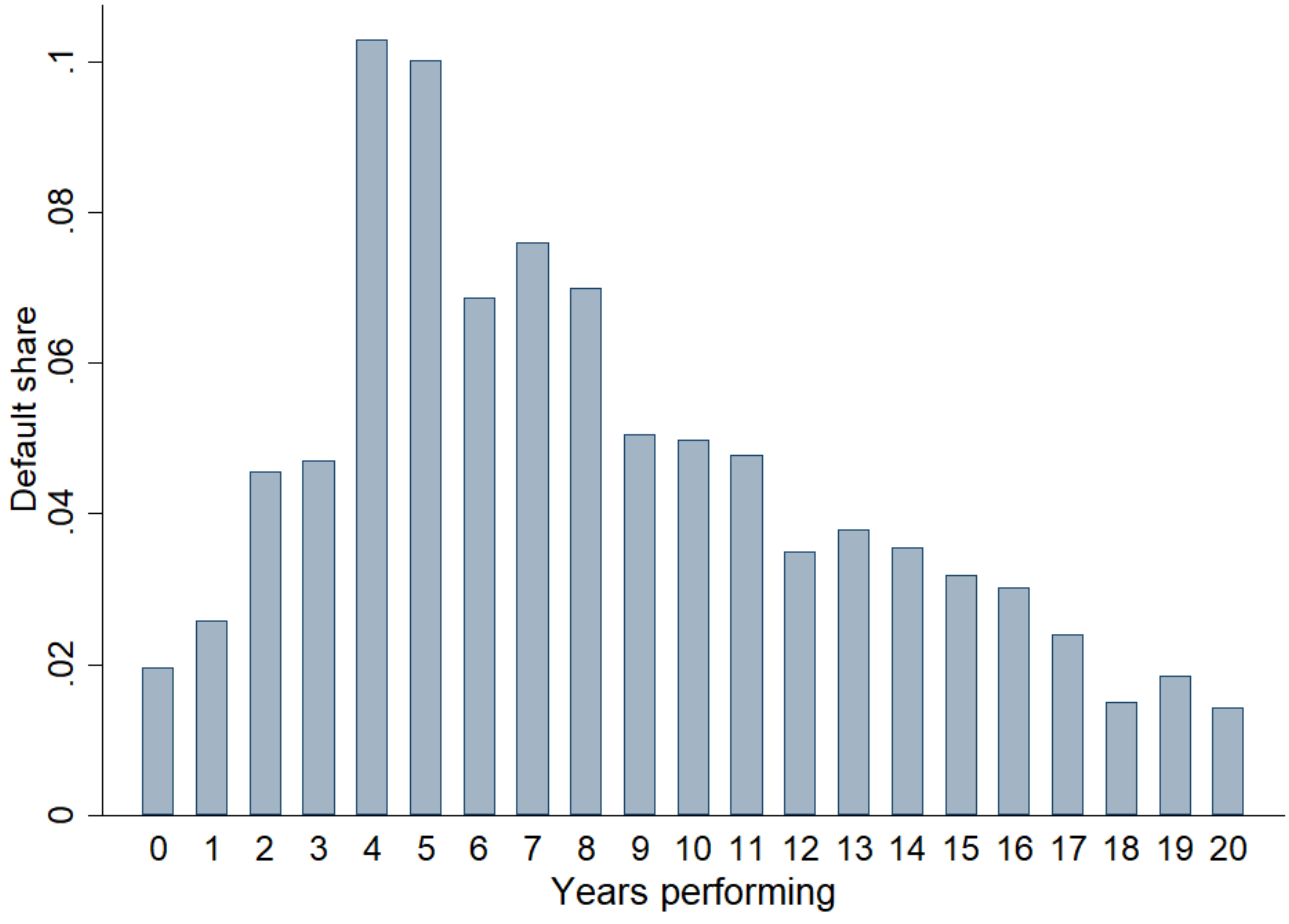
- Higher share of variable rate loans associated with higher default rate.
- Relationship between default rate and bullet loans not so clear.





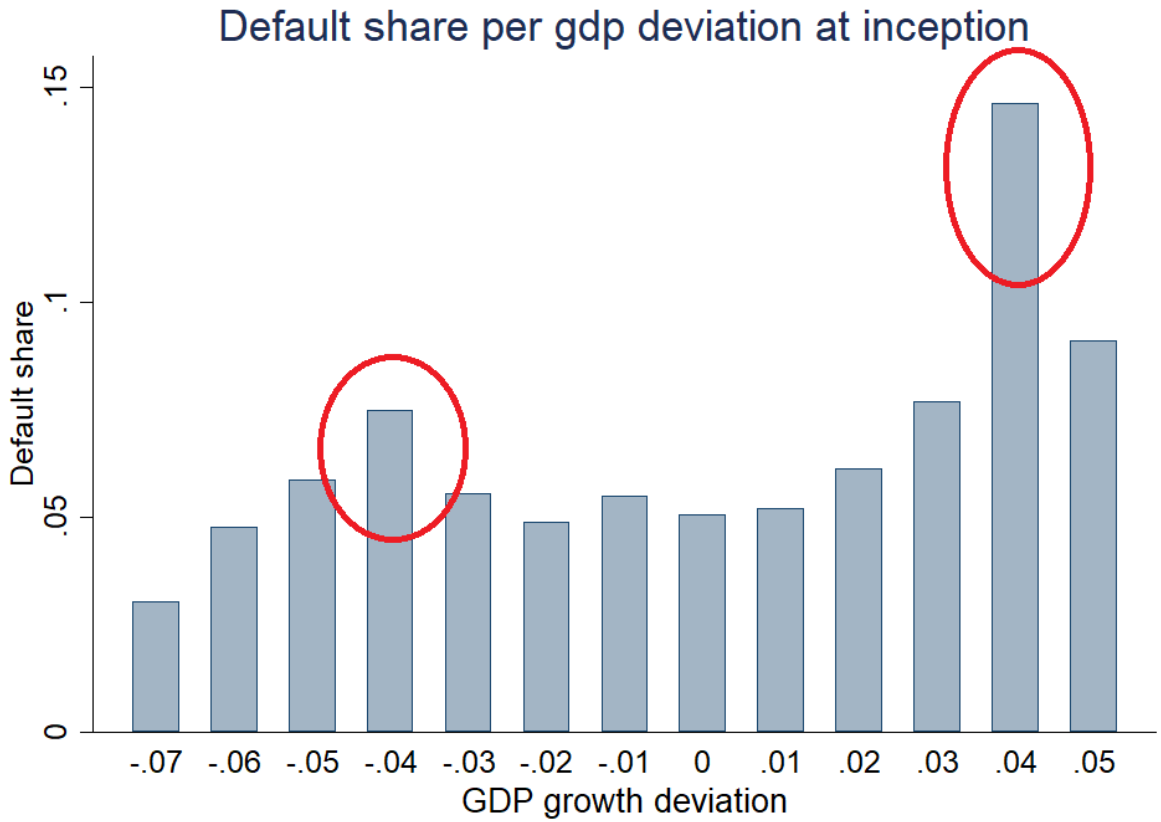
Stylized facts: time and credit risk

- Link between time in performing status and default: hump-shaped



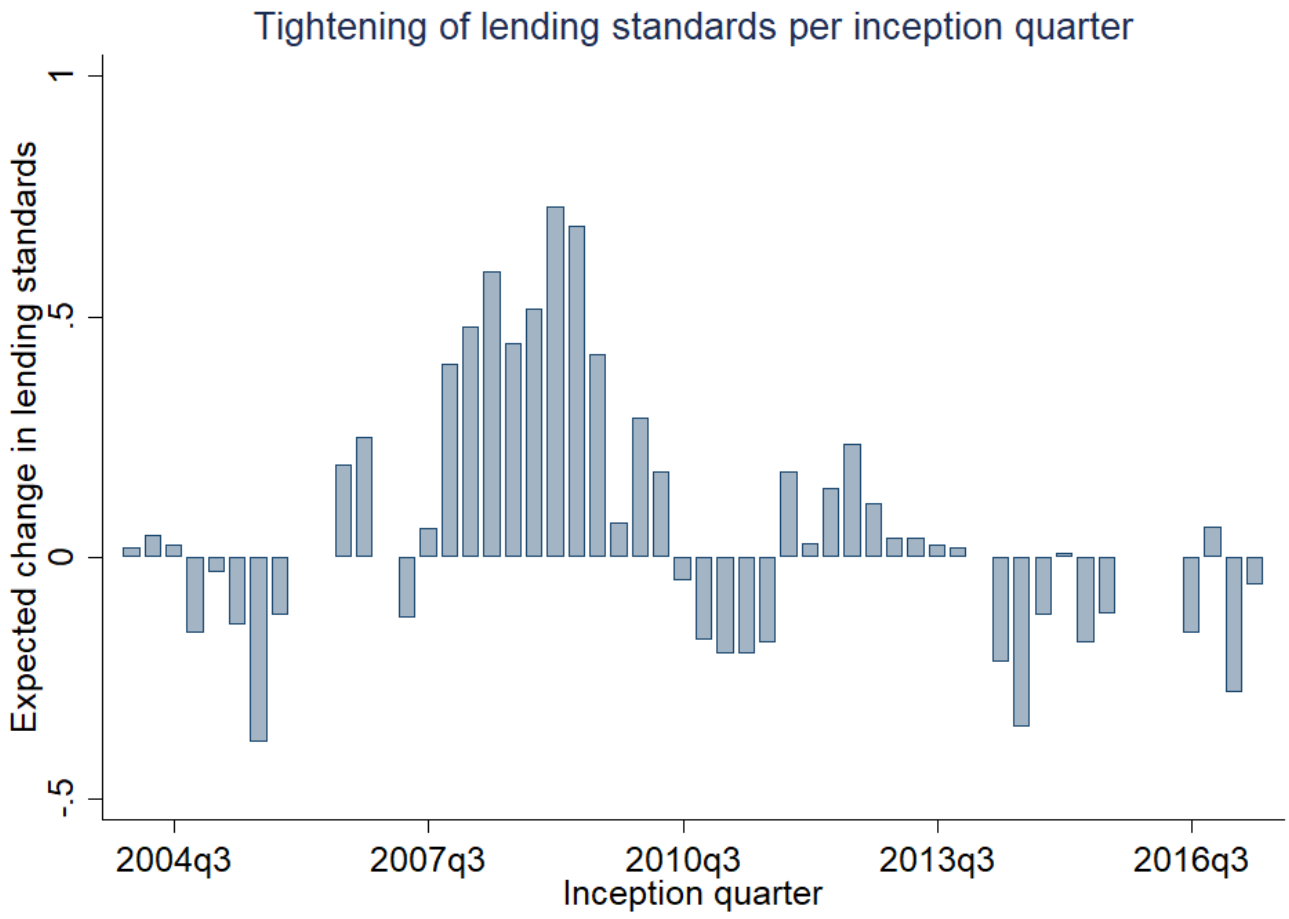
Macro factors: GDP at loan origination

- The link between defaults and business cycle (deviation from GDP trend at time of origination) is not so straight-forward: we need a different way to distinguish the two local peaks.



Macro factors: GDP and lending standards

- Solution: use Bank Lending Survey!
- Both high and low growth years see an elevated number of defaults, but they **have different levels of lending standards**:



Section 4

Empirical results

Empirical model

- We want to estimate macro and idiosyncratic effects in one default model: use a logit.

Y_i takes the value 1 if the counterparty is in default:

$$\begin{cases} Y_i = 1 & \text{if } Y_i^\star > 0 \\ Y_i = 0 & \text{if } Y_i^\star <= 0 \end{cases} \tag{1}$$

The latent variable $Y_i^\star$ is a linear function of loan and macroeconomic characteristics:

$$Y_i^\star = X_i'\beta + \Gamma_i'\delta + \gamma time_i + \varepsilon_i \,, \text{ for } i = 1, 2, ..., N \text{ joint} - \text{liability pools} \tag{2}$$

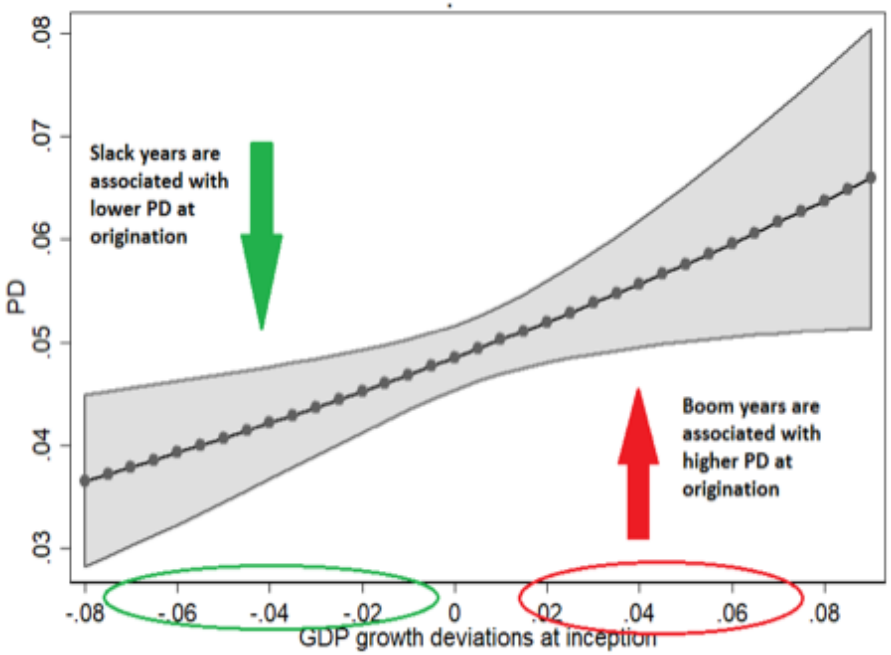
where $\varepsilon_i \sim Logistic(0, 1)$ and X_i includes loan specific variables (LTV, interest rate, collateral characteristics), Γ_i includes GDP, lending standards and CRE prices at origination and at default, and $time_i$ is the time a debtor has spent in performing status before default.

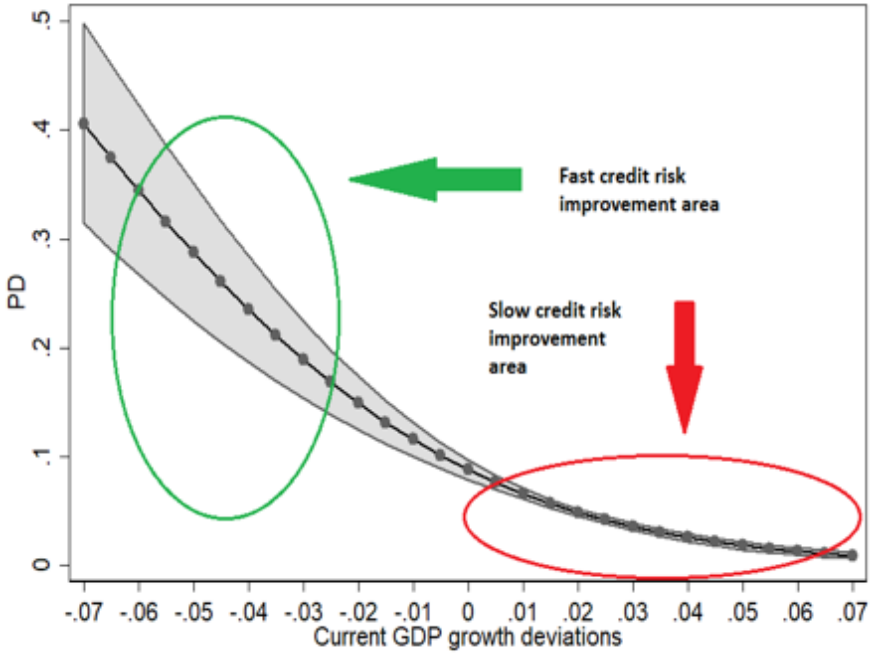
	(1)	(2)	(3)	(4)	(5)	(6)
Time in performing	-0.0141	0.1272***	0.3049***	0.3077***	0.2933***	0.5056***
	(0.01)	(0.03)	(0.05)	(0.05)	(0.05)	(0.11)
Time in performing, squared	0.0002	-0.0078***	-0.0245***	-0.0248***	-0.0242***	-0.0403***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Current Loan to Value	4.0928***	3.8174***	4.0895***	4.0968***	4.0447***	5.6721***
	(0.26)	(0.28)	(0.32)	(0.32)	(0.32)	(0.85)
Current Loan to Value, squared	-0.9326***	-0.8697***	-0.9708***	-0.9721***	-0.9589***	-1.3107***
	(0.10)	(0.11)	(0.12)	(0.12)	(0.12)	(0.33)
Current interest rate	38.7367***	45.7365***	43.2241***	43.2142***	72.5555***	68.6585***
	(3.39)	(3.55)	(3.92)	(3.94)	(6.93)	(14.52)
Share of bullet loans	-0.3661**	-0.4147**	-0.4127*	-0.4060*	3.0150***	3.1341**
	(0.13)	(0.15)	(0.16)	(0.16)	(0.86)	(1.22)
Share of variable rate loans	1.8192***	1.7682***	1.6789***	1.6733***	3.2490***	2.9254***
	(0.09)	(0.09)	(0.10)	(0.10)	(0.34)	(0.66)
Share of residential real estate	-0.4709***	-0.5628***	-0.5112***	-0.5126***	-0.4814***	-0.4229
	(0.10)	(0.10)	(0.11)	(0.11)	(0.11)	(0.23)
GDP growth deviation, inception		1.1343	4.2731**	4.8563**	4.7132**	0.4298
		(1.36)	(1.50)	(1.60)	(1.62)	(3.28)
GDP growth deviation, default		-68.6985***	-66.4226***	-66.3270***	-66.8347***	-76.8281***
		(2.35)	(2.63)	(2.64)	(2.68)	(5.02)
Lending standards, inception			0.1514	0.2411	0.2223	-0.1881
			(0.15)	(0.18)	(0.17)	(0.34)
CRE price growth deviation, inception				-1.6535	-2.0858	0.4770
				(1.57)	(1.59)	(3.23)
Occupancy rate						-0.0112***
						(0.00)
Observations	23198	22778	18126	18126	18126	5857
Bank dummies	Yes	Yes	Yes	Yes	Yes	Yes
Province effects	Yes	No	No	No	No	No
Interactions	No	No	No	No	Yes	Yes

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Marginal effects - GDP at inception and at default

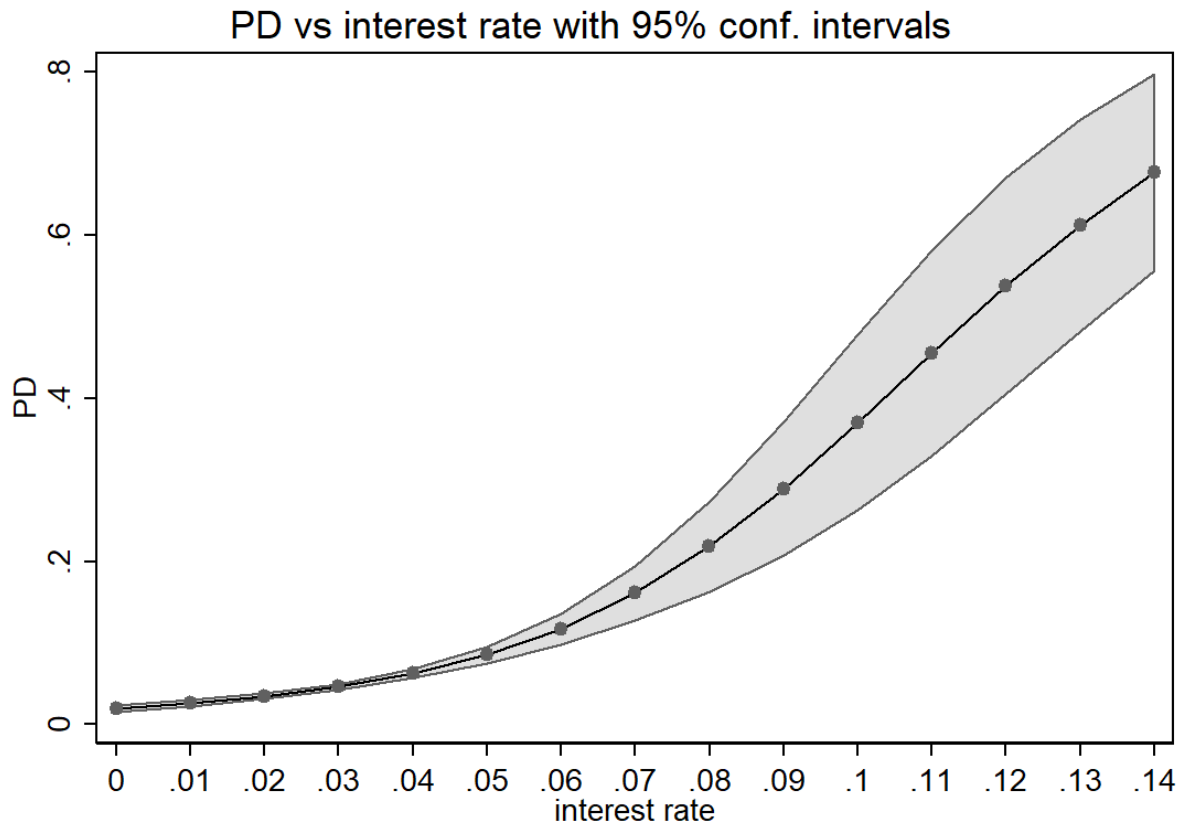
- We show marginal effects, to compare to the stylized facts, but controlling for other variables.
- Macroeconomic factors are indeed relevant!
- "Boom" loans, with high GDP deviation from trend, see higher PD.





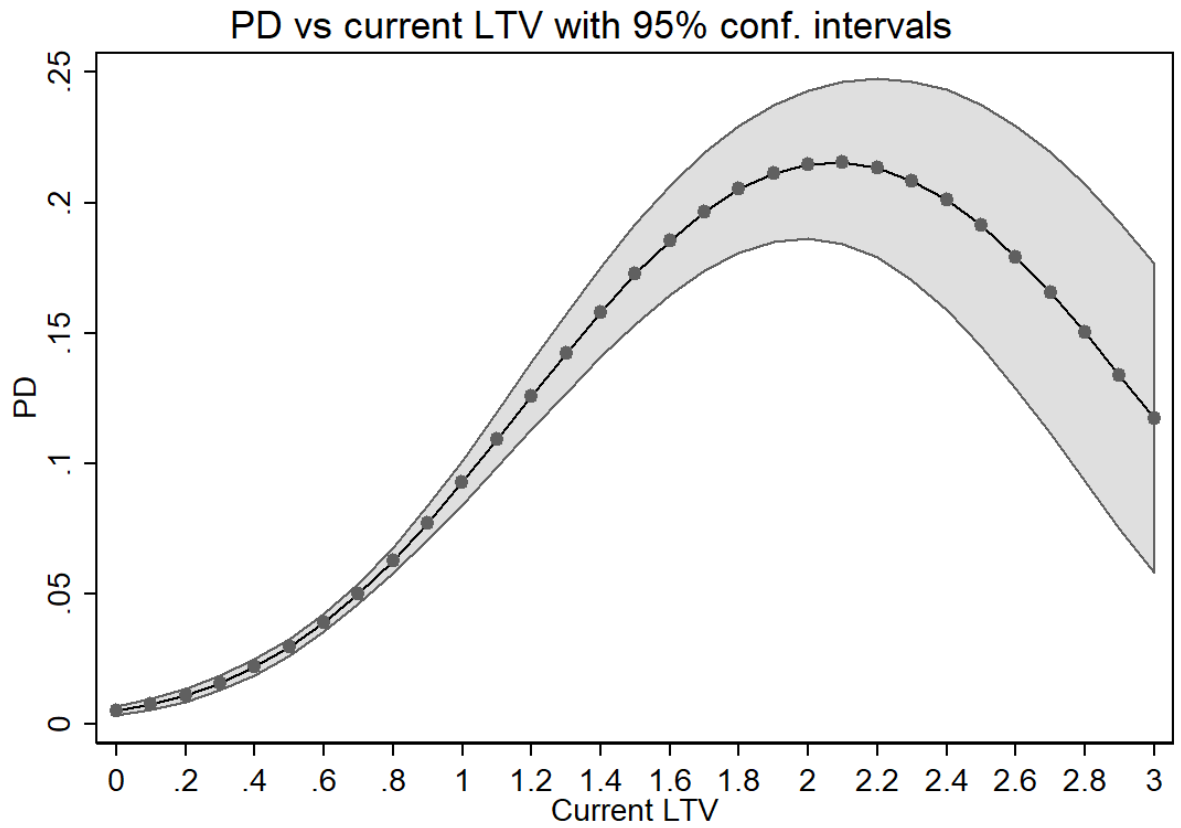
Marginal effects - current interest rate

- Higher interest rates are associated with higher PD
- Reverse causality: higher PD $\rightarrow$ higher risk premium?



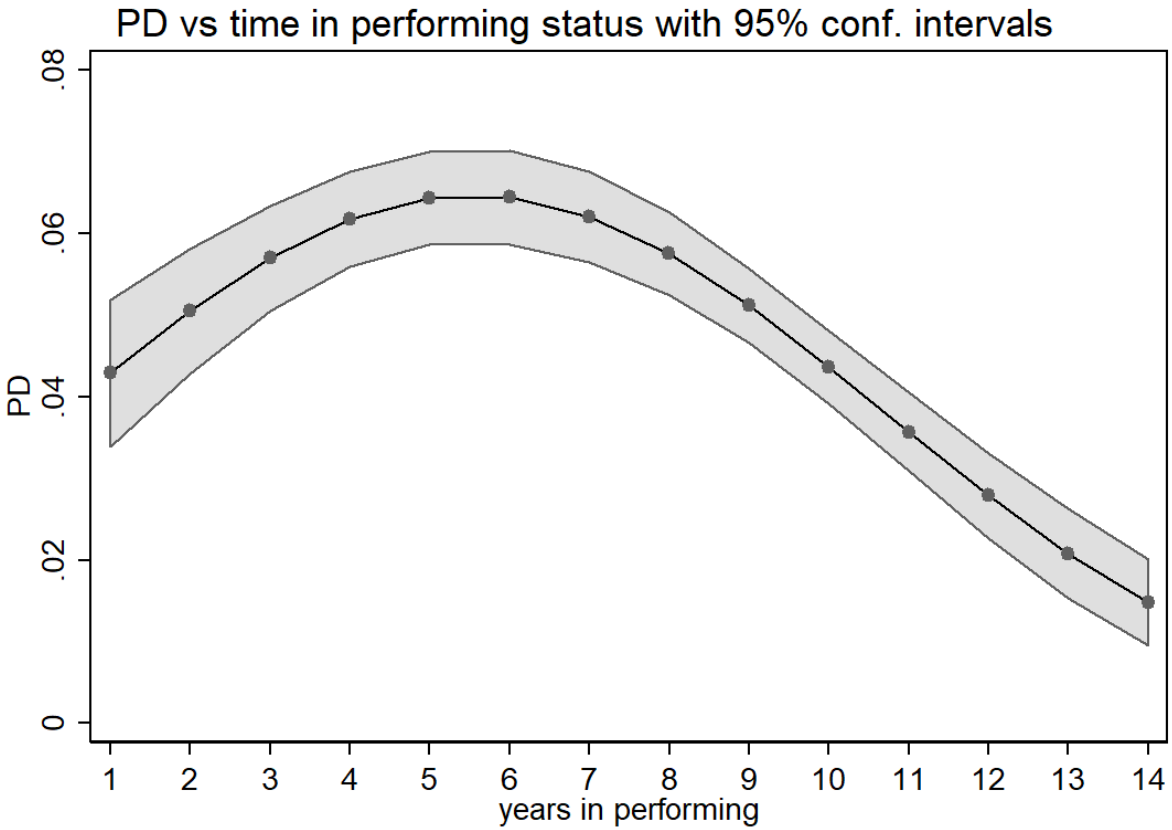
Marginal effects - LTV

- Higher LTV associated with higher PD, but hump-shaped!
- Caveat: current LTV instead of LTV at inception.



Marginal effects - time

- Hump-shaped relationship: after 6 years, loans are less likely to default.
- Caveat: survivorship bias. Robustness checks show: no problem.



Section 5

Concluding remarks

Contribution to the literature

- Results show that the business cycle matters for default risk of CRE loans; interest rate structure, LTV and collateral characteristics are also significant.
- We conduct one of the few studies of default on CRE bank loans, by employing a unique micro dataset of Dutch banks.
- We differentiate between idiosyncratic and macro-economic factors affecting credit risk in the commercial real estate market; relatively thin literature as of yet.
- The findings show the importance of lender behaviour as a control for distinguishing between good and bad credit growth (Dell'Ariccia et al., 2012; Kirti, 2017). To the best of our knowledge this has not been investigated for CRE loans at the microeconomic level.
- Caveats: no time series/panel data (yet), little information about counterparties.

Policy implications

- Portfolio and collateral characteristics of CRE loans should be monitored closely.
  - Idiosyncratic factors such as shorter maturity debt with variable interest rates can pose a strain on borrowers' balance sheets.
  - The type of collateral plays a role, as loans secured by non-residential real estate are riskier.
- Policymakers should monitor lending standards closely, especially during good times, as an indicator of subsequent defaults.
- A dynamic provisioning regime could discourage risky lending during boom times and stimulate lending during downturns.

Section 6

Background slides

Marginal effects - other

- Bank Lending Survey lending standards *as such* do not matter; they mainly control for macro environment and allow for identification.
- Occupancy rate is significant, but only available for small sample.
- Non-residential real estate (i.e. offices, industrial, retail), variable rate and bullet loans are more risky.
- No significant effect of CRE prices: probably runs through LTV.
- Interaction effects matter as well: bullet loans with high variable interest rates are very risky.

Prediction accuracy

- AUROC of 0.88 shows that model has a good in-sample fit.
- At a 4% PD cut-off, the model correctly predicts 80% of defaults.