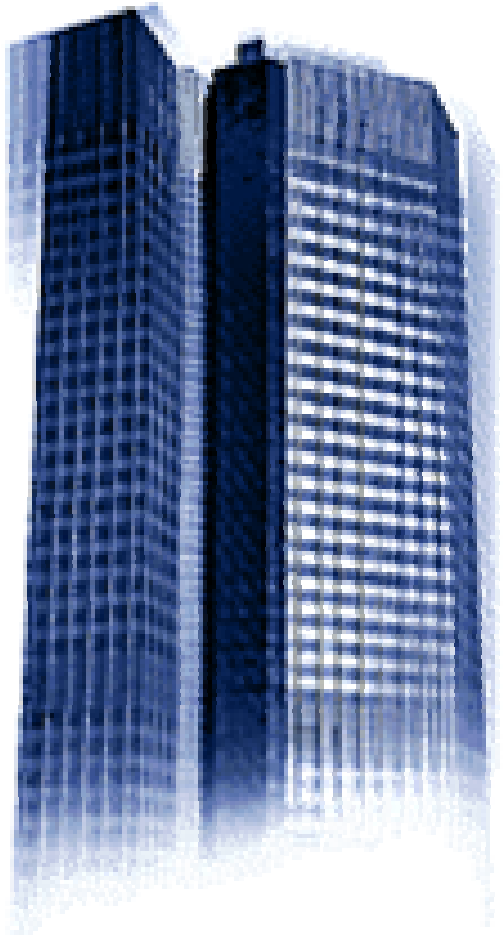

Explaining the CDS Basis

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Motivation

- **Credit risk models for credit default swap (CDS) and bond markets**

- **CDS:** Contract to insure against losses due to the default of a certain reference entity (e.g. Bayer AG)

	No Default	**Default**
CDS Buyer	pays quarterly CDS spread e.g. 25 bp	delivers defaulted bond e.g. 40%
CDS Seller	no payments 0	pays notional amount 100%

→ CDS spread is quoted in the CDS market

Motivation

- **Corporate bonds:**

	No Default	Default
Bondholder	receives regular coupon payments + redemption	receives recovery of bond e.g. 40%

- **Information on the bond markets:**
  - Bond price
  - Bond spread

- **Bond spread:** Add-on to the riskfree interest rates that the investor receives to compensate for credit risk.

Introduction

- Basic intensity-based credit risk models provide the following **theoretical relation**:

  CDS spread ≈ corporate bond spread

- On CDS markets and corporate bond markets the CDS spread and bond spread significantly differ → **empirical relation:**

  on average: CDS spread > corporate bond spread

- In the literature this difference is termed **CDS basis** (= CDS spread – bond spread)

- **Aim of the paper:** Extension of basic intensity-based models to correctly price CDS and bonds, and therefore explain the observed CDS basis.

Data

- **Daily bond and CDS quotes for 12 corporate issuers**
  - Data collected by Bank Austria Creditanstalt AG
  - **Time-series:** January 2003 through January 2005
  - Quality standards concerning the frequency and the number of bonds and CDS per day

Corporation	Rating	Industry
Rabobank	Aaa	Banking
ABN Amro	Aa3	Banking
Siemens	Aa3	Electrical Equipment
Aventis	A1	Pharmaceuticals
British American Tobacco	A2	Tobacco
Commerzbank	A2	Banking
Bayer	A3	Pharmaceuticals
Daimler Chrysler	A3	Automobiles
France Telecom	A3	Telecom
Philips Electronics	Baa1	Electronics
Telecom Italia	Baa2	Telecom
Fiat	Ba3	Automobiles

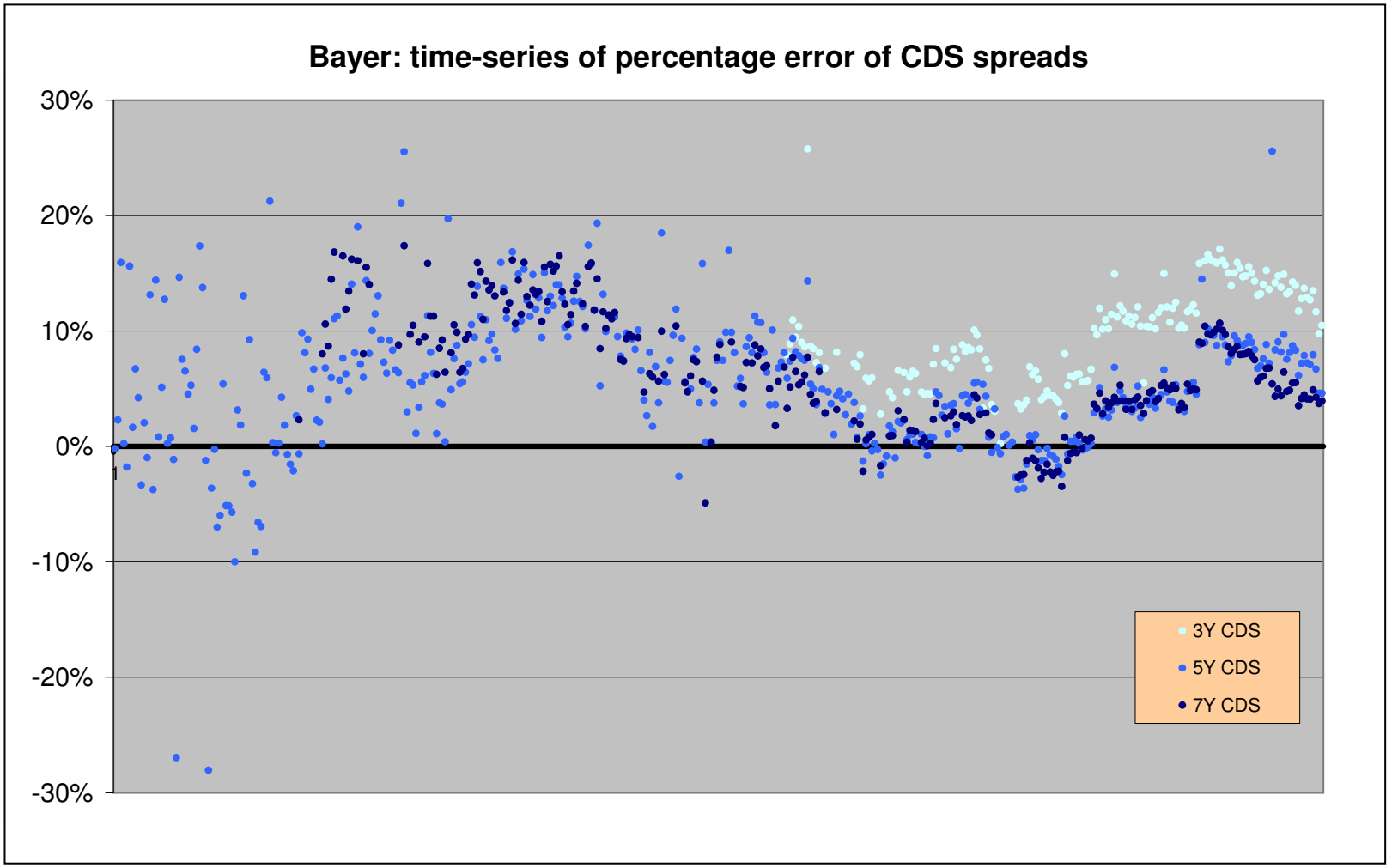
Results – Basic Model

- **Model fitted to bond prices** (errors within bid-ask spread)

- **Observed CDS spreads significantly differ from model values**
  - Mean absolute error (MAE): 24.30 bp
    → percentage error of 23.9 % (relative to the market CDS spread)
  - For 8 companies CDS spread is underestimated: up to 53%
  - For 4 companies CDS spread is overestimated: up to 27%

  → **high errors with different signs**

Results – Basic Model



Extension: Liquidity vs Delivery Option

- **Liquidity risk**
  - Different liquidity in CDS and bond markets
  - Longstaff/Mithal/Neis (Journal of Finance 2005)
    - Extension of credit risk models by **liquidity risk factor**

    → Unable to explain positive CDS basis

- **CDS delivery option**
  - Approach in this project

Modeling the CDS delivery option

- In default **different bonds** with the same seniority can be delivered in the CDS.

- Delivery option is in-the-money if deliverable bonds in the case of default have **different prices**.

  → bond with lowest expected recovery is cheapest-to-deliver

- **In the basic model:**
  - Expected bond recovery is a constant (40% in our case)
  - Implicit assumption that bond prices in default are equal

    → **delivery option has no value**

Modeling the CDS delivery option

- **Our extension:**
  - E[bond recovery] = π remains 40%

$$bond\ \ price = \sum_{i=1}^{n} coupon \cdot d(t_i) \cdot p(t_i) + 1 \cdot d(t_n) \cdot p(t_n) + \int_0^{t_n} \pi \cdot d(s) \cdot f(s) \cdot ds$$

  - **Additional free parameter** E[min(bond recovery)] = π_{min} used to price CDS

$$CDS\ spread = \frac{\int_0^{t_m} (1 - \pi_{min}) \cdot d(s) \cdot f(s) \cdot ds}{\sum_{i=1}^{m} d(t_i) \cdot \alpha_i \cdot p(t_i) + \int_0^{t_m} d(s) \cdot \alpha_s \cdot f(s) \cdot ds}$$

Modeling the CDS delivery option

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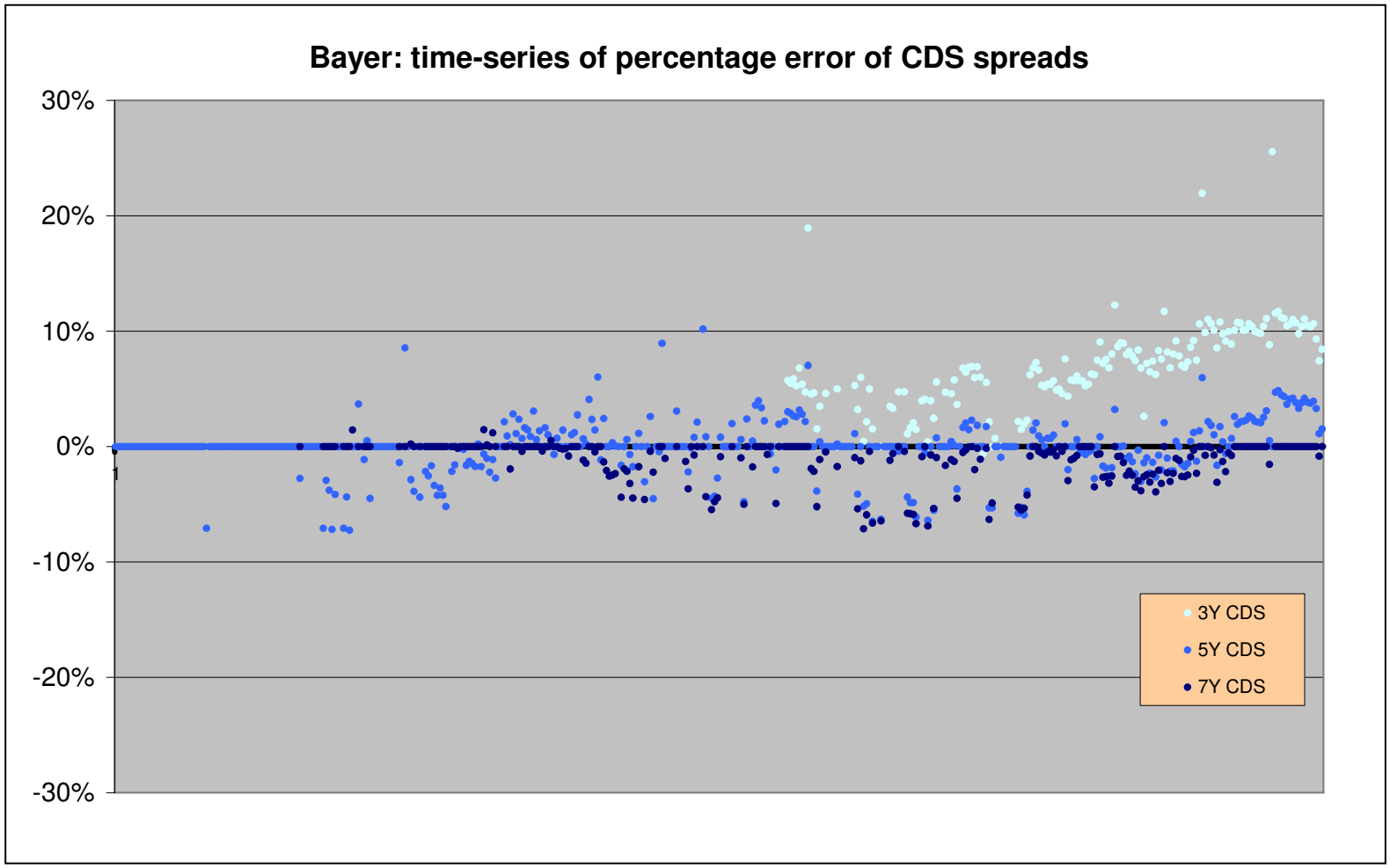
Results – Extended Model

Corporation	Rating	Implicit minimum recovery
Rabobank	Aaa	8,87%
ABN Amro	Aa3	35,34%
Siemens	Aa3	31,86%
Aventis	A1	46,11%
British American Tobacco	A2	45,93%
Commerzbank	A2	27,14%
Bayer	A3	46,34%
Daimler Chrysler	A3	11,48%
France Telecom	A3	29,97%
Philips Electronics	Baa1	43,91%
Telecom Italia	Baa2	33,37%
Fiat	Ba3	13,74%

- MAE of CDS decrease from 24.3 bp to 7.86 bp

Results – Extended Model



Analysis of implicit minimum recovery

- **Delivery option proxies:**
  - Number of bonds (more bonds → lower recovery)
  - MAE of bonds (higher error → lower recovery)
  - Minimum bond pricing error (lower min. error → lower recovery)
  - Maturity of bonds (higher maturity → lower recovery)

Analysis of implicit recovery

- **Regression based on cross-sectional data:**

covariate	constant	coefficient	t-statistic	prob.
number of bonds	54.81	-6.34	-5.23	0.0004*
bond error	39.36	-0.85	-2.86	0.0168*
min bond error	40.17	-0.54	-3.99	0.0025*
maturity	-9.67	8.01	2.37	0.0396*

- The delivery option proxies are statistically and economically significant.

- Tested liquidity proxies are not significant.

Summary

- Basic intensity-based credit risk models **cannot correctly price CDS and bonds simultaneously**.
- Basic models calibrated to bond data **significantly misprice** CDS.
- Extension to model the **delivery option** by estimating the implicit expected minimum recovery significantly improves the price fit.
- This **new parameter is linked to delivery option proxies** (e.g. number of bonds), but not to liquidity proxies.
- Therefore it is important to model the delivery option when pricing CDS.
- **Possible extensions:** More complex structures for the delivery option