

Firm Default and Aggregate Fluctuations

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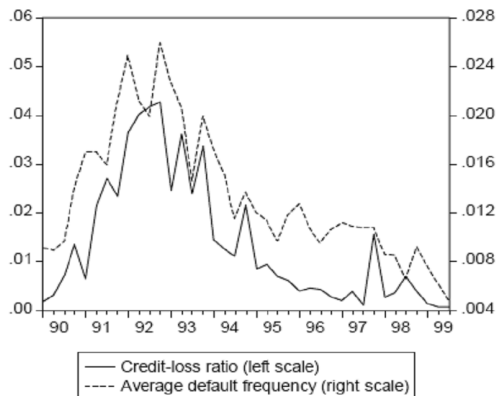
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Motivation

- Default frequency highly correlated with banks credit losses



Motivation

- Default frequency carry forecasting content for aggregate quantities and prices (Jacobson, Lindé and Roszbach, 2005)
- Augment VAR with different indicators of financial stance
 - Default frequency, housing prices, bank lending, stock prices, financial ratios
- Find that only default frequency and housing prices carry information for aggregate quantities and prices
 - Results driven by the deep recession in the beginning of the 1990s

Existing evidence

- Some evidence that macro can predict development of firms:
 - Bomfin (2009): GDP growth, loan growth stock index
 - Das Duffie Kapadia Saita (2006): S&P500, 3M T-bill return
 - Pesaran, Schuermann et al. (2004, 2007): Global VAR
- Limitations:
 - Long small panels w/o firm-specific information, or short broad panel with good firm-specific information
 - Typically only publicly quoted firms (U.S. data)
 - Assume common firm-specific factors capture comovement
 - Little known about out-of-sample properties

What we do

- Questions:
 - Can we explain firm default (individual / industry level / economy-wide) with parsimonious model? Key variables?
 - Do macro variables affect default behavior over and above firm-specific and industry information?
- Compare model with macro with "standard" model w/o macro
 - Estimate default-risk models for industries, at one-digit level
- Test in-sample and out-of-sample:
 - Time-series: 1-step ahead prediction performance
 - Cross section: pseudo R^2 , decile test, predicted PD distribution

What we find

- Firm-level default-risk (logit) model can replicate high/low default risk in early/late 1990s:
 - Firm-specific variables do good job risk-ranking firms
 - Macro variables essential for determining absolute default risk
 - Default risk model on average T-S data not informative
 - Even Swedish banking crisis can be "explained" with model
- Effects of aggregate fluctuations surprisingly similar across industries
- Industry and eco-wide models performance equal out-of-sample:
 - Both in T-S and C-S dimension \Rightarrow macro seems to have "structural" effect

Data

- All incorporated Swedish firms:
 - In-sample: 1990Q1 - 1999Q4: 8.1m observations on $\approx 200k$ firms
 - Out-of-sample: 2000Q1-2002Q4: 2.6m observations
- Financial statement data (annual, National Patent Office)
- Payment remarks data (daily, Upplysningscentralen):
 - Reported by banks, Tax authorities (*Skatteverket*), District Courts (*Tingsrätten*), the Swedish Companies Registration Office (*Bolagsverket*), the Swedish Enforcement Authority (*Kronofogdemyndigheten*), and firms: 61 credit/tax events

Data

- **Default definition:**
 - Suspension of payments, negotiated a debt resettlement, undergoing reconstruction, no assets present at seizure or bankruptcy
- **Terminality of defaults**
 - 117,481 first-time-terminal defaults
 - 111,702 legal bankruptcy declarations, remainder distraint, no assets
 - 45% have 2nd default-triggering distress event same quarter
 - 3,662 firms default twice in sample period.
 - 3,555 defaults terminal at 2nd occurrence; 107 re-emerge again.
 - No firm defaults more than two times in sample period

Econometric Model

- Multiperiod logit model:

$$y_{i,t}^* = x_{i,t}\beta + z_t\gamma + \varepsilon_{i,t}, \text{ and}$$
$$y_{i,t} = \begin{cases} 1 & \text{if } y_{i,t}^* \geq 0 \text{ (firm defaults)} \\ 0 & \text{if } y_{i,t}^* < 0 \text{ (firm stays in business)} \end{cases}$$

- A1: $\{x_{i,t}, z_t\}$ and $\varepsilon_{i,t}$ are stochastically independent
 - A2: $f(\varepsilon_{i,t}, \varepsilon_{j,t}) = f(\varepsilon_{i,t})f(\varepsilon_{j,t})$ for $i \neq j$
 - A3: $f(\varepsilon_{i,t}, \varepsilon_{i,t+l}) = f(\varepsilon_{i,t})f(\varepsilon_{i,t+l})$ for $l \neq 0$.
 - A1 more credible if specification of systematic part richer
-
- Estimate model over 1990Q1-1999Q4:

Firm-specific regressors only

- Pseudo R^2 :
- Pseudo $R^2|_{\text{ecow.coef}}$: Relative C-S quality of industry model
 - In-sample, industry models outperform eco-wide model
- Aggregate R^2 : T-S fit
 - Lifting out idiosyncratic variation increases fit
- Aggregate $R^2|_{\text{ecow.coef}}$:

Firm-specific regressors only

Table 2: Regression results 1990Q1-1999Q4 for the default risk model estimated with only firm-specific variables

	Agriculture	Manu- facturing	Construction	Retail	Hotel & Restaurant	Transport	Bank, Finance & Insurance	Real Estate	Consulting & Rental	Not Classified	Economy Wide
Firm-specific variables ^a											
EBITDA/TA	-1.308 (0.115)	-1.419 (0.045)	-1.472 (0.053)	-0.957 (0.024)	-0.856 (0.040)	-1.148 (0.058)	-0.361 (0.088)	-0.738 (0.059)	-0.857 (0.030)	-1.069 (0.028)	-0.949 (0.012)
TL/TA	0.989 (0.082)	1.104 (0.034)	0.599 (0.041)	0.636 (0.016)	0.205 (0.028)	0.753 (0.045)	0.185 (0.054)	0.726 (0.030)	0.342 (0.023)	0.160 (0.021)	0.491 (0.008)
LA/TL	-0.317 (0.093)	-0.488 (0.040)	-0.493 (0.042)	-0.373 (0.020)	-0.092 (0.041)	-0.192 (0.036)	-0.180 (0.052)	-0.317 (0.035)	-0.247 (0.017)	0.011 (0.000)	-0.251 (0.008)
I/TS	0.069 (0.049)	0.325 (0.036)	-0.177 (0.044)	0.274 (0.016)	1.315 (0.310)	0.040 (0.240)	0.014 (0.055)	0.053 (0.009)	0.340 (0.041)	0.083 (0.021)	0.124 (0.006)
TL/TS	0.177 (0.025)	0.128 (0.006)	0.306 (0.008)	0.157 (0.004)	0.237 (0.013)	0.091 (0.010)	0.038 (0.015)	0.068 (0.006)	0.202 (0.006)	0.358 (0.006)	0.164 (0.002)
IP(IP+EBITDA)	0.094 (0.037)	0.103 (0.013)	0.055 (0.014)	0.061 (0.007)	0.003 (0.019)	0.194 (0.025)	0.070 (0.052)	0.180 (0.017)	0.045 (0.012)	0.145 (0.014)	0.088 (0.004)
PAYREMARK	1.284 (0.123)	1.449 (0.045)	1.691 (0.045)	1.523 (0.028)	1.531 (0.058)	1.682 (0.061)	2.239 (0.157)	1.604 (0.053)	1.775 (0.038)	2.512 (0.044)	1.712 (0.015)
TAXARREARS	2.796 (0.078)	2.216 (0.028)	2.461 (0.029)	2.449 (0.017)	2.380 (0.040)	2.837 (0.041)	3.108 (0.110)	2.419 (0.033)	2.848 (0.024)	2.693 (0.027)	2.566 (0.009)
PAYDIV	-2.310 (0.401)	-1.912 (0.114)	-1.900 (0.078)	-2.119 (0.078)	-1.667 (0.219)	-1.755 (0.178)	-1.180 (0.298)	-1.710 (0.139)	-1.754 (0.085)	-2.204 (0.132)	-2.004 (0.039)
TTLFS	4.161 (0.072)	3.695 (0.027)	4.046 (0.029)	3.643 (0.016)	3.371 (0.039)	3.918 (0.038)	3.720 (0.097)	3.615 (0.030)	3.796 (0.022)	3.333 (0.022)	3.670 (0.009)
Mean log-likelihood	-0.024	-0.044	-0.044	-0.051	-0.071	-0.036	-0.025	-0.061	-0.032	-0.058	-0.046
Pseudo R ²	0.39	0.29	0.36	0.32	0.31	0.38	0.40	0.33	0.38	0.41	0.34
Pseudo R ² agg.par. ^b	0.35	0.28	0.36	0.31	0.30	0.38	0.32	0.32	0.37	0.39	0.34
Industry R ²	0.50	0.51	0.47	0.53	0.52	0.38	0.27	0.45	0.45	0.56	0.49
Industry R ² agg.par. ^b	-2.09	0.39	0.37	0.42	0.39	0.27	-1.97	0.52	0.02	0.46	0.49
Number of obs	219,804	1,035,359	848,658	2,161,684	251,693	515,674	99,363	473,831	1,739,890	760,402	8,106,138

Notes: Standard errors in parentheses. The variables are not scaled, so the importance of a variable cannot be interpreted directly from the size of the parameter estimate. ^a See Subsection 2.1 for exact definition of these variables. ^b Pseudo R² | agg.par is the Pseudo R² value calculated for each industry using the estimated coefficients in the economy-wide model (i.e., the coefficients in the last column in the table above). The pseudo R² values are calculated according to McFadden (1974).

Firm-specific regressors only (eco-wide model)

Firm-specific variables ^a	
EBITDA/TA	-0.949 (0.012)
TL/TA	0.491 (0.008)
LA/TL	-0.251 (0.008)
I/TS	0.124 (0.006)
TL/TS	0.164 (0.002)
IP/(IP+EBITDA)	0.088 (0.004)
PAYREMARK	1.712 (0.015)
TAXARREARS	2.566 (0.009)
PAYDIV	-2.004 (0.039)
TTLFS	3.670 (0.009)

Introducing macro factors

- Pseudo R^2 and Pseudo $R^2|_{ecow.coef}$:
 - Not much affected: in-sample the industry models still outperform economy-wide model
 - R^2 levels only marginally higher
- Aggregate R^2 :
 - Rises to approximately .90!
 - Intuition for higher values: macro picks up variation over time in default rates while ignoring idiosyncratic noise

Model with macro factors

Table 3: Regression results 1990Q1-1999Q4 for the default risk model estimated with both firm-specific and aggregate variables

	Agriculture	Manu- facturing	Construction	Retail	Hotel & Restaurant	Transport	Bank, Finance & Insurance	Real Estate	Consulting & Rental	Not Classified	Economy Wide
Firm-specific variables ^a											
EBITDA/TA	-1.323 (-0.025)	-1.412 (0.008)	-1.420 (0.008)	-0.950 (0.004)	-0.850 (0.013)	-1.159 (0.011)	-0.373 (0.015)	-0.673 (0.006)	-0.880 (0.006)	-1.073 (0.006)	-0.954 (0.002)
TL/TA	0.960 (0.082)	1.088 (0.035)	0.591 (0.042)	0.629 (0.016)	0.201 (0.028)	0.734 (0.046)	0.168 (0.055)	0.734 (0.031)	0.317 (0.024)	0.146 (0.021)	0.480 (0.008)
LA/TL	-0.327 (0.093)	-0.476 (0.040)	-0.478 (0.042)	-0.371 (0.020)	-0.091 (0.040)	-0.190 (0.036)	-0.168 (0.049)	-0.299 (0.033)	-0.233 (0.041)	0.011 (0.009)	-0.237 (0.008)
I/TS	0.021 (0.050)	0.323 (0.038)	-0.207 (0.044)	0.264 (0.017)	1.310 (0.310)	0.206 (0.240)	0.008 (0.056)	0.047 (0.006)	0.297 (0.041)	0.067 (0.006)	0.115 (0.006)
TL/TS	0.167 (0.025)	0.124 (0.008)	0.301 (0.008)	0.148 (0.004)	0.224 (0.013)	0.082 (0.011)	0.040 (0.015)	0.064 (0.006)	0.198 (0.006)	0.353 (0.006)	0.162 (0.002)
IP/(IP+EBITDA)	0.089 (0.037)	0.092 (0.013)	0.048 (0.014)	0.054 (0.007)	-0.002 (0.018)	0.174 (0.025)	0.054 (0.053)	0.157 (0.017)	0.039 (0.012)	0.138 (0.014)	0.079 (0.004)
PAYREMARK	1.449 (0.125)	1.604 (0.046)	1.854 (0.046)	1.643 (0.028)	1.616 (0.059)	1.815 (0.062)	2.369 (0.158)	1.773 (0.043)	1.694 (0.037)	2.592 (0.044)	1.838 (0.015)
TAXARREARS	2.910 (0.081)	2.361 (0.029)	2.652 (0.030)	2.579 (0.018)	2.468 (0.041)	2.951 (0.042)	3.210 (0.112)	2.538 (0.025)	2.997 (0.034)	2.786 (0.025)	2.698 (0.010)
PAYDIV	-2.168 (0.400)	-1.674 (0.114)	-1.627 (0.085)	-1.922 (0.075)	-1.493 (0.214)	-1.549 (0.179)	-0.977 (0.206)	+1.444 (0.140)	-1.579 (0.085)	-2.077 (0.131)	-1.809 (0.039)
TTLFS	4.070 (0.073)	3.593 (0.027)	3.941 (0.029)	3.551 (0.018)	3.278 (0.040)	3.864 (0.039)	3.680 (0.097)	3.460 (0.030)	3.720 (0.022)	3.300 (0.022)	3.587 (0.009)
Aggregate variables ^b											
Output gap	-0.128 (0.020)	-0.120 (0.007)	-0.156 (0.007)	-0.104 (0.004)	-0.111 (0.010)	-0.126 (0.010)	-0.129 (0.029)	-0.187 (0.008)	-0.120 (0.006)	-0.040 (0.006)	-0.115 (0.002)
Nominal interest rate	0.058 (0.015)	0.072 (0.005)	0.088 (0.006)	0.073 (0.003)	0.048 (0.008)	0.050 (0.006)	0.093 (0.021)	0.082 (0.006)	0.073 (0.005)	0.060 (0.005)	0.072 (0.002)
GDP inflation	-0.022 (0.021)	0.014 (0.007)	-0.034 (0.005)	0.016 (0.005)	0.036 (0.011)	0.024 (0.012)	-0.053 (0.035)	-0.013 (0.009)	0.006 (0.007)	0.011 (0.007)	0.006 (0.005)
Real exchange rate	0.000 (0.005)	-0.011 (0.002)	-0.002 (0.002)	-0.003 (0.001)	0.000 (0.002)	-0.010 (0.002)	-0.011 (0.007)	-0.007 (0.002)	-0.008 (0.001)	-0.009 (0.001)	-0.006 (0.001)
Mean log-likelihood	-0.024	-0.043	-0.043	-0.050	-0.070	-0.035	-0.025	-0.059	-0.031	-0.058	-0.045
Pseudo R ²	0.40	0.30	0.38	0.33	0.31	0.39	0.42	0.35	0.39	0.41	0.35
Pseudo R ² agg. coeffs. ^c	0.36	0.29	0.37	0.32	0.30	0.39	0.34	0.34	0.38	0.39	0.35
Industry R ²	0.88	0.95	0.95	0.97	0.85	0.89	0.84	0.86	0.94	0.83	0.96
Industry R ² agg. coeffs. ^c	-2.01	0.87	0.89	0.90	0.63	0.71	-1.82	0.78	0.34	0.55	0.96
Number of obs	219,604	1,035,359	848,658	2,161,664	251,693	515,674	99,363	473,831	1,739,890	760,402	8,106,138

Notes: Standard errors in parentheses. The variables are not scaled, so the importance of a variable cannot be interpreted directly from the size of the parameter estimate. ^a See Subsection 2. exact definition of these variables. ^b See Subsection 2.2 for definition and sources. ^c Pseudo R² | agg. coeffs. is the Pseudo R² value calculated for each industry using the estimated coefficient economy-wide model (i.e., the coefficients in the last column in the table above). The pseudo R² values are calculated according to McFadden (1974).

Model with macro factors (eco-wide)

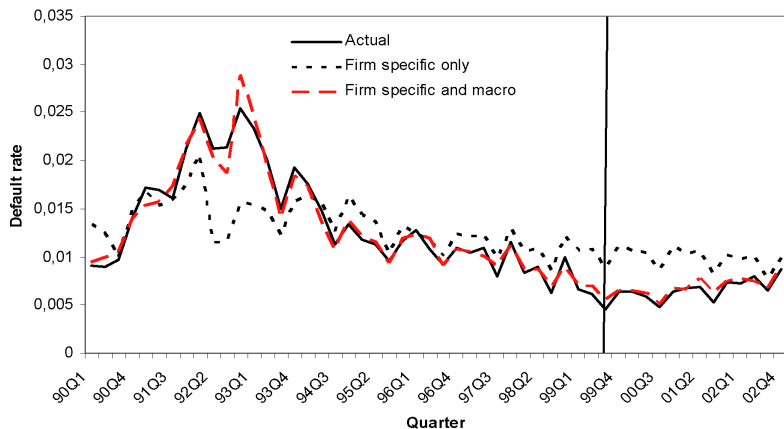
Firm-specific variables ^a

EBITDA/TA	-0.954 (0.002)
TL/TA	0.480 (0.008)
LA/TL	-0.237 (0.008)
I/TS	0.115 (0.006)
TL/TS	0.162 (0.002)
IP/(IP+EBITDA)	0.079 (0.004)
PAYREMARK	1.838 (0.015)
TAXARREARS	2.698 (0.010)
PAYDIV	-1.809 (0.039)
TTLFS	3.587 (0.009)

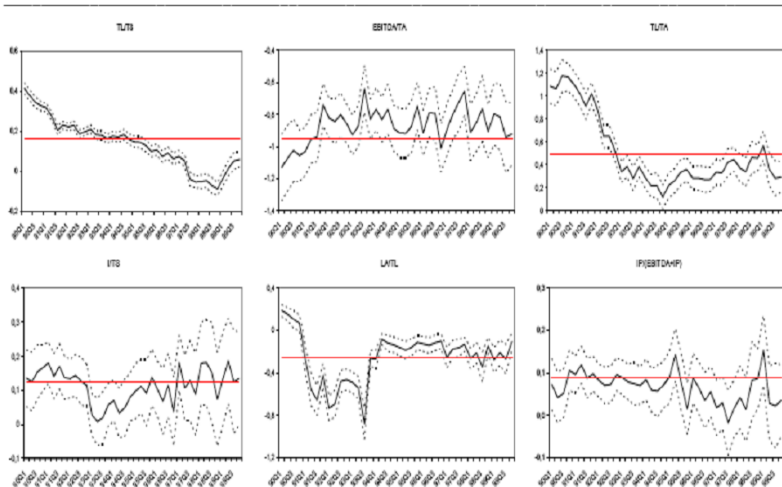
Aggregate variables ^b

Output gap	-0.115 (0.002)
Nominal interest rate	0.072 (0.002)
GDP inflation	0.006 (0.003)
Real exchange rate	-0.006 (0.001)

Contribution of macro factors



Model updating an option?



OLS on average data useful?

$$\begin{aligned}
 df_t = & \underset{(0.09)}{-0.15} + \underset{(0.15)}{0.15} \left(\frac{\text{EBITDA}}{\text{TA}} \right)_t + \underset{(0.13)}{0.19} \left(\frac{\text{TL}}{\text{TA}} \right)_t + \underset{(0.04)}{0.06} \left(\frac{\text{LA}}{\text{TL}} \right)_t \dots \\
 & \underset{(0.18)}{-0.26} \left(\frac{\text{I}}{\text{TS}} \right)_t - \underset{(0.04)}{0.04} \left(\frac{\text{TL}}{\text{TS}} \right)_t + \underset{(0.11)}{0.21} \left(\frac{\text{IP}}{\text{IP} + \text{EBITDA}} \right)_t \dots \\
 & \underset{(0.03)}{-0.11} y_{d,t} - \underset{(0.03)}{0.03} \pi_{d,t} + \underset{(0.03)}{0.07} R_{d,t} - \underset{(0.007)}{0.005} q_t + \hat{u}_{df,t}, \quad (1)
 \end{aligned}$$

$R^2 = 0.91$, $DW = 2.15$, Sample: 1990Q1 – 1999Q4 ($T = 40$)

Fit of industry models

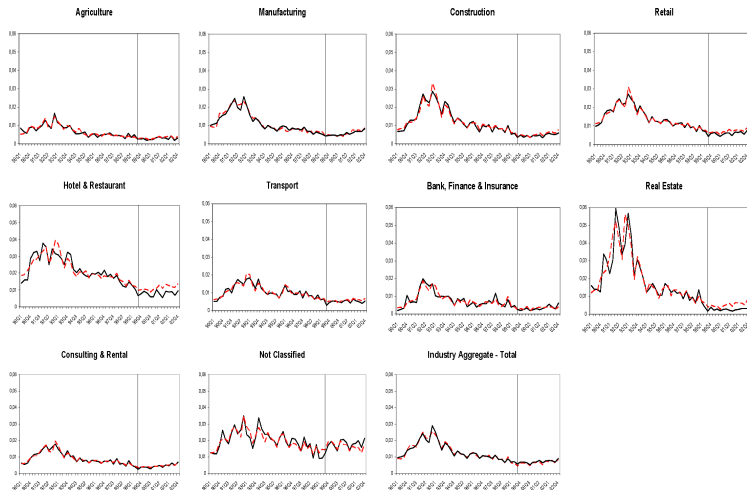


Figure 4: Actual (solid) and projected (dashed) industry default frequency rates 1990Q1-2002Q4. The projected rates are constructed using the estimated industry-specific models in Table 3. The models are estimated on data until 1999Q4. The projections shown to the right of the vertical line are out-of-sample.

Fit of economy-wide model

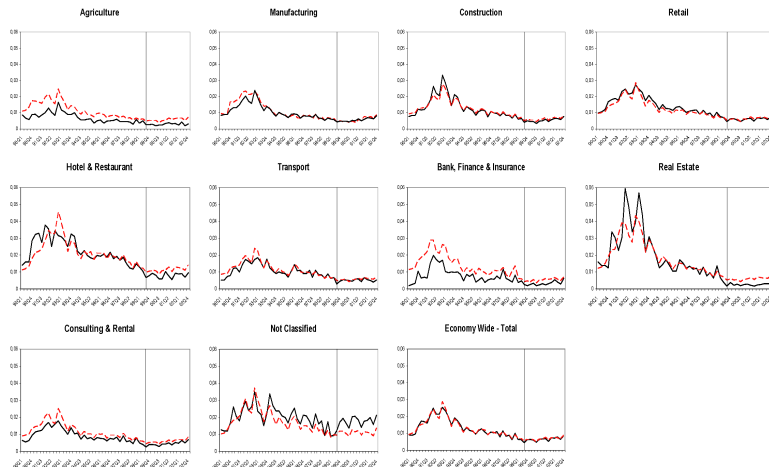


Figure 5: Actual (solid) and projected (dashed) industry default frequency rates 1990Q1-2002Q4. The projected rates are constructed using the estimated economy-wide model in Table 3. The model is estimated on data until 1999Q4; hence the projections to the right of the vertical line are out-of-sample.

Time-series fit

- Out-of-sample period: 2000Q1 – 2002Q4, $\Rightarrow \approx 2.6m$ obs.
- Compare with 5 models:
 - ① Conventional model: only firm-specific variables
 - ② Firm-specific and macro variables
 - ③ Firm-specific and macro variables with eco-wide coefficients
 - ④ Random walk time-series model
 - ⑤ Industry "average" OLS regression
 - ⑥ Four quarter moving average time-series model
- Measure of fit: One-quarter ahead forecast errors on mean default rate (RMSE) / RMSE(model 2)

Time-series fit

- Findings:
 - Industry models with macro variables added:
 - outperform models with only firm-specific variables
 - are slightly better in forecasting industry average default rates than “eco-wide” model with macro (excluding retail increases efficiency of industry models relative to eco-wide)
 - Generally outperform T-S models (most industries, and both industry aggregate and eco-wide model)

RMSE

Table 5: Out-of-Sample Root Mean Squared Error (RMSE) of the Average Default Rate for Various Models

Model	RMSE (in percent) ^b											
	Absolute RMSE for Model j ^a	Agriculture	Manu- facturing	Construction	Retail	Hotel & Restaurant	Transport	Bank, Finance & Insurance	Real- Estate	Consulting & Rental	Not Classified	Industry aggregate
Only firm-specific variables	0,1973	0,3039	0,4239	0,4509	0,7457	0,2641	0,2070	0,7079	0,2273	0,2680	0,3455	0,3350
Firm-specific and macro	0,0711	0,0849	0,0842	0,1216	0,3210	0,0897	0,1013	0,2459	0,0659	0,2381	0,0714	0,0478
Economy-wide coefficients	0,2830	0,0904	0,1612	0,0540	0,3454	0,0789	0,2124	0,3490	0,1464	0,7155	0,0506	0,0478
Time series random walk	0,1082	0,1179	0,1023	0,1180	0,2338	0,1119	0,1400	0,0737	0,1133	0,3576	0,1267	0,1262
Industry OLS macroregression	0,1216	0,1288	0,2327	0,1788	0,4608	0,1608	0,1081	0,4265	0,0620	0,3934	0,1325	0,1419
4 quarter moving average	0,0884	0,1208	0,0772	0,0797	0,1570	0,0782	0,1137	0,0761	0,0889	0,3316	0,0882	0,0893
RMSE model j / RMSE												
Table 4 model ^c												
Only firm-specific variables	2,7762	3,6783	6,0988	3,7114	2,3281	3,7888	2,0435	2,8788	3,4477	1,1257	4,8411	7,0082
Economy-wide coefficients	3,9808	1,0646	1,9166	0,4444	1,0759	1,1318	2,0983	1,4181	2,2203	3,0066	0,7009	1,0000
Time series random walk	1,5219	1,3885	1,2152	0,9712	0,7203	1,6053	1,3817	0,2000	1,7188	1,6018	1,7748	2,8401
Industry OLS macroregression	1,7103	1,6171	2,7697	1,4718	1,4366	2,3070	1,0571	1,7844	0,9356	1,8622	1,8584	2,9881
4 quarter moving average	1,2007	1,4280	0,9173	0,6602	0,4691	1,1217	1,1225	0,3086	1,3172	1,3928	1,2507	1,8888

RMSE: eco-wide model and industry aggregate

Absolute RMSE for Model J ^d	Industry aggregate	Economy Wide
Only firm-specific variables	0,3455	0,3350
Firm-specific and macro	0,0714	0,0478
Economy-wide coefficients	0,0506	0,0478
Time series random walk	0,1267	0,1262
Industry OLS macroregression	0,1325	0,1419
4 quarter moving average	0,0882	0,0893
RMSE model J / RMSE		
Table 4 model ^e		
Only firm-specific variables	4,8411	7,0662
Economy-wide coefficients	0,7009	1,0000
Time series random walk	1,7748	2,6401
Industry OLS macroregression	1,8584	2,8681
4 quarter moving average	1,2507	1,8689

Cross-sectional fit

- **Experiment 1: Models' ability to detect actual defaults**
 - Sort firms by estimated default probability
 - Table 5: defaulting firms are typically classified to be more risky than non-defaulting firms
 - Appr. 75% of defaults in decile #1; 4% in deciles #5-10
 - Pseudo R^2 's out-of-sample not worse than in-sample

Table 5: Out-of-sample Pseudo R² and decile tests at the industry level

Industry-specific model coefficients											
	Agriculture	Manufacturing	Construction	Retail	Hotel & Restaurant	Transport	Bank, Finance & Insurance	Real-Estate	Consulting & Rental	Not Classified	Industry aggregate
Pseudo R²	0.36	0.31	0.46	0.33	0.34	0.41	0.40	0.32	0.38	0.46	0.40
Decile											
1	0.74	0.71	0.85	0.72	0.76	0.82	0.79	0.75	0.78	0.78	0.79
2	0.11	0.13	0.06	0.10	0.09	0.07	0.03	0.06	0.08	0.08	0.08
3	0.08	0.05	0.03	0.06	0.03	0.05	0.05	0.03	0.05	0.10	0.04
4	0.02	0.05	0.02	0.05	0.02	0.02	0.05	0.04	0.03	0.01	0.03
5	0.02	0.02	0.01	0.03	0.03	0.01	0.04	0.04	0.02	0.01	0.02
6 - 10	0.02	0.04	0.03	0.05	0.07	0.03	0.05	0.08	0.04	0.03	0.04
Sum	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Economy-wide model coefficients											
	Agriculture	Manufacturing	Construction	Retail	Hotel & Restaurant	Transport	Bank, Finance & Insurance	Real-Estate	Consulting & Rental	Not Classified	Aggregate
Pseudo R²	0.35	0.31	0.46	0.33	0.34	0.41	0.35	0.35	0.38	0.46	0.39
Decile											
1	0.75	0.69	0.86	0.71	0.76	0.81	0.76	0.72	0.78	0.78	0.76
2	0.11	0.12	0.05	0.09	0.09	0.08	0.04	0.05	0.08	0.04	0.09
3	0.06	0.07	0.03	0.06	0.02	0.04	0.06	0.06	0.05	0.11	0.06
4	0.03	0.05	0.02	0.05	0.04	0.02	0.04	0.04	0.03	0.03	0.03
5	0.03	0.03	0.01	0.03	0.02	0.01	0.03	0.02	0.02	0.01	0.02
6 - 10	0.02	0.04	0.03	0.05	0.06	0.03	0.08	0.10	0.04	0.02	0.04
Sum	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ROC: eco-wide model

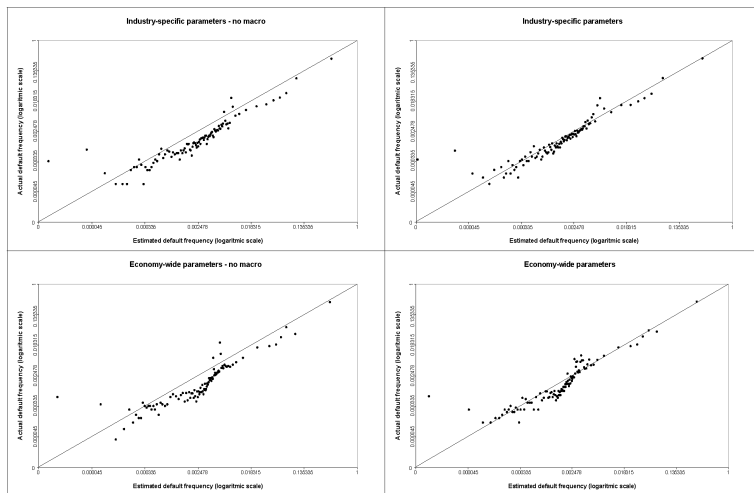
Pseudo R²	0,40
Decile	
1	0.79
2	0.08
3	0.04
4	0.03
5	0.02
6 - 10	0.04
Sum	1.00

Pseudo R²	0,39
Decile	
1	0.76
2	0.09
3	0.06
4	0.03
5	0.02
6 - 10	0.04
Sum	1.00

Cross-sectional fit

- **Experiment 2:** Is distribution of estimated mean PDs equal to that of true PDs?
 - Sort firms by estimated PD, then calculate actual default frequency per percentile
 - Reports results for industry aggregate and eco-wide model
 - Not enough observations for industry analysis: use all obs.
 - Most observations close to 45-degree line from origin

Cross-sectional fit



Conclusions

- Default-risk model with macro replicates data including peaks in beginning of the 1990s
 - Firm-specific variables do good job *ranking* firms; payment remarks in particular
 - Macro variables drivers of *levels* of firm-level default risk
 - Banking-crisis episode "captured" by model
 - Estimation of default risk model using average data not informative
- Effects of macro variables on default:
 - Very similar across industries, slightly more pronounced in some (construction, real estate, banking finance & insurance)
 - Differences occur in plausible way

Conclusions

- Out-of-sample performance of industry and eco-wide models:
 - T-S dimension: both perform very well, beat all competitors
 - Industry models with macro outperform eco-wide model (9/10 industries)
 - Eco-wide slightly better when considering average over all industries
 - C-S dimension: both have as good fit as Shumway (2001)
 - Models tie in terms of R^2 and decile test
- Role for separate models for industries? No general gain, but likely dependent on the data

What happened to default and credit losses?

- Correlation over 20 years: 0.943!

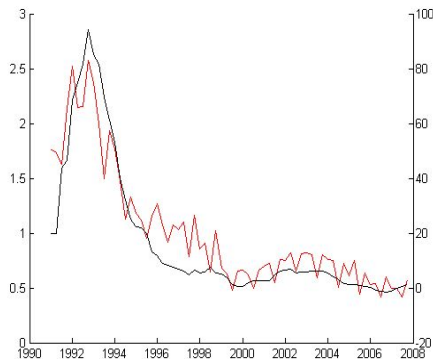
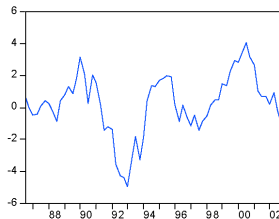


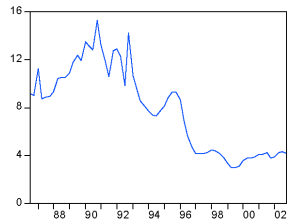
Figure: Red line (left axis) represents default rate, black line (right axis, bn SEK) credit losses.

Extra: macro data

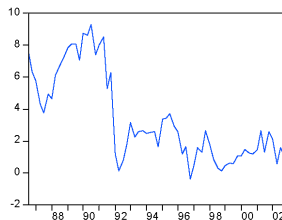
Output gap (in percent)



Nominal interest rate (APR)



Yearly inflation rate (in percent)



Real exchange rate (in percent)

