Essays on Corporate Loans and Credit Risk

Mølgaard, Pia

COPENHAGEN BUSINESS SCHOOL
SOLBJERG PLADS 3
DK-2000 FREDERIKSBERG
DANMARK

WWW.CBS.DK

ISSN 0906-6934

Print ISBN: 978-87-93744-22-6
Online ISBN: 978-87-93744-23-3

ESSAYS ON CORPORATE LOANS AND CREDIT RISK

PhD Series 38-2018

Pia Mølgaard

ESSAYS ON CORPORATE LOANS AND CREDIT RISK

PhD School in Economics and Management

PhD Series 38.2018

CBS COPENHAGEN BUSINESS SCHOOL
HANDELSHØJSKOLEN

Essays on Corporate Loans and Credit Risk

Pia Mølgaard

A thesis presented for the degree of
Doctor of Philosophy

Supervisor: David Lando
Ph.D. School in Economics and Management
Copenhagen Business School

Pia Mølgaard
Essays on Corporate Loans and Credit Risk

1st edition 2018
PhD Series 38.2018

Print ISBN: 978-87-93744-22-6
Online ISBN: 978-87-93744-23-3

ISSN 0906-6934

The PhD School in Economics and Management is an active national and international research environment at CBS for research degree students who deal with economics and management at business, industry and country level in a theoretical and empirical manner.

Preface

This thesis consists of three chapters, which can be read independently. The chapters investigate how prices are set in the secondary market for corporate loans, corporate bonds, and credit default swaps (CDS).

The first chapter investigates how managers of collateralized loan obligations (CLO) trade in the leveraged loan market. Some CLO managers face search or information frictions implying that they trade loans at less favorable prices than other CLO managers. The managers who obtain the most favorable prices are those that are most actively trading in the leveraged loan market. We show that, the more active the CLO manager is, the better the CLO performs.

The second chapter addresses differences between bank loans issued when the bank and the borrower had a close relationship (relationship loans) and bank loans issued when the bank and the borrower had no relationship (non-relationship loans). I show that relationship loans outperform non-relationship loans in the sense that relationship loans are more likely to get upgraded and trade at higher prices in the secondary market. This is after controlling for the publics perception of the borrowers credit risk at the time of loan issuance. This finding suggests that relationship banks are in possession of proprietary information about the borrower.

The third and final chapter examines how information flows between the CDS and the corporate bond market. The focus of the paper is the methodologies used to quantify how such information flows, i.e., Granger causality, the Hasbrouck measure, and the Gonzalo Granger measure. We show that the presence of market microstructural frictions, e.g., illiquidity, bias the tests in favor of showing that information flows from the market without microstructural noise to the market with microstructural noise, even though both markets absorb new information simultaneously.

Acknowledgements

This thesis has benefited from discussions with more people than I can mention here. I am grateful to everyone who made my time at Copenhagen Business School inspiring, educational, and fun. However, a few people deserve special recognition.

Most importantly, I would like to express my sincere gratitude to my advisor David Lando who taught me how to develop and communicate research ideas. David has been an outstanding mentor. I have benefited greatly from his advises on research and on life. I am also grateful to Annette Vissing-Jørgensen for sponsoring me at Berkeley. Working with my co-author Peter Feldhütter helped me grow as a researcher, for that I am grateful. I also wish to thank my fellow PhD student Sven Klingler for many enlightening and enjoyable discussions. My cohort Stine, Christian, and Andreas provided countless hours of fun.

My partner Christian deserves special thanks. We had many discussions on large as well as small details about my research. He always believed in me and encouraged me when I needed it the most. Sharing this experience with him has meant the world to me. Finally, I am grateful to my parents and my sister for their constant support and guidance over the years.

Introduction and Summaries

Classical asset pricing theory assumes "perfect markets" which means that financial markets are frictionless. However, in the real world financial frictions exists. Recently the financial literature has focused more on these frictions and on how they affect asset prices. This thesis contributes to the literature by providing evidence on how financial frictions affect pricing and trading of corporate loans.

The first chapter examines how managers of collateralized loan obligations (CLOs) trade leveraged loans and how their activity affects the performance of the CLO. The second chapter examines how the performance of leveraged loans depends on the borrowers' relationship with its bank. The third chapter studies methodologies used to quantify how information flows between the corporate bond and the credit default swap market.

1 Summaries in English

Active Loan Trading

The first chapter studies the activity of managers of collateral loan obligations (CLOs). CLOs are structured finance products where a portfolio of high yield corporate loans (leveraged loans) are pooled and formed into tranches with different seniorities. The CLO manager is in charge of selecting the initial loan portfolio and actively rebalancing the collateral pool by selling and purchasing loans. That the manager actively manages the portfolio after issuance is a special feature, distinguishing CLOs from most other asset-backed securities. We define active loan trades as transactions a CLO manager executes to rebalance the collateral portfolio, to enhance the CLO's performance. The counterfactual is non-active trades, which the CLO manager executed to comply with pre-specified restrictions. In the chapter, we answer two questions: (1) Is active trading benefitting the CLO investors? (2) What distinguish CLO managers who are active from CLO managers who are not so active?

We start by distinguishing active loan trades from non-active trades and find that active loan trades are conducted at better prices than non-active trades. The effect is much larger for sales than purchases, which is intuitive as the primary market for leveraged loans, where mosts loan purchases take place, is much bigger than the secondary market, where loan sales take place. The opaque and less liquid secondary market is naturally a market where a more skilled investor can employ his or hers comparative advantage. Investigating loan sales further we find that active sales predict rating downgrades, suggesting that CLO managers sell loans before they are downgraded.

Motivated by this finding, we investigate if CLOs with different levels of active turnover, measured as the ratio between active sales and CLO size, execute loan transactions at different prices and find that CLOs with a higher active turnover trade loans at better prices than less active CLOs. In addition, active CLOs sell leveraged loans earlier than less active CLOs and before rating downgrades. Turning to the implications of more active turnover for CLO performance, more active trading increases the returns to equity investors and, at the same time, lowers the default rate of the CLO's collateral portfolio. By contrast, using a placebo variable that captures non-active turnover (the ratio between non-active sales and CLO size), we find that non-active turnover predicts higher CLO collateral default rates.

Relationship Lending and Loan Performance on the Secondary Market

In this chapter, I examine the benefits of relationship lending, i.e. when a bank continues to lend to the same borrower. I distinguish myself from the existing literature by examining how, so called, relationship loans perform on the secondary market. For this purpose, I employ the same dataset as is used in chapter 1. The data provides transaction prices and credit ratings of leveraged loans, which are bank loans extended to below investment grade rated corporations. When a bank lends money to a firm, the bank typically starts a strict monitoring process. The monitoring process implies that the bank collects proprietary information which is not known to the public. The information gathering is put in place in order for the bank to decide whether to grant a loan and if so, to decide the appropriate terms for the loan. The objective of this paper is to document that relationship loans outperform relative to market expectations at loan issuance, and thereby document that banks learn the true credit quality of the firm through repeated lending.

I measure post issuance loan performance on two dimensions: credit ratings and transactions prices. First, I show that relationship loans are more likely to be upgraded and to some extent less likely to be downgraded. That is, the relationship bank is able to pick borrowers who outperform relative to other firms that, at the time of loan issuance, are viewed equally risky by the market. The only way banks can select these borrowers, who later outperform, is by having proprietary information allowing them to observe the borrowers' true credit quality. Secondly, I show that transactions prices are higher for relationship loans than non-relationship loans, after controlling for the public's view of the borrowers' credit quality at loan issuance. This result is consistent with relationship loans more frequently being upgraded. Furthermore, it shows that investors who trade relationship loans can earn higher returns than investors who are trading non-relationship loans. Finally, I examine the volatility of transaction prices and find that relationship loan prices are less volatility which benefits the investor as well.

Revisiting the Lead-Lag Relationship Between Corporate Bonds and Credit Default Swaps

The third chapter studies methodologies used to quantify which financial market is first to incorporate new information of the underlying risk, the so-called lead-lag relationship between the two markets. The study is done on the CDS and the corporate bond market, but the methodologies apply to any two markets that share an underlying risk. In a simulation study, we show that prevailing lead-lag tests in the literature, i.e. Granger causality, the Hasbrouck measure, and the Gonzalo Granger measure, are biased if asset prices include a microstructural noise component, in the form of a bid-ask spread or a time-varying liquidity component. The microstructural noise component creates negative autocorrelation in price increments which biases the tests in favor of finding that information flows from the market without microstructural noise to the market with microstructural noise.

We compute autocorrelations of the data and find no signs of consistent non-zero autocorrelation in CDS spread increments, but a strong tendency towards negative autocorrelation in corporate bond spread increments derived from both end-of-day transaction prices and daily bid quotes. This raises the question of whether earlier papers, that test the lead-lag relationship between CDS and corporate bonds using Granger causality, Hasbrouck or Gonzalo Granger, are biased. We then test the lead-lag relationship between CDS and corporate bonds and find that price discovery increases in the corporate bond market when we use a method that is not prone to this bias.

The first part of the analysis is done using corporate bond quotes. Utilizing information from public end-of-day transactions of corporate bonds, we find that price discovery in the corporate bond market increases. Furthermore, we document the importance of controlling execution time of transactions, by showing that price discovery in the corporate bond market increases further if we only consider transactions that are executed after 3 pm. Finally, to reject the notion that the last result is driven by a subsample selection, we look at the interaction between relative liquidity in the CDS and the corporate bond market and the relative contribution to price discovery. We find that high CDS liquidity improves the relative contribution to price discovery from the CDS market, but no clear evidence of such a link in the corporate bond market.

2 Summaries in Danish

Active Loan Trading

Det første kapitel undersøger hvor aktivet managere af collateralized loan obligation (CLO'er) agerer i markedet. CLO'er er strukturerede finansielle produkter, hvor en portefølje af gearede lån samles og formes i trancher med forskellige anciennitet. CLO-manageren har ansvaret for at vælge den initiale låneportepølje og aktivt at rebalancere porteføljen ved at sælge og købe lån efter CLO'ens ustedelse. Det at CLO-manageren aktivt forvalter porteføljen efter udstedelses datoen er en speciel karakteristika ved CLO'er og noget som managere af de fleste andre typer af asset-backed securities ikke gør. Vi definerer aktive handler som transaktioner udført af CLO-manageren for at optimere lån-porteføljen og derved at forbedre CLO'ens afkast. Det modsatte af aktive handler er ikke-aktive handler, som CLO-manageren udfører for at overholde forudbestemte krav til porteføljens sammensætning. Vi besvarer 2 spørgsmål i kapitlet: (1) Gavner aktive handler CLO-investorerne? (2) Hvad adskiller CLO-managere, der er aktive fra CLO-managere, der er mindre aktive?

Vi starter med at skelne mellem aktive handler og ikke-aktive handler og finder at aktive handler udføres til bedre priser end ikke-aktive handler. Effekten er væsenligt større for salg end køb, hvilket intuitivt giver mening, da det primære marked for gearede lån, hvor de fleste køb finder sted, er langt større end det sekundære marked for gearede lån, hvor salg finder sted. Det uigennemsigtige og mindre likvide sekundære marked er naturligt et marked, hvor den talentfulde investor bedre kan udnytte sin komparative fordel. Desmere finder vi at aktive salg forudsiger nedjusteringer af lånets kredritværdighed, hvilket tyder på, at CLO-manageren sælger lån, umiddelbart før deres kredritværdighed nedjusteres.

Motiveret af disse resultater undersøger vi, om CLO'er som er mere eller mindre aktive, målt ved forholdet mellem CLO'ens samlede omsætning fra aktive salg og CLO'ens størrelse, sælger lån til forskellige priser. Vi finder at CLO'er, som er mere aktive, handler lån til bedre priser end mindre aktive CLO. Derudover sælger aktive CLO'er lånene tidligere end mindre aktive CLO'er, og før at lånenes kreditvurdering bliver nedjusteret. Til sidst finder vi, at en øget aktivitet hos CLO manageren også har betydning for CLO investorerne i form af højere afkast til egenkapitalinvestorer og lavere konkursrater i lånporteføljen. Tests med en placebo-variable, der måler forholdet mellem omsætningen ved *ikke*-aktivt salg og CLO'ens størrelse, viser at en større andel ikke-aktive handler forudsiger højere konkursrater i lånporteføljen.

Relationship Lending and Loan Performance on the Secondary Market

I dette kapitel undersøger jeg fordelene ved "relationship-lån", dvs. lån der er udstedt af en bank til en virksomhed, som banken kender godt igennem gentagen långivning. Jeg bidrager til den eksisterende litteratur ved at undersøge, hvordan disse "relationship-lån" handler pådet sekundære marked. Til dette formål anvender jeg det samme datasæt, som der er anvendt i kapitel 1. Datasættet indeholder transaktionspriser og kreditvurderinger af gearede lån, som er banklån udstedt til virksomheder med lavere kreditvurdering. Når en bank udlåner penge til en virksomhed, vil banken typisk starte en vurderingsproces af virksomheden. Processen indebærer, at banken indsamler information om virksomheden, som ikke er kendt for offentligheden. Formålet med indsamlingen af information er at gøre det muligt for banken at vurdere om den skal yde et lån til virksomheden, og i såtilfælde, at beslutte hvilke vilkår lånet skal udstedes til. Målet med dette papir er at dokumentere, at "relationship-lån" klare sig bedre end hvad markedsforventningerne var ved udstedelse af lånet, og derved at dokumenterer at banker lærer virksomhedens sande kreditkvalitet gennem det tætte forhold de har til kunden.

Jeg måler hvordan lånet klarer sig på to parametre: lånets kreditvurdering og transaktionspriser. Først viser jeg, at "relationship-lån" er mere tilbøjelige til at få deres kreditvurdering opjusteret og til en vis grad mindre tilbøjelige til at få deres kreditvurdering nedjusteret. Det vil sige, at banken er i stand til at vælge at låne til virksomheder, der klarer sig bedre end andre virksomheder, som markedet vurderer lige risikable på tidspunktet for udstedelsen af lånene. Den eneste måde hvorpå banken kan vælge disse fordelagtige låntagere på, er ved at have kendskab til information vedrørende låntagernes sande kreditkvalitet, som markedet, ved lånet udstedelse, endnu ikke er opmærksom på. Ydermere viser jeg, at transaktionspriserne er højere for "relationship-lån" end andre lån, efter at jeg har kontrolleret for offentlighedens opfattelse af låntagernes kreditkvalitet i udstedelsestidspunktet. Dette resultat er i overensstemmelse med det tidligere resultat – at “relationship-lånenes” kreditvurdering oftere bliver opjusteret. Desuden viser dette resultat, at investorer, der handler med “relationship-lån”, kan opnå højere afkast end investorer, der handler andre lån. Endeligt undersøger jeg volatiliteten i transaktionspriser og finder at transaktionspriser på“relationship-lån” er mindre volatile, hvilket tillige er en fordel for investorerne.

Revisiting the Lead-Lag Relationship Between Corporate Bonds and Credit Default Swaps

Det tredje kapitel studerer metoder, der bruges til at kvantificere hvilket af to finansielle markeder, der først inkorporerer nye oplysninger om den underliggende risiko i prisen, det såkaldte lead-lag-forhold mellem de to markeder. Kapitlet undersøger specifikt CDS- og erhvervsobligations-markedet, men metoderne, der omtales, gælder for to vilkårlige markeder, så længe de er drevet af samme underliggende risiko. Vi viser i et simuleringsstudie, at de gængse lead-lag test i litteraturen, dvs. Granger kausalitet, Hasbrouck målet, og Gonzalo Granger målet, kan producere skævvredet resultater hvis priserne i et af markederne inkluderer et mikrostrukturelt støj-led, i form af et bid-ask spænd eller en tidsvarierende likviditet. Den mikrostrukturelle støj skaber negativ autokorrelation i daglige prisændringer, som skævvrider konklusionen af testene. Skævvridningen fungerer således at man vil konkludere at ny information først inkorporeres i markedet uden mikrostrukturel støj, for derefter at blive inkorporeret i markedet med mikrostrukturel støj. På trods af at begge markeder – i virkeligheden – er lige hurtige til at inkorporere ny information.

Vi beregner autokorrelationer i data og finder ingen tegn på at autokorrelationen i daglig ændringer i CDS-spændet er forskellig fra nul. Til gengæld finder vi en stærk tendens til negativ autokorrelation i daglige prisændringer i erhvervsobligationer. Det gælder både når vi hente obligationspriser fra daglige transaktionspriser eller fra daglige dealer bid-quotes. Dette rejser spørgsmålet, om hvorvidt resultaterne fra tidligere studier, der tester lead-lag forholdet mellem CDS og erhvervsobligationer ved brugen af Granger kausalitet, Hasbrouck eller Gonzalo Granger, er skævvredet. Vi tester derefter lead-lag forholdet mellem CDS og erhvervsobligationerne og finder at inkorporationen af ny information i erhvervsobligationer i større grad sker tidligere end i CDS markedet, når vi bruger en metode, som ikke er udsat for denne skævvridning.

Den første del af analysen er lavet ved brug af bid-quotes på erhvervsobligationerne. Udnytter vi oplysninger fra offentlige handlestransaktioner af erhvervsobligationerne, finder vi, at inkorporationen af ny information i obligationsmarkedet sker tidligere. Desuden dokumenterer vi vigtigheden af at tage højde for tidspunktet transaktioner er gennemført på, ved at vise at inkorporationen af ny information i erhvervsobligationsmarkedet stiger yderligere, hvis vi kun betragte transaktioner, der udføres efter kl 15:00. For at afkræfte at det sidste resultat opstår fordi vi sidder tilbage med de mest likvide obligationer, ser vi til sidst på sammenhængen mellem den relative likviditet i CDS- og erhvervsobligationsmarkedet og de to markeders indbyrdes lead-lag forhold. Vi finder at højere CDS-likviditet betyder tidligere inkorporering af ny information i CDS-markedet, men ingen tydelige tegn på at det samme er tilfældet for erhvervsobligationsmarkedet.

Contents

Chapter 1

Active Loan Trading

with Frank Fabozzi, Sven Klingler, and Mads Stenbo Nielsen

Abstract:
Analyzing a novel dataset of leveraged loan trades executed by managers of collateralized loan obligations (CLOs), we document the importance of "active loan trades" – trades executed at a manager's discretion. Active loan sales are conducted at better prices than non-active sales and before rating downgrades. More active CLOs trade at better prices than less active CLOs, selling leveraged loans earlier and before they get downgraded. More active trading also increases the returns to equity investors and lowers collateral portfolio default rates. In contrast, tests with a placebo variable, capturing passive turnover, lead to insignificant results.

We are grateful to Niels Friewald (discussant), David Lando, conference participants at the 2017 NFN PhD workshop, seminar participants at BI Norwegian Business School, Copenhagen Business School, Tilburg University, and WU Vienna for helpful comments. Klingler, Mølgaard, and Nielsen gratefully acknowledge support from the FRIC Center for Financial Frictions (grant no. DNRF102).

1 Introduction

Leveraged loans – loans in which a lead bank arranges a syndicate of lenders – are a primary source of financing for low-rated corporations. These loans are traded over the counter (OTC) and in contrast to other OTC transactions, there is no systematic post-trade reporting for leveraged loan transactions. In this paper, we investigate trading patterns in this market by utilizing a novel dataset of transaction prices reported by collateralized loan obligations (CLOs). CLOs are structured finance products with an actively managed collateral pool comprised of leveraged loans and are one of the largest leveraged loan investors. Besides purchasing new loans from arranging banks, the CLO collateral manager can enhance the CLO performance by trading parts of the existing loan portfolio on the secondary market. This active loan trading by CLO managers is the focus of our paper.

We define active loan trading as transactions a CLO manager executes to rebalance the collateral portfolio. Distinguishing active loan sales from other sales (henceforth non-active sales), we find that active loan sales are conducted at better prices than non-active sales. Furthermore, active sales predict rating downgrades. Motivated by this finding, we investigate if CLOs with different levels of active turnover, measured as the ratio between active sales and CLO size, execute loan transactions at different prices and find that CLOs with a higher active turnover trade loans at better prices than less active CLOs. In addition, active CLOs sell leveraged loans earlier than less active CLOs and before rating downgrades. Turning to the implications of more active turnover for CLO performance, more active trading increases the returns to equity investors and, at the same time, lowers the default rate of the CLO's collateral portfolio. By contrast, using a placebo variable that captures non-active turnover (the ratio between non-active sales and CLO size), we find that non-active turnover predicts higher CLO collateral default rates.

The leveraged loan trading of CLOs provides an interesting laboratory for studying the impact of active portfolio management on loan transaction prices and managerial performance. In contrast to other active portfolio managers, CLOs face complex portfolio constraints which can prevent less skilled managers from portfolio rebalancing. Contractually imposed performance-based tests for the collateral enforce a specific structure on the collateral portfolio, thereby limiting the risk-taking capability of CLOs. In rebalancing the collateral portfolio, a CLO needs to comply with these tests – it needs to find a potential buyer for part of the loan portfolio and find new loans that ensure compliance with the collateral tests. Given these challenges for portfolio rebalancing, we hypothesize that more of this active trading indicates good collateral management.

As a starting point of our analysis, after splitting the sample of loan trades into active sales and non-active sales, we find that active sales are conducted at better prices than non-active sales. Moreover, active sales predict rating downgrades. Next, we investigate the drivers of active turnover and find that CLO-specific characteristics (e.g. CLO age and size) have more explanatory power for active turnover than collateral portfolio characteristics (e.g. diversification and average time to maturity), refuting a mechanical link between active turnover and the liquidity of the CLO collateral portfolio.

Given the higher transaction prices for active sales and their predictive power for rating downgrades, we next investigate if more active and less active CLOs differ in their trading patterns. To that end, we split the sample of CLOs into three portfolios, based on their quarterly active turnover, and rebalance the portfolios every quarter. Comparing the average transaction prices of the most active and least active CLOs, we find that more active CLOs, earn 5.47 dollars (on an average transaction of 88.60 dollars) more than less active CLOs when they sell loans. In addition, more active CLOs purchase cheaper loans than less active CLOs, but the average difference of 37 cents (on a 96.93 dollar transaction) is small compared to the difference in sale prices. We next compare active and less active CLO managers' transaction prices of the same loan, for trades executed within the same month. Studying these matched transactions, we find that high turnover CLOs earn 9 cents (on a 94 dollar transaction) more when selling the same loan in the same month as low turnover CLOs, and pay 5 cents less (on a 98 dollar transaction) when purchasing the same loan at the same time. Despite the lower economic magnitude, both price differences are statistically significant at a 1% level. In line with our intuition that finding a potential loan buyer is more difficult than simply purchasing a loan on the primary market (where price differences across loan buyers are smaller), the difference in sale prices is considerably larger than the difference in purchase prices for both tests. Hence, we focus our next tests on loan sales.

If we refrain from matching on transaction time in the matched sample we find that active CLOs earn 95 cent (on a 95 dollar transaction) more than less active CLOs. This difference in earnings is more than 10 times larger than the difference in earnings we find in the loan and time matched sample. Hence, we next investigate if more active CLOs are better capable of timing the leveraged loan market by selling non-performing loans earlier. To that end, we compare transaction prices of the same loan without controlling for the timing of the transaction and find that high turnover CLOs earn 95 cents more (on a 94.59 dollar transaction) when they sell the same loan as a low turnover CLO. Investigating our timing hypothesis, we find that high turnover CLOs sell 111 days earlier than low turnover CLOs. In addition, when high turnover CLOs sell a loan, the loan rating is significantly higher than when low turnover CLOs sell the same loan, suggesting that more active CLOs are better at anticipating deteriorating loan conditions.

Motivated by the large differences in transaction prices between active and less active CLOs, we next investigate if more active trading impacts the overall CLO performance. To that end, we compare the performance of the most active and least active CLOs, where we form portfolios using information from the previous quarter. We find that more active CLOs generate higher returns to their equity investors and have lower collateral default rates. Most noticeably, the percentage of defaulted loans is over 50% higher for the least active CLOs, compared to the most active CLOs, suggesting that the most active CLOs are better capable of avoiding defaults in their loan portfolios. As a placebo test, we also sort CLOs into portfolios based on their non-active turnover, measured as sales without matching purchases within a 7-day time window, and find no significant difference in equity returns but a significantly higher default rate for CLOs with more passive turnover.

To conclude our investigation of the CLO managers' performance, we check if CLO investors could utilize our active turnover measure to guide their investment choices. We compute the average active turnover of each CLO in the first observed year and split the CLO sample into three portfolios, based on first-year active turnover. Similar to the previous portfolio splits, we find that more active CLO managers outperform less active managers. Most notably, using a subset of closed CLOs for which we observe all available cash flows, we compute the internal rate of return (IRR) and find that CLOs with a high initial active turnover have an IRR of 14% compared to an IRR of 2% for the less active CLOs.

The drawback of comparing portfolios of CLOs with different levels of active turnover is that it does not allow us to control for other effects. Hence, as a robustness test, we run panel regressions of transaction prices and CLO performance on active turnover. We find that, even after controlling for transaction size, loan time to maturity and rating, as well as various CLO and collateral portfolio characteristics, CLOs with higher active turnover sell leveraged loans at higher prices than CLOs with a lower active turnover. Similarly, CLOs with a higher active turnover in the previous quarter have higher equity payments and lower collateral default rates, even after controlling for CLO and collateral portfolio characteristics.

Related Literature

We study the link between active portfolio management by CLOs and the quality of their leveraged loan transactions. In that our research relates to the literature on CLOs and structured finance, the literature on leveraged loans and trading in OTC markets, and the literature on active portfolio management. Structured finance issuance data from Bank of America illustrate the growing importance of CLOs: Between 2006 and 2016 there was an increase in both the absolute CLO issuance (from \$64 billion to \$83 billion) and the share of CLOs in the overall structured finance issuance (from 26% to 98%). Given this recent surge in popularity, investigating CLOs and their active portfolio management is crucial. Benmelech and Dlugosz (2009) give a detailed overview of rating practices in the CLO market and find that most CLOs have a similar "boilerplate" structure. More recently, Liebscher and Mählmann (2016) find that the best CLO managers (measured by their past returns) keep outperforming their peers despite of new capital inflows. This finding contradicts the cash flow performance relationship documented for mutual funds by Chevalier and Ellison (1997) and challenge the theory by Berk and Green (2004) on active management. Our finding that CLOs with more active trading get better transaction prices explains why an increase in assets under management does not weaken future CLO performance.

The CLO collateral portfolio comprises leveraged loans, which are syndicated loans to credit-risky corporations. Unlike stocks, these loans trade in an opaque OTC market where it is crucial to pick the right loans. Benmelech, Dlugosz, and Ivashina (2012) and Bord and Santos (2015) debate whether CLOs differ from other securitizations in the sense that there is no adverse loan selection problem for CLOs. The effects of securitization on leveraged loan prices are studied by, among others, Ivashina and Sun (2011), Nadauld and Weisbach (2012), and Shivdasani and Wang (2011). Ivashina and Sun (2011) show that institutional demand for buying leveraged loans by CLOs can decrease loan prices. Nadauld and Weisbach (2012) and Shivdasani and Wang (2011) study the influence of securitization on corporate debt and leveraged buyouts, respectively. Loan sales have been studied by Gatev and Strahan (2009) who find that banks are a primary investor in illiquid loans and by Drucker and Puri (2009) who study the link between loans' characteristics and their propensity to be sold. We contribute to this literature by investigating trade-level data of leveraged loan transaction on the secondary market.

Our findings suggest an inefficiency in the leveraged loan market that enables more active CLOs to outperform less active CLOs by selling deteriorating loans early. Thereby, we contribute to the current debate on whether active portfolio management can improve the investor returns. For example, Pastor, Stambaugh, and Taylor (2017) find that more active mutual fund managers outperform less active managers. We find a similar result for CLOs, where more active CLOs have higher equity returns and lower collateral default rates. In addition, Busse, Tong, Tong, and Zhang (2016) find a positive relationship between trading frequency and portfolio returns for institutional equity investors. Our findings add to this literature by showing that the effects of more active management are even more pronounced in the leveraged loan market. To the best of our knowledge, our paper is the first one to investigate leveraged loan transactions executed by CLOs.

The remainder of the paper is organized as follows. We provide a brief description of CLOs in Section 2 and describe our dataset and variable construction in Section 3. Section 4 provides motivating evidence for investigating active loan turnover. We present our main analysis as well as additional regression analysis in Sections 5 and 6, respectively. Section 7 concludes.

2 CLOs and Leveraged Loans

We now summarize the relevant CLO features for our analysis, focusing on the CLO manager and the underlying collateral portfolio. Like other structured finance products, the securities issued by the CLO have a strict seniority ranking. The equity tranche takes the first losses of the underlying portfolio and the senior tranche only suffers losses if all other tranches have already defaulted. The securities issued by the CLO are backed by an asset portfolio, which mainly consists of leveraged loans. These loans are tradable on a secondary market and allow for a manager who, besides the initial selection and purchase of the loan portfolio, purchases and sells leveraged loans throughout the CLO's lifetime.

A leveraged loan is defined as "a syndicated loan given to a non-investment-grade company or a loan that exceeds a certain interest threshold, for instance, LIBOR + 125 basis points" (LSTA, 2013). As we can see from the definition, leveraged loans are loans to risky corporations.[1] In addition, leveraged loans are syndicated, meaning that a lead bank, called the arranger, organizes the loan issuance with several counterparties to raise the required volume. At issuance, the arranger searches for investors to co-finance the loan, which makes it relatively easy for CLOs to purchase leveraged loans. On the other hand, selling a leveraged loan is more difficult. While the notional amount of leveraged loans outstanding is huge, there is a small secondary market for leveraged loans, which makes it difficult to find a counterparty. Hence, as we explain in more detail in the next section, a high CLO turnover can point to better managerial skill.

To understand the typical CLO and leveraged loan size, note that CLOs only invest in a small fraction of a leveraged loan. The average leveraged loan notional is approximately \$523 million (e.g. Benmelech, Dlugosz, and Ivashina (2012)) while, in our sample described in the following section, the average number of leveraged loans in a CLO portfolio is 352 and the average CLO balance of USD-denominated CLOs is approximately \$510 million. Hence, a CLO manager only invests in a small fraction

[1] Lower-rated corporations who need to raise large amounts of debt that exceed normal loan volumes have two financing options, issuing bonds or syndicated loans. See Denis and Mihov (2003) and Altunbas, Kara, and Marques-Ibanez (2010) for more details on this trade-off.

of a leveraged loan. The large number of leveraged loans is because the CLO manager is required to hold a diversified loan portfolio that mitigates the default risk of the senior tranches. We next discuss the CLO manager's incentives and constraints in more detail.

2.1 The Manager's Incentives and Constraints

The CLO manager receives a compensation in the form of three different fees. First, a senior fee, which is around 15 basis points of the CLO balance. Usually, this fee has the highest priority in the cash flow waterfall and is paid to the manager before the interest on the senior tranches. Second, a junior fee of approximately 30 basis points, which is paid if all cash flows to senior and mezzanine tranches are made and the collateral tests (described below) are met. Finally, an incentive fee is paid to the manager if all the criteria for the junior fees are fulfilled and the CLO equity returns exceed a pre-specified threshold. The incentive fee is approximately 20% of the payment to the equity investors but can vary significantly across CLOs. This complex compensation structure, combined with the fact that junior and senior tranche holders might have different incentives, distinguishes CLOs from other actively managed portfolios such as mutual funds.

Besides the complex compensation structure, the CLO manager has to comply with a variety of constraints.[2] As described by Aufsatz (2015) in an industry-research note, there are three major constraints. First, the loan portfolio must fulfill a pre-specified diversity score, avoiding concentration in specific issuers or industries. Second, managers can only invest in "eligible" assets, which are assets that are consistent with the structure of the CLO. For example, a manager of a U.S. CLO must allocate most of the collateral portfolio to USD denominated assets. Third, the amount invested in risky loans that are rated as CCC or below may not exceed a pre-specified threshold. Hence, high portfolio turnover could also be due to rating deteriorations in the loan portfolio, which force the CLO manager to sell CCC rated loans. We label forced trades as "non-active trading" and next describe the different reasons for non-active

[2]In general, the CLO manager's portfolio constraints are tighter in CLOs issued after the financial crisis. Further, with the Volker rules becoming effective, CLO managers are also required to retain 5% of the CLO risk on their own books.

trading.

2.2 Active Trading and Non-Active Trading

The simplest reason for a non-active trade occurs when a loan in the collateral portfolio matures. In that case, the manager uses the proceeds from the matured loan to invest in new loan(s). Other non-active trades occur in the first 3-6 months after closing of the CLO (referred to as the ramp-up period). In this period, the manager still needs to purchase part of the initial collateral portfolio. Together with the potential difficulties in selling leveraged loans, these simple reasons for non-active trading highlight that loan sales are more informative for constructing a measure of active trading than loan purchases.

As described above, one reason for non-active loan sales are binding portfolio restrictions. In addition to these portfolio restrictions, the CLO's performance is monitored through a variety of collateral tests, which ensure the safety of the senior debt tranches. The most common collateral test is the over-collateralization (OC) test which measures the cushion of the par value of the CLO assets relative to the par value of the senior CLO tranche(s):

$$\frac{Asset\ Par}{CLO\ Tranche\ Par} \geq Limit. \tag{1.1}$$

The asset par value is the sum of the notional value of all performing loans and the notional value of all non-performing loans, which enter at a haircut. The CLO tranche par value is the current par amount of outstanding principal for the respective CLO tranche. If the tranche is not the most senior one, the CLO tranche par is the sum of the tranche par and all tranches above it in seniority. If the test result (1.1) is below the limit, the OC test is breached, which forces the CLO manager to sell part of the loan portfolio and repay a fraction of the debt tranches to comply with the test limit again. This is another reason for a non-active loan sale.

Overall, a large amount of non-active transactions is an indicator of poor collateral management rather than managerial skill. Therefore, to rule out that a sale was enforced to repay debt tranches, we construct our measure of active trading as one where loan sales and loan purchases occur within a small time window. Matching a loan sale with a loan purchase ensures that the manager is selling the loan to purchase new loans instead of selling the loan to repay tranche holders. In contrast to non-active trades, these trades are more likely based on the manager's view about the underlying credits regarding rating changes or changes in credit spreads.

While a simultaneous sale and purchase of different leveraged loans is more likely to positively influence the CLO performance, the CLO manager might simply sell loans with a high market value and buy loans with a lower market value but a higher principal value instead. This transaction is called "par building". A CLO manager engaging in par building avoids an OC test breach because the transaction increases the par value of the asset portfolio, thereby increasing the test cushion. In contrast to active trading based on managerial insights, it is not obvious that par building affects collateral default rates or CLO equity returns.

Finally, the CLO trading activity can vary over its lifetime, which comprises the following three periods. First, the first 3–6 months after issuance, called ramp-up period. As mentioned above, the CLO manager still purchases parts of the loan portfolio in this period. However, given that we measure active turnover by matching loan sales to loan purchases, we do not expect this period to affect our active turnover measure. Second, the reinvestment period starts, which follows after the ramp-up period and lasts for 3–6 years. In this period, the CLO manager can reinvest the proceeds from maturing loans and loan sales in new loans. Finally, in the amortization period, which starts after the reinvestment period, the CLO manager must dedicate most cash flows from maturing loans and loan sales to debt repayments. In this period, we expect active loan trading to be significantly lower than in the first two periods. Overall, this discussion shows that CLO age is an important control variable.

3 Data and Variable Construction

We describe the underlying data of our analysis in this section. Our dataset contains information on the CLO structure and performance, the underlying collateral portfolios, and collateral transactions conducted by the CLO managers. The data source is the Creditflux CLO-i database and we focus our analysis on U.S. CLOs and the period from January 2009 to December 2016. In this section we first describe the sample of

CLOs we use in our analysis and summarize our sample of loan transactions executed by CLOs. Afterwards, we construct our active and non-active turnover measures.

3.1 CLO Data

We apply the following four filters to the CLO-i database. First, we require the CLOs to report both tranche information and equity returns. These are the minimum information necessary to understand the CLO structure. Second, we drop CLOs where we are unable to identify the equity tranche, which is important to compute the CLO's leverage ratio and annualized equity payment. Third, we remove observations where the CLO's original tranche balance deviates from the median original balance of the CLO. If over 20% of the original balance observations deviate from the median, we deem that we are unable to determine the true original balance of the CLO and remove the CLO from the sample.[3] Finally, to avoid strong outliers driving our results, we remove observations where the CLO repaid over 50% of the original balance. CLOs that have repaid half of their original balance, tend to report extremely high default rates and/or high equity payments.[4] Our final sample comprises 892 CLOs.

The two main performance measures in our analysis are the payments to the most junior tranche holders, called equity payments, and collateral default rates, which measure the percentage of loans in default for each CLO. Panel A of Table 1.1 reports summary statistics of the different CLO characteristics and performance measures in our filtered database. As we can see from the table, the average annualized equity payment is 19.72% with a standard deviation of 8.30%. While annual equity payment is the annual percentage return that CLO equity investors receive on their initial investment, these numbers are not the return on equity because the equity payment also includes return of principal. We address this potential issue in Section 5.2, where we compute the IRR for a subsample of closed CLOs and test the impact of active turnover on these figures. Finally, the average collateral default rate in our CLO sample is 1.65%, with a high standard deviation of 4.59%.

[3]Changes in the original balance are a clear mistake and happen, for example, when the reports for some tranches are missing in some months. This filter is relatively harsh and leads us to drop 77 CLOs. In addition, we remove outliers in another 186 CLOs, where the original balance deviates in some months.

[4]Our results are robust to using other cut-off values, such as 20% or 90%.

Panel A of Table 1.1 also shows that the percentage of CCC or below rated loans is, on average, 5.95%, and almost four times as high as the percentage of defaulted loans. The average CLO size is $510 million and CLOs hold, on average, 352 different leveraged loans in their portfolio, which is in line with Benmelech, Dlugosz, and Ivashina (2012). Family size shown in Table 1.1 gives the number of CLOs under the same CLO manager. On average, a CLO manager handles 12.62 CLOs, although there is a large cross-sectional variation in family size, ranging from a 10% quantile of 2.54 to a 90% quantile of 24.88. On average, CLOs have an equity share of 10.53% and are 41.94 months old. Finally, for a subset of CLOs, we also have information on the fee structure and note that the median senior and junior fees are 20 basis points and 30 basis points, respectively.

3.2 Transaction Data

We next describe the sample of CLO collateral transactions, which enables us to obtain insights into leveraged loan transactions. The observations include information on the loan in question, the transaction price, and the transaction date. The dataset comprises purchases and sales made by CLOs in our filtered sample and we focus on term leveraged loans, denominated in US dollars, which comprise over 90% of the transaction data sample. We delete observations with obvious reporting mistakes in the price or the size of the transaction, namely zero or negative values or prices above $120 or below $15.[5] Finally, 14% of the transactions have a price equal to $100, which is most likely a default value used when the actual transaction price is not observed. We delete these observations from our sample but note that the results are robust to including transactions with a price equal to $100.

We report summary statistics of transaction prices, trade size, loan rating, and loan maturity in Panel B of Table 1.1. The sample comprises almost half a million transactions with 196,312 sales and 280,612 purchases, indicating that approximately one third of the purchased loans are held until the loan either matures or defaults. The average transaction size is $1.06 million, ranging from a 10% quantile of $0.13 million to a 90% quantile of $2.45 million. Splitting these numbers into loan purchases and

[5]Most of these misreportings occur in the early part of the sample.

sales, the average transaction size is \$1.2 million and \$0.8 million, respectively (we do not report these separate numbers in the table to conserve space). The credit rating and loan maturity are available for a subsample of 245,179 and 343,870 of the traded loans respectively. The average traded loan has a rating of B+ and a time to maturity of 4.98 years. Again, splitting these numbers into purchases and sales, the loans in our sample have 5.2 years to maturity and are B+ rated on average when purchased, and have 4.5 years to maturity and are B rated on average when they are sold.

3.3 The Active Trading Measure

As noted in section 2.2, a CLO manager can be forced to sell loans (e.g. after a collateral test breach) or to purchase new loans if part of the collateral portfolio matures. Hence, we need to distinguish between these non-active trades and active trades which occur at the CLO manager's discretion. To distinguish active from non-active trades, we first identify active sales by matching the cash flows from loan sales at day i (CF_i^{Sales}) to the cash flows of loan purchases (CF_i^{Purch}) executed within a 3-day window:

$$\text{ActiveSale}_{i,3} := \min\left(CF_i^{Sales}, CF_{k\in[i-3,i+3]}^{Purch}\right). \tag{1.2}$$

Equation 1.2 identifies transactions where the manager has sold part of the loan portfolio to purchase new loans.

We then construct our measure of active turnover as follows. On each day we compute $\text{ActiveSale}_{i,3}$, where we remove any previously matched purchases to avoid double-counting of loan purchases. Afterwards, we aggregate all active sales within quarter t and divide this figure by the total CLO liabilities in quarter t. In summary, our measure of active turnover is defined as:

$$\text{ActiveTurnover}_t := \sum_{i\in t} \frac{\text{ActiveSale}_{i,3}}{CLO\ Tranche\ Par_t}. \tag{1.3}$$

Next, we construct a measure of non-active turnover that comprises all sales without matching expenses from loan purchases. As before, we take the sum of all non-active transactions in quarter t and divide by the total CLO liabilities in quarter t. In contrast to the 3-day window for active trades, we use a 7-day window to identify non-active trades to ensure that there is no matching purchase withing a short time window.[6] Our measure for non-active trading is defined as:

$$\text{PassiveTurnover}_t := \sum_{i \in t} \frac{CF_i^{Sales} - \text{ActiveSale}_{i,7}}{CLO\ Tranche\ Par_t}. \tag{1.4}$$

Panel C of Table 1.1 provides summary statistics for the active and non-active turnover measures. Active turnover is on average 1.38%. It varies from a 10% quantile of 0.22% to a 90% quantile of 2.66%, illustrating that there is a large variation in trading activity across CLOs. Non-active turnover is on average 0.78%, ranging from a 10% quantile of 0.05% to a 90% quantile of 1.53%. The median active turnover is 0.99% and the median non-active turnover is 0.45%, indicating that approximately two thirds of the loan sales are classified as "active".

4 Understanding Active and Non-Active Turnover

In this section, we explore the loan transaction data in two steps. First, we compare active and non-active loan sales and test if the nature of the transaction affects the sale price and has predictive power for the future credit rating of the sold loan. Afterwards, we investigate the drivers of active turnover and non-active turnover, testing if the trading behavior of a CLO is linked to its characteristics or its collateral portfolio.

4.1 Active and Non-Active Loan Sales

In this section, we focus our analysis on loan sales because our construction of the active turnover measure allows for an easy identification of "active sales", i.e., sales for the purpose of portfolio rebalancing. By contrast, loan purchases are more frequent and distinguishing "active purchases" from purchases that occur, say, to replace a maturing loan, is difficult. To explore the difference between active and non-active loan sales, we run panel regressions of the following form:

[6] Our results are robust to using different time windows, like using the same 3-day window for both active and non-active turnover or using the same 7-day window for both active and non-active turnover.

$$
\begin{aligned}
Price_{i,t} &= \alpha + \beta^{Active} FracActive_{i,t} + \\
&\quad + \beta^{TTM} TTM_{i,t} + \beta^{Principal} \log(Principal)_{i,t} + \beta^{Rating} Rating_{i,t} + \varepsilon_{i,t}. \qquad (1.5)
\end{aligned}
$$

In a first step, we regress the sale price of loan i at time t on $FracActive_{i,t}$ – the fraction of notional for each sale that we can match to a purchase within a 3-day window – which is defined as:

$$
FracActive_{i,t} := \frac{ActiveSale_{i,t}}{CF^{Sales}_{i,t}}.
$$

We assign the same $FracActive$ if multiple sales occur on the same day. In that specification, the intercept α corresponds to the average sale price and β^{Active} can be interpreted as the difference between a non-active and an active sale. As shown in the first panel of Table 1.2, active sales are executed at significantly higher prices compared to non-active sales. On average, an active sale is conducted at a \$1.612 higher price (relative to a price of \$93.475) compared to a non-active trade. The difference between active and non-active trades is statistically significant at a 1% level. In a second step, we add year-month fixed effects, the loan time to maturity, loan transaction principal, and loan rating, as controls. As shown, in the second panel of Table 1.2, the difference between active and non-active sales remains significant at a 1% level, despite a drop in the economic significance of active trading.

In addition to the price tests, we investigate if more active sales contain more information about the future credit quality of a loan issuer by testing their predictive power for rating downgrades. To that end, we compute the rating change for each transaction as change from current rating to the credit rating in six months, which we compute as the average credit rating among all available transactions of that loan after six months of the transaction date. We then replace $Price_{i,t}$ in Equation (1.5) with $Rating\ Change_{i,t}$ and repeat our analysis. The last two panels of Table 1.2 exhibit the results of the rating change test. The third panel shows the results without adding controls and we can again interpret the intercept as the average rating change and β^{Active} as the difference between active and non-active loan sales. While the intercept is not significantly different from zero, $FracActive_{i,t}$ is significantly negative, suggesting that the loan quality tends to deteriorate after an active sale. Taken together, the results in the third panel suggest that, approximately, one out of 11 actively sold loans is downgraded within six months of the loan sale. The results remain robust to adding time to maturity, principal amount, current rating, and time fixed effects as controls.

Overall, these findings suggest that active CLO trades are executed at better prices and before the credit quality of the underlying loan deteriorates. Next, we investigate the drivers for active and non-active CLO turnover.

4.2 The Drivers of Active and Non-Active Turnover

We run a panel regression of active CLO turnover and non-active CLO turnover on the following form:

$$\begin{aligned} Turnover_{i,t} = \alpha + \beta^{Size}\log(Size_{i,t}) + \beta^{Age}Age_{i,t} + \beta^{Reinv}1_{\{t\leq Reinv_{i,t}\}}(t) + \beta^{Fam}Family\ Size_{i,t} \\ + \beta^{Ret}Equity\ Ret_{i,t} + \beta^{ES}Equity\ Share_{i,t} + \beta^{Test}1_{\{\text{Test breach}_{i,t}\}} + \beta^{Def}Perc\ Def_{i,t} + \\ \beta^{TTM}AvgTTM_{i,t} + \beta^{Diversif}Diversif_{i,t} + \varepsilon_{i,t}. \end{aligned} \quad (1.6)$$

The first set of explanatory variables is related to the CLO characteristics and lifetime. They include the CLO size ($Size_{i,t}$) and Age ($Age_{i,t}$), a dummy variable that is equal to one if the CLO is still in its reinvestment period ($1_{\{t\leq Reinvest_i\}}$), the number of CLOs under the same management firm ($Family\ Size_{i,t}$), the annualized payments to equity investors in the current period ($Equity\ Ret_{i,t}$), and the ratio between equity tranche balance and total CLO balance ($Equity\ Share_{i,t}$). In a second step, we add control variables that capture the quality of the CLO collateral portfolio. These variables include a dummy variable that is equal to one if a senior OC test has been breached ($1_{\{Test\ breach_{i,t}\}}$), the percentage of defaulted loans in the collateral portfolio ($Perc\ Def_{i,t}$), the average time to maturity of the loan portfolio ($AvgTTM_{i,t}$), and a measure of portfolio diversification ($Diversif_{i,t}$).[7] The results from this panel regression are exhibited in Table 1.3.

[7] The measure of portfolio diversification is constructed as follows: First, we compute the percentage of loans within a certain industry held by the CLO. Second, we compute an Herfindahl-Hirschman Index (HHI) of the portfolio holdings, that is, we compute the sum of squared industry percentages. Finally, we use $1 - \frac{HHI}{10{,}000}$ as our proxy for portfolio diversification, where we divide by the highest possible HHI, which is $10,000$.

We examine active CLO turnover in the first two panels and non-active turnover in the last two panels. In both cases, we first use explanatory variables capturing CLO characteristics and add controls for the portfolio holdings in a second step. Examining the results, the adjusted R^2 values suggest that CLO characteristics explain more of the variation in active turnover compared to non-active turnover. The additional portfolio holding controls double the explanatory power of our regressions for non-active turnover but only lead to a small increase in adjusted R^2 for active turnover.

Turning to the regression coefficients, we first observe a higher active turnover and a lower non-active turnover for larger CLOs, indicating that a larger portfolio enables a collateral manager to trade more. Age and Reinvestment Dummy suggest that younger CLOs and CLOs still in their reinvestment period engage in more active trading, while there is a significant increase in non-active trading after the reinvestment period. Interestingly, the CLO family size is an insignificant explanatory variable which tends to lower active and non-active turnover, suggesting that CLOs under the same manager do not trade significantly more with each other. Higher equity returns increase both active turnover and non-active turnover and we explore the relationship between active turnover and equity returns in more detail in the following section. Finally, CLOs with a larger equity share exhibit both more active trading and more non-active trading.

Inspecting the results after adding CLO collateral portfolio controls reveals that CLOs with a worse quality of collateral do less active trading. Active turnover drops after test breaches and is lower for CLOs with more defaulted collateral. The opposite is true for non-active turnover which increases if a test breach occurs and if collateral default rates increase. The remaining two controls are only significant for active turnover. CLOs that have a collateral portfolio with a longer average time to maturity have a higher active turnover. Portfolio time to maturity tends to have the opposite effect for non-active turnover. Finally, better diversified CLOs have more active trading and less non-active trading.

5 Analyzing CLOs with Different Trading Activity

Motivated by the results from the previous section, we next test our main hypothesis: CLOs with high active turnover trade at better prices and outperform CLOs with low active turnover. To test this hypothesis, we split the overall sample of CLOs into three buckets (high active turnover, medium active turnover, and low active turnover) and run two sets of tests. First, we test whether CLOs with higher active turnover trade loans at better prices than CLOs with a lower turnover. Afterwards, we form the portfolios based on turnover in the previous quarter and test if active turnover or non-active turnover can predict CLO performance in the next quarter.

5.1 More Active CLOs Trade at Better Prices

We first compare loan transactions by high and low turnover CLOs. To get CLO portfolios with significantly different active turnover, we use the quarterly active turnover measure described in Section 3.3 and form three portfolios: High turnover, medium turnover, and low turnover. The portfolio formation is based on the active trading measure within the same quarter and we rebalance the portfolios every quarter. Figure 1.1 shows that high turnover CLOs buy and sell leveraged loans at better prices than low turnover CLOs. Figure 1.1 (a) shows that more active CLOs sell more leveraged loans above par value while less active CLOs sell more loans with a market value below 55%. Figure 1.1 (b) shows that the picture is reversed for purchases, where less active CLOs tend to purchase loans at par value.

Overall, Figure 1.1 suggests that high turnover and low turnover CLOs exhibit different trading patterns, both when purchasing loans, where more active CLOs pay less, and, even more so, when selling loans, where more active CLOs are able to sell loans at much higher prices. In Panel A of Table 1.4 we test if there is a significant difference between the transaction prices that more active and less active managers obtain. We first compare the transactions of the most active and least active CLOs and find that more active CLOs, on average, sell loans at 5.47% higher prices (t-statistic of 5.15) than less active CLOs. More active CLOs also purchase cheaper loans than less active CLOs, but the average difference of -0.37% (t-statistic of -2.54) is small compared to the difference in sale prices. Note that these results do not control for loan type or the timing of the loan trade. That is, we cannot yet claim that more active investors get better prices when they trade assets with a similar risk. We investigate this hypothesis next.

Trading and Prices

We now investigate the link between active trading and trade prices, proceeding in four steps. First, we test if high turnover CLOs and low turnover CLOs trade at different prices when trading the same loan in the same month. Second, we compare the transaction prices of loans traded by high and low turnover CLOs at any point in time. Third, we repeat our analysis on the CLO manager level instead of comparing individual CLOs. Finally, we use a subset of transactions with the same principal balance to control for transaction size.

Investigating trades of the same loan, executed in the same month, we compare the average transaction prices for high turnover, medium turnover and low turnover CLOs in Panel B of Table 1.4. For each loan and each month, we compute the median sale and purchase price for high, medium, and low turnover CLOs. We then use the subset of loan-months where both high and low turnover CLOs sell the same loan in the same month and report the average sale price of high turnover, medium turnover, and low turnover CLOs. We find that high turnover CLOs, on average, get 9 cents more on a $94 transaction when selling the same loan in the same month as low turnover CLOs. This difference of 9 cents is statistically significant at a 1% level despite its low economical significance. For loan purchases, we find that high turnover CLOs, on average, pay 5 cents less buying the same loan in the same month as low turnover CLOs. As for sales, the difference in price is statistically significant at a 1% level despite its low economic significance.

So far, these results document that high turnover CLOs get better prices than low turnover CLOs when trading the same loan in the same month. However, the 9 cents difference in sales is surprisingly small compared to the sale price difference of $5.47 we found when we did not match on loan-months. Hence, we next consider the subset of loans sold by both high and low turnover CLOs without requiring that the transactions occurred within the same month. We focus on loan sales because the difference in unmatched transaction prices is more than 50 times larger than for the matched transactions. As explained above, a higher difference for loan sales is intuitive because finding a potential loan buyer is more difficult than purchasing a new loan on the primary market.

Turning to our second test, for each of the loan transactions and for each CLO turnover group, we compute the median sale price, sale date, and credit rating at the median sale date of all sales. We report the averages of these values across loans for each turnover group in Panel B of Table 1.4 (last three rows). We find a difference of $0.95 in transaction prices when a high turnover CLO sells the same loan as a low turnover CLO. Moreover, a high turnover CLO sells 111 days earlier than a low turnover CLO and the average numerical rating of the loans at the time they are sold is 7.4 for high turnover CLOs and 7.31 for low turnover CLOs. Though both numerical ratings correspond to a credit rating of B, there is a statistically significant difference in credit ratings for the two groups. Hence, high turnover CLOs tend to sell loans with better ratings than low turnover CLOs. Taken together, the results in Panel B suggest that more active CLOs get better prices when high and low turnover CLOs trade the same loan simultaneously. Furthermore, when we compare transactions without matching the transaction month, we find that active CLOs sell earlier, at a better price, and while the loan has a better credit rating.

Alternative Explanations?

As we have seen in Table 1.1, the average CLO manager is in charge of 12 different CLOs, which raises two potential concerns. First, industry practitioners indicated to us that several of the trades executed by individual CLOs could occur within the same family, for example, when a CLO manager wants to sell the same loan in various CLOs he would first transfer the loans to one CLO to sell them as one bundle. We alleviate this concern by excluding transactions executed at a price of $100, which is the most common price for these transactions. Second, Eisele, Nefedova, and Parise (2016) find that, for mutual funds, trades within the same fund family are more likely executed at a different price than the market price. They hypothesize that mutual fund managers use transactions within the same family to improve the performance of one "star fund".

Hence, we next analyze whether our results remain intact if we compare CLO families instead of individual CLOs.

Hence, we investigate the results on the manager level in our third test. We first aggregate CLO turnover at the manager level and define manager turnover as the weighted average of the turnover of all CLOs under the same manager. We then sort CLO managers into high turnover, medium turnover, and low turnover buckets. Panel C of Table 1.4 exhibits the results for the manager level tests, following the same logic we used for individual CLOs in Panel B. As before, for each loan in the sample, we determine the median sale price, median sale date, and rating at the median sale date. We find that, on average, the high turnover managers earn $0.59 more on a transaction of $95 when they sell the same loan as a low turnover manager. Moreover, active managers sell, on average, 73 days earlier than the passive managers and tend to sell loans with a better rating. Overall, the manager level results are consistent with the individual CLO level tests: Compared to less active managers, more active managers trade earlier, at better prices, and while the loans have a higher credit rating. Hence, we can rule out that the better transaction prices are only driven by a spurious manager effect, arising, for example from managers shifting loans across CLOs.

In our analysis up to this point, we did not control for transaction size even though it might influence prices. In stock markets larger transactions have a higher price impact and therefore a large sale drives the price down. The opposite is true in corporate bond markets where large participants, who are typically behind the large transactions, are better negotiators and therefore capable of obtaining tighter bid-ask spreads (see, for example, Feldhütter (2012)) and higher sale prices. Hence, the transaction volume can influence the sale price, although it is not a priori clear in which direction. To control for transaction size, we next analyze a subset of transactions with a similar volume.

CLOs execute sales at a wide range of transaction sizes but one large transaction cluster is around $1,000,000. We therefore use a subset of transactions within the range of $900,000 to $1,100,000 to test the impact of transaction size. The results are exhibited in Panel D of Table 1.4. We report the same results as before but only include transactions with a size between $900,000 and $1,100,000, and consider loans sold at least once by both high and low turnover CLOs at the appropriate transactions size. For each loan we compute the median price, the median transaction date and the loan rating at the median date, again only considering transactions of the appropriate size, and report averages across loans.

We find that, in this subsample, high turnover CLOs earn \$1.19 more when selling the same loan as low turnover CLOs. High turnover CLOs sell 139 days earlier and when the loans are 0.19 notches higher rated. Overall, Panel D of Table 1.4 suggests that the positive relation between high trading activity and favorable prices is even stronger when focusing on large transactions with a similar volume (recall that the average transaction size for loan sales is \$0.8 million). Hence, Panel D suggests that the benefit of being more active is stronger when the CLO sells larger shares of the loan portfolio.

5.2 More Active CLOs Perform Better

Next, we investigate whether the payments to equity tranche holders and the collateral default rates differ between high and low turnover CLOs. As before, we form portfolios based on active turnover now using the turnover in quarter $t-1$ to classify CLOs as high turnover, medium turnover, or low turnover and to predict CLO performance in quarter t. First, we use the active turnover measure constructed in Section 3.3 and test if there is a significant difference between the equity returns and default rates of high active turnover and low active turnover CLOs. We then run a placebo test with the non-active turnover measure described in Section 3.3. In this placebo test, we form three CLO portfolios based on their non-active trading activity in quarter $t-1$ and analyze the difference between equity returns and default rates in the three portfolios.

As we can see from Panel A of Table 1.5, there is a significant difference between active turnover in quarter t for CLOs with a high turnover in quarter $t-1$ and CLOs with a low turnover in quarter $t-1$. Moreover, annualized equity payments decrease monotonically from CLOs with high turnover to CLOs with low turnover and there is a difference of 2.20% (t-statistic of 2.27) between the high and low turnover groups. Similarly, default rates increase monotonically from high turnover to low turnover CLOs and the difference between the high and low turnover groups is -0.76% (t-statistic of -5.93). Overall, these findings suggest that more active turnover predicts better CLO performance.

Turning to our placebo test with non-active turnover, we first note that more non-active turnover should not improve the CLO performance. If anything, a higher non-active turnover may indicate that the CLO is in financial distress which forces it to sell part of the loan portfolio to redeem senior note holders. In line with this intuition, Panel B of Table 1.5 shows that more non-active turnover does not predict a significant difference in equity returns. However, CLOs with more non-active turnover have significantly higher default rates with a difference of 1.79% (t-statistic 2.40), compared to CLOs with less non-active turnover. Hence, more non-active turnover is indeed an indicator for deteriorations in the credit quality of the loan portfolio.

Making Money with Investments in Active CLOs

In this subsection, we investigate whether CLO investors could use our active turnover measure to guide their investment choices. To that end, we compute the average active turnover of each CLO in the first observed year and split the CLO sample into three portfolios, based on first-year active turnover. We then form three portfolios, using the remaining performance data. This split ensures that, in theory, an investor is capable of observing the active turnover of CLO managers and then follow a buy and hold strategy in the most active CLOs.

In line with our previous results, Panel C of Table 1.5 shows that more active CLOs outperform less active CLOs. CLOs with the most active turnover have an average equity payment of 24.99% while CLOs with the least active turnover only pay an average of 20.58% to their investors. Similarly, the percentage of defaulted loans is almost twice as high for the least active CLOs when compared to the most active CLOs. In addition, we use a subset of closed CLOs for which we observe all cash flows to compute the internal rate of return (IRR). Using the IRR instead of equity payments enables us to obtain a cleaner measure of CLO performance which is not affected by notional repayments. Comparing the IRR for high active turnover and low active turnover CLOs, we find a striking difference: CLOs with a high initial active turnover have an IRR of 14% compared to an IRR of 2% for the CLOs with a low initial turnover.

6 Regression Analysis

The previous section shows that CLOs with a higher active turnover trade at better prices and outperform less active CLOs. We now test the robustness of this finding in a regression setting, which enables us to control for other CLO or loan-specific characteristics.

6.1 More Active Turnover and Better Transaction Prices

In this section we further investigate the link between transaction prices and active CLO turnover by running panel regressions of transaction prices – separately for sales and purchases – on the active turnover measure, controlling for the time to maturity ($TTM_{i,t}$), principal ($Principal_{i,t}$), and rating ($Rating_{i,t}$) of the transaction, as well as a variety of CLO and collateral portfolio characteristics:

$$Price_{i,t} = \alpha_i + \beta^{Active} Turnover_{i,t}^{Active} + \beta^{TTM} TTM_{i,t} \\ +\beta^{Principal} Principal_{i,t} + \beta^{Rating} Rating_{i,t} + \gamma Controls_{j,t} + \varepsilon_{i,t}. \tag{1.7}$$

In the above regression, the subscipt i, t refers to a specific loan trade while the subscript j, t refers to a specific CLO characteristic at the time of the trade. $Turnover_{j,t}^{Active}$ is the active turnover measure constructed in Section 3.3 and we add time and loan type fixed effects to all regressions. In a second step, we add $Controls_{j,t}$, which are at the CLO level and include the ten explanatory variables from Equation (1.6) that we used before to explain active turnover in Section 4.2.

As we can see from Table 1.6, active turnover is a significant explanatory variable for both sales and purchases. To interpret the coefficient on $Turnover_{j,t}^{Active}$ we note that the standard deviation of active turnover is 0.04 and, hence, a one standard deviation increase in active turnover corresponds to a $5.268 \times 0.04 = 0.211$ dollar increase in sale price, after controlling for other CLO characteristics. Similarly, a one standard deviation increase in $Turnover_{j,t}^{Active}$ corresponds to a 0.242 dollar drop in purchase prices.

6.2 More Active Turnover and Better CLO Performance

In this section we further investigate the relationship between active turnover and CLO performance. As in Section 4, we use the payoffs to CLO equity holders as a proxy for CLO returns and the percentage of defaulted loans in the CLO collateral portfolio as a measure of the CLO's riskiness. We then test whether our measures of active and non-active turnover have any predictive power for equity returns and default rates. In contrast to Section 4, we now estimate the impact of active turnover on returns and portfolio defaults using a panel regressions with the following controls:

$$Perf_{j,t} = \alpha + \beta^{Active} Turnover^{Active}_{j,t-1} + \gamma^{CLO} Controls^{CLO}_{j,t} + \gamma^{Collat} Controls^{Collat}_{j,t} + \varepsilon_{j,t}. \tag{1.8}$$

The dependent variable in this regression is either equity payment (the annualized cash return to equity holders), or percentage default (the average quarterly collateral default rate). We regress these performance measures on $Turnover^{Active}_{i,t-1}$ which is the lagged quarterly active turnover measure we constructed in Section 3.3, gradually adding the ten explanatory variables from Equation 1.6 that we used before to explain active turnover in Section 4.2. In a first step we only use the controls related to the CLO structure and add controls related to the collateral portfolio and time fixed effects in a second step.

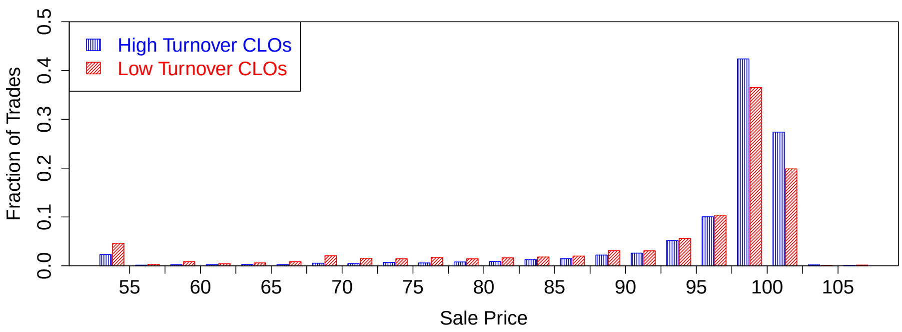
As shown in Table 1.7, active turnover is statistically significant for all four model specifications. From the first two specifications, we can see that a higher active turnover predicts a lower percentage of defaulted loans in a CLO portfolio. In the baseline specification, a one standard deviation increase in active turnover, corresponding to 4%, predicts a decrease of 0.16% in the collateral default rate. Adding portfolio controls and time fixed effects approximately halves the economic and statistical significance of the coefficient. From the last two regression specifications in Table 1.7 we can see that a higher active turnover predicts higher equity payments. In the baseline specification, a one standard deviation increase in active turnover predicts a 1% increase in equity payments. The effect remains significant after adding collateral controls and time fixed effects.

Overall, Table 1.7 shows that more trading activity improves CLO performance. This improved performance is reflected in both higher equity returns, which benefit equity tranche holders and lower default rates, which tend to benefit both equity and senior tranche holders.

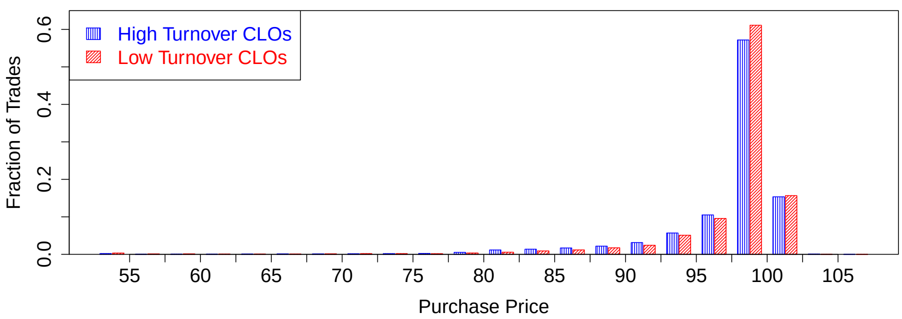
7 Conclusion

In this paper, we analyze a novel set of leveraged loan transactions executed by managers of CLOs. After constructing a measure for active portfolio turnover of CLOs, we find that active loan sales are executed at better prices and predict rating downgrades. In addition, CLOs with a higher trading activity trade at better prices than CLOs with a lower trading activity. This finding is robust to controlling for transaction size and tests on the manager level instead of the individual CLO level. Moreover, we document that more active CLOs trade earlier than less active CLOs and sell loans with a higher credit rating. In addition to these trade-level tests, we find that higher active turnover predicts higher equity returns and lower CLO portfolio default rates. This finding is in line with previous research on active versus passive management in the case of equities, showing that more active managers are capable of outperforming the market. Placebo tests with an alternative turnover measure which captures non-active trading lead to insignificant or qualitatively different results, suggesting that our measure of active turnover is capable of capturing a unique skill of CLO managers.

8 Figures and Tables



(a) Distribution of sale prices



(b) Distribution of purchase prices

Figure 1.1: **Do CLOs with high active turnover trade at better prices?** We categorize transactions as high turnover, medium turnover, and low turnover based on the active turnover of the CLO which executed the transaction. The measure for active turnover is defined in Section 3.3. The figure shows the empirical distribution of the median sale price (panel (a)) or median purchase price (panel (b)), respectively. For each loan we find the median high turnover and low turnover price over the full sample period of transactions and include the median prices in the computation of the empirical density. The sample period is January 2009 to December 2016. The sample of transactions consists of loans that are sold by both high and low turnover CLOs in this period.

Table 1.1: **Summary Statistics.** This table reports summary statistics of our filtered CLO and loan trade sample. Panel A reports CLO performance measures and other characteristics. Panel B reports summary statistics for loan transactions executed by CLOs in our sample. Panel C reports the summary statistics for the active and non-active turnover measures constructed in Equations (1.3) and (1.4). We report mean, standard deviation (std), 10% quantile (10%), median, 90% quantile (90%), and the number of observations (N) for transaction price and transaction size. In Panels A and C, we first compute CLO lifetime averages of all variables and then use these averages to compute mean, standard deviation (std), 10% quantile (10%), median, and 90% quantile (90%). The number of observations in Panels A and C refer to the number of CLOs with available data. The sample period for all data is January 2009 to December 2016.

	Mean	std	10%	Median	90%	N
Panel A: CLO characteristics						
Equity payment (%)	19.72	8.30	10.39	19.67	27.58	892
Default (%)	1.65	4.59	0.00	0.65	4.00	892
CCC bucket (%)	5.95	3.29	2.68	5.40	9.62	892
Original size	509.48	201.78	333.79	499.45	712.19	892
Family size	12.62	10.04	2.54	10.19	24.88	892
# Loans	352.24	187.11	158.65	318.93	602.47	892
Equity share (%)	10.53	5.11	7.90	9.45	13.17	892
Age (months)	41.94	29.74	8.26	32.05	80.89	892
Panel B: Transaction Data						
Sale price	94.57	12.16	83.12	99.01	100.50	196,312
Purchase price	97.36	5.48	92.50	99.00	100.25	280,612
Transaction size (mill $)	1.06	1.41	0.13	0.69	2.45	476,924
Rating	B+	1.67	B-	B	BB	245,179
Maturity (years)	4.98	1.60	2.70	5.12	7.00	343,870
Panel C: Turnover measures						
Active turnover (%)	1.38	1.65	0.22	0.99	2.66	855
Non-active turnover (%)	0.78	1.44	0.05	0.45	1.53	855

Table 1.2: **Comparing active and non-active trades.** This table exhibits the results of regressing sale prices and future rating changes on *FracActive*, the fraction of sales notional that can be matched to a purchase within a 3-day window. TTM, log(*Principal*), and Rating are the time to maturity, principal amount sold, and rating, of the loan transaction. Heteroskedasticity robust standard errors, clustered at the issuer level are reported in parentheses. ***, **, and * indicate significance at a 1%, 5%, and 10% level respectively. The sample period is January 2009 to December 2016.

	Sale Price		Rating Change	
Intercept	93.475***	36.582***	−0.035	0.078
	(0.633)	(4.484)	(0.045)	(0.681)
FracActive	1.612***	0.645***	−0.053*	−0.074**
	(0.300)	(0.184)	(0.031)	(0.030)
TTM		0.573***		0.019
		(0.157)		(0.022)
log(*Principal*)		0.504***		0.066***
		(0.159)		(0.018)
Rating		2.921***		−0.091***
		(0.238)		(0.029)
Time FE	*No*	*Yes*	*No*	*Yes*
Observations	172,580	132,437	60,206	45,974
Adjusted R^2	0.004	0.415	0.000	0.080

Table 1.3: **What drives active and non-active trading?** This table exhibits the results of regressing active turnover and non-active turnover on the indicated variables. log(Size) is the logarithm of the total balance of the CLO debt tranche. Age is the age of the CLO in years. Reinvest dummy is an indicator variable that equals one if the CLO is still in the reinvestment period and zero otherwise. Family size is the number of CLOs under the same manager. Equity return is the annualized payment to equity tranche holders. Equity share is the ratio between the CLO equity tranche and the CLO debt balance. Test breach dummy is a dummy variable that equals one if the CLO had an OC test breach and zero otherwise. Percent default is the percentage of defaulted loans in the collateral portfolio. Average TTM is the average time to maturity of the CLO loan portfolio in years. Diversification is a diversification score based on the Herfindahl-Hirschmann Index that is described in more detail in Section 4. The numbers in parentheses are Newey-West t-statistics. ***, **, and * indicate significance at a 1%, 5%, and 10% level respectively. The sample period is January 2009 to December 2016, including all CLOs from our filtered sample.

	Active Turnover		Non-Active Turnover	
Intercept	-9.39^{***}	-11.94^{***}	5.76	11.69^{***}
	(2.15)	(2.25)	(3.51)	(4.25)
log(Size)	0.55^{***}	0.53^{***}	-0.34^{*}	-0.55^{**}
	(0.11)	(0.11)	(0.18)	(0.22)
Age (years)	-0.25^{***}	-0.14^{***}	-0.09^{**}	-0.24^{***}
	(0.02)	(0.03)	(0.04)	(0.09)
Reinvest dummy	1.50^{***}	1.57^{***}	-0.97^{***}	-1.28^{***}
	(0.12)	(0.12)	(0.23)	(0.24)
Family size	-0.33	-0.71^{**}	-0.22	0.83
	(0.32)	(0.33)	(0.44)	(0.59)
Equity return (%)	1.22^{***}	0.62^{***}	4.89^{**}	6.70^{***}
	(0.29)	(0.23)	(2.08)	(2.45)
Equity share	5.59^{***}	6.90^{***}	18.96^{**}	14.54^{**}
	(1.68)	(1.65)	(8.85)	(6.09)
Test breach dummy		-1.22^{***}		0.85
		(0.21)		(1.23)
Percent default		-5.93^{***}		30.35^{**}
		(1.30)		(13.32)
Average TTM		0.36^{***}		-0.07
		(0.06)		(0.20)
Diversification		1.04^{***}		-1.22
		(0.26)		(1.08)
Observations	8,626	8,483	8,626	8,483
Adjusted R^2	0.15	0.17	0.06	0.12

Table 1.4: **CLOs with high active turnover trade at better prices.** We categorize transactions as high turnover, medium turnover, and low turnover based on the active turnover of the CLO which executed the transaction in Panels A, B and D, or based on the aggregate active turnover of the CLO manager in Panel C. The active turnover measure is defined in Section 3.3. Panel A shows the average transaction prices without matching the same loans. In Panels B–D we start with the sample of loans that are traded by both high turnover and low turnover CLOs. For each loan and for each turnover group we compute the median sale price over the full sample length, the median sale date, and numerical rating (defined in Section 4) at the median sale date. We then report averages of the median values across loans and test if high and low turnover values are significantly different. The addition (same month) indicates that we match transactions by high turnover and low turnover CLOs of the same loan executed in the same month. Panel D shows the results for a subset of transactions with a transaction size between USD 900,000 and USD 1,100,000. ***, **, and * indicate significance at a 1%, 5%, and 10% level respectively. The sample period is January 2009 to December 2016.

	High Turnover	Medium Turnover	Low Turnover	High - Low	[t-stat]
		Panel A: Results without matching loans			
Sale price	94.07	91.57	88.60	5.47***	[5.15]
Purchase price	96.56	96.73	96.93	−0.37**	[-2.54]
		Panel B: Results for individual CLOs			
Sale price (same month)	94.26	94.14	94.17	0.09***	[3.71]
Purchase price (same month)	97.80	97.78	97.85	−0.05***	[-6.47]
Sale price (anytime)	95.55	95.09	94.59	0.95***	[7.68]
Sale date	Jan 4, 2014	Apr 15, 2014	Apr 25, 2014	-111***	[-13.29]
Loan rating at sale date	7.40	7.34	7.31	0.09***	[4.60]
		Panel C: Results at manager level			
Sale price (anytime)	95.64	95.28	95.05	0.59***	[4.39]
Sale date	Feb 6, 2014	May 9, 2014	Apr 20, 2014	-73***	[-8.18]
Loan rating at sale date	7.44	7.42	7.33	0.11***	[5.23]
		Panel D: Transaction size between $900,000 and $1,100,000			
Sale price (anytime)	95.87	95.32	94.67	1.19***	[4.74]
Sale date	Dec 25, 2013	Jun 1, 2014	May 13, 2014	-139***	[-6.69]
Loan rating at sale date	7.59	7.56	7.40	0.19***	[3.78]

Table 1.5: **Analysis of different CLO subsamples split by turnover.** This table shows average CLO performance and transaction prices for different subsamples of the entire CLO sample. At the beginning of quarter t, the entire CLO sample is split into three portfolios based on their turnover in quarter $t-1$. In Panel A, the sample is split based on the active turnover measure constructed in Section 3.3. Panel A reports average turnover, equity payments and collateral default rates for the different portfolios. Panel B reports results for portfolios sorted on the non-active turnover measure constructed in Section 3.3. In Panel C, the average active turnover for the first four observed quarters are computed for each CLO and we split the entire CLO sample into three portfolios based on their average active turnover in the first year. IRR is the internal rate of return which is computed for the subset of closed CLOs for which we have complete payment information. High - Low tests if there is a significant difference between high and low turnover portfolios. Newey-West t-statistics are reported in parentheses. ***, **, and * indicate significance at a 1%, 5%, and 10% level respectively. The sample period is January 2009 to December 2016.

	High Turnover	Medium Turnover	Low Turnover	High - Low	[t-stat]
	Panel A: Results for active turnover				
Turnover_t	0.06	0.02	0.01	0.05***	[24.52]
Equity_t	23.20	22.26	21.00	2.20**	[2.27]
Default_t	1.34	1.61	2.10	−0.76***	[−5.93]
	Panel B: Results for non-active turnover				
Turnover_t	0.10	0.02	0.00	0.09***	[3.36]
Equity_t	25.57	19.00	20.90	4.91	[0.83]
Default_t	3.67	1.95	1.88	1.79**	[2.40]
	Panel C: Results for active turnover in the first 4 quarters				
Active turnover	3.02	1.65	1.18	1.84 * **	[9.74]
Equity payment	24.99	23.65	20.58	4.41 * **	[4.08]
Percent default	1.12	1.44	2.37	−1.25 * **	[−11.73]
IRR	0.14	0.11	0.02	−−	−−

Table 1.6: **Higher active turnover predicts better transaction prices.** This table shows regressions of sale prices (first two columns) and purchase prices (last two columns) regressed on the active turnover measure constructed in Section 3.3, controlling for the time to maturity ($\text{TTM}_{i,t}$) of the traded loan, the loan principal ($\log(Principal_{i,t})$, and the loan rating at the transaction date ($Rating_{i,t}$), as well as several CLO and CLO collateral controls that are described in the caption of Table 1.2. Heteroskedasticity robust standard errors, clustered at the issuer level, are reported in parentheses. ***, **, and * indicate significance at a 1%, 5%, and 10% level respectively. The sample period is January 2009 to December 2016, including all USD leveraged loan transactions executed by the CLOs from our filtered sample.

	Sale price		Purchase price	
Intercept	43.374***	46.647***	64.696***	69.240***
	(3.096)	(5.885)	(1.605)	(2.256)
$\text{Turnover}^{Active}_{j,t}$	9.129***	5.268**	−7.380***	−6.042***
	(2.367)	(2.333)	(1.167)	(1.050)
$\text{TTM}_{i,t}$	0.557***	0.506***	0.298***	0.373***
	(0.146)	(0.158)	(0.054)	(0.062)
$\log(Principal_{j,t})$	0.429***	0.438***	0.388***	0.405***
	(0.125)	(0.135)	(0.053)	(0.056)
$Rating_{i,t}$	2.614***	2.657***	0.720***	0.719***
	(0.241)	(0.244)	(0.068)	(0.066)
$\log(Size_{j,t})$		−0.291		−0.182*
		(0.325)		(0.101)
$Age_{j,t}$ (years)		0.032		0.124***
		(0.068)		(0.028)
Reinvest dummy		1.236***		−0.483***
		(0.380)		(0.118)
Family size		0.615		2.124***
		(0.859)		(0.467)
Equity share		2.700*		0.889
		(1.544)		(0.789)
Test breach dummy		−2.323**		0.022
		(0.941)		(0.343)
Average TTM		0.256		−0.303***
		(0.286)		(0.098)
Diversification		0.296		0.414
		(0.517)		(0.252)
Equity return (%)		0.012**		−0.007**
		(0.005)		(0.003)
Percent default		0.025		−0.237***
		(0.018)		(0.035)
Time FE	Yes	Yes	Yes	Yes
Loan type FE	Yes	Yes	Yes	Yes
Observations	97,585	92,180	101,723	96,739
Adjusted R^2	0.379	0.383	0.410	0.415

Table 1.7: **Higher active turnover predicts better CLO performance.** This table shows regressions of collateral default rates (first two columns) and annualized equity returns (last two columns) regressed on the active turnover measure constructed in Section 3.3 and controlling for the CLO and CLO collateral controls described in the caption of Table 1.2. Newey-West standard errors are reported in parentheses. ***, **, and * indicate significance at a 1%, 5%, and 10% level respectively. The sample period is January 2009 to December 2016, including all CLOs from our filtered sample.

	Perc Default		Equity Return (%)	
Intercept	−3.73	−4.18	−17.45**	−20.58**
	(2.52)	(3.94)	(7.61)	(9.03)
$\text{Turnover}_{i,t}^{Active}$	−0.04***	−0.02*	0.25***	0.11***
	(0.01)	(0.01)	(0.04)	(0.04)
log(Size)	0.18	0.32	1.05***	1.10**
	(0.12)	(0.21)	(0.39)	(0.45)
Age (years)	0.06	0.08*	0.50***	0.33*
	(0.04)	(0.05)	(0.10)	(0.20)
Reinvest dummy	0.07	−0.00	1.46***	1.12*
	(0.13)	(0.07)	(0.47)	(0.62)
Family size	−0.87*	−0.65*	−0.03	−1.49
	(0.47)	(0.37)	(1.11)	(1.15)
Equity share	0.04**	0.06**	−0.17***	−0.24***
	(0.02)	(0.03)	(0.05)	(0.06)
Test breach dummy		2.24***		−4.14***
		(0.82)		(0.92)
Average TTM		−0.15**		0.79
		(0.07)		(0.71)
Diversification		−0.10		−6.27**
		(0.10)		(3.17)
lagged percent default	0.79***	0.67***		
	(0.14)	(0.18)		
lagged equity return			0.73***	0.64***
			(0.05)	(0.06)
Time FE	*No*	*Yes*	*No*	*Yes*
Observations	8,214	8,151	7,740	7,653
Adjusted R^2	0.50	0.57	0.41	0.45

9 Appendix: Characteristics of the Different CLO Portfolios

In this section, we investigate whether the difference in performance between high turnover and low turnover CLOs can be related to other CLO characteristics. To that end, we compare average CLO characteristics for high and low active turnover CLOs in Table 1.8. As we can see from the table, the most active and least active CLOs are comparable across most dimensions. In particular, there is no significant difference in their original size, CCC bucket, senior or junior fees, family size, or number of loans held in their portfolios. The only two characteristics that are significantly different are equity share and age. On average, more active CLOs tend to have a smaller equity share, indicating that they are using more leverage. However, the difference in equity share between active and less active CLOs is not economically significant and below 0.005%. The more active CLOs are, on average, 14 months younger than less active CLOs. We attribute this difference in CLO age to the lifecycle of a CLO. As explained in Section 2, older CLOs are more likely to enter their redemption period, in which they face tighter regulation on purchasing new loans.

Table 1.8: **Analysis of different CLO subsamples split by turnover.** This table shows average CLO characteristics of different subsamples of the entire CLO sample based on previous quarter turnover. At the beginning of quarter t, the entire CLO sample is split into three portfolios based on their active turnover in quarter $t-1$. ***, **, and * indicate significance at a 1%, 5%, and 10% level respectively. The sample period is January 2009 to December 2016.

	High Turnover	Medium Turnover	Low Turnover	High - Low	[t-stat]
Original size	540.23	536.48	520.72	19.51	[1.44]
Equity share	0.09	0.09	0.10	0.00**	[−2.02]
Age	44.31	50.26	59.10	−14.79***	[−2.99]
CCC bucket	0.07	0.07	0.07	0.00	[0.87]
Senior fee	17.67	17.34	17.54	0.13	[0.28]
Junior fee	34.50	32.65	34.36	0.14	[0.18]
CLO family	12.35	12.63	12.60	−0.25	[−0.56]
# Loans	385.06	408.91	376.23	8.83	[0.51]

Chapter 2

Relationship Lending and Loan Performance on the Secondary Market

Abstract:
I show that loans with strong borrower-lender relationships (relationship loans) are of higher quality than loans with weak borrower-lender relationship (non-relationship loans). A one-year increase in the length of the relationship between the borrower and the lender implies a 7% decrease in the odds of downgrade and a 15-19% increase in the odds of upgrade. Furthermore, relationship loans trade at prices that are \$1 (per \$100 notional) higher than non-relationship loans, with the same Z-score. Finally, prices of relationship loans are less volatile and closer to par value of the loan. I hypothesize that the high-quality firm is unable to get competitive rates from outside banks and therefore continues to borrow from the same bank.

I am grateful for valuable comments from Jens Dick-Nielsen, Björn Imbierowicz, David Lando, and Christian Skov Jensen. I gratefully acknowledge support from the FRIC Center for Financial Frictions (grant no. DNRF102).

1 Introduction

Empirical evidence suggests that firms benefit from long-term relationships with their bank in terms of cheaper credit (Berger and Udell (1995) and Bharath, Dahiya, Saunders, and Srinivasan (2011)) and easier access to credit (Petersen and Rajan (1994)). Presumably, this is because banks become more informed about the firm's business over the course of the relationship, i.e., asymmetric information diminishes which allows the relationship bank to charge high-quality borrowers a fair low interest rate. Botsch and Vanasco (2017) use a proxy that captures firms' creditworthiness but is unobservable to the market and show that banks learn private information about firms through repeated lending.

In this paper I show, using post-issuance loan performance measures, that borrowers who repeatedly borrow from the same bank are of higher quality than borrowers who switch between banks, even if the borrowers have the same publicly observable quality in the form of credit rating or Z-score at loan issuance date. This is consistent with the notion that banks learn private information about the firm over the course of the relationship. To better understand this notion, consider the following. When a relationship is formed between a bank and a borrower, the bank obtains some private information about the borrower and becomes able to assess the true credit quality of the borrower. Following Sharpe (1990), the relationship bank then offers lower interest rates on future loans which outside banks cannot match. This implies that high-quality firms keep borrowing from the same bank whereas lower quality firms might find it optimal to switch bank.

Using a novel dataset of syndicated loan transactions I document that loans with strong borrower-lender relationships (relationship loans) are of higher quality than loans with weak borrower-lender relationships (non-relationship loans) after controlling for the publicly observed quality of the loan at issuance date. I measure loan quality ex-post issuance date on three dimensions: (1) relationship loans are less likely to get downgraded and more likely to get upgraded, (2) a relationship loan trades at a higher price on the secondary market than a non-relationship loan when the borrowers have the same Z-score at loan issuance, and (3) secondary market prices of relationship loans are less volatile and closer to par value.

I contribute to the literature on relationship lending by providing evidence suggesting that banks become more informed about private information of a firm through repeated lending. This contribution is closely related to that of Botsch and Vanasco (2017). However, our identification strategies differ greatly. Botsch and Vanasco (2017) consider firm-level performance and rely on one unexpected shock to the economy. I consider loan-level performance and I track this performance continuously through time – not just around one event.

To the best of my knowledge, I am the first to look at loan performance in the form of rating changes and transaction prices on the secondary market in the context of relationship lending. Specifically, I consider syndicated loans, which are large corporate loans where more than one entity acts as lenders. The lead arranging bank of a syndicated loan keeps, on average, 27% of the loan notional on its own balance sheet, implying that the borrower is monitored by the relationship bank although parts of the loan are traded on the secondary market. The secondary market for syndicated loans is an over-the-counter market and very illiquid, hence data is sparse. I use a dataset of collateral holdings and collateral transactions of collateralized loan obligations (CLOs). CLOs are structured finance products, where a CLO manager actively maintains a portfolio of syndicated loans. CLOs are designed with the purpose of combining a well-diversified portfolio of risky assets into one safe asset with relatively high return. Therefore, CLOs invest in the riskiest segments of the syndicated loan market. This makes this dataset tilted towards lower rated loans, which serves as a particularly interesting sample for studying the question of loan performance.

My dataset is unique since I can track loans continuously from issuance until maturity. The dataset includes monthly CLO collateral holdings which allow me to track loans' credit ratings on a monthly basis. Furthermore, the CLO manager is an active manager, meaning that he buys and sells corporate loans on the secondary market, which allows me to track loan prices. This is illustrated in Figure 2.1 and Figure 2.2. The figures plot transaction prices and credit ratings of four loans made to two firms. Figure 2.1 is two loans issued to Constellation Brands on June 5, 2006. On the issuance date, Constellation brands had regularly been borrowing money from the same lead bank for 1,174 days, which means that Constellation Brands and the bank had a strong relationship. Presumably, this means that the bank is very well informed about Constellation Brands' credit risk and agrees to the loan because Constellation Brands is a relatively safe borrower. From Figure 2.1 we see that credit ratings and transaction prices of the loans dropped shortly after loan issuance but later recovered to a level above the original. Figure 2.2 is two loans issued to Walter Energy on April 1, 2011. Walter Energy and the lead bank of the loan had not previously done any business together, implying that the bank had limited private information about the credit risk of Walter Energy. Evidently, Walter Energy's loans experienced a persistent drop in credit rating and transaction prices a couple of years after issuance before Walter Energy finally filed for bankruptcy in July 2015. Earlier studies on loan performance have only considered default rates and would merely have concluded that the Walter Energy loans defaulted and that the Constellation Brands did not. My data allow me to track a considerably more refined set of performance parameters. I can track both upgrades and downgrades, also when they occur consecutively to the same loan. In addition, I can track variation in loan prices on the secondary market over time.

The paper's main finding, that relationship loans are of higher quality than non-relationship loans, manifests itself in three separate findings. The first finding is that relationship loans are less likely to get downgraded and more likely to get upgraded. In a logistic regression setting, I find that the odds of getting downgraded decreases with 7% and that the odds of getting upgraded increases with 15%-19% when the relationship length between the borrower and the lender is increased by one year. Next, I split the sample into 1, 2, 3, 4, and 5 years after loan issuance and run a categorical logistic regression to test the relationship effect on rating changes after different horizons. I find that the effect becomes stronger the further we are from loan issuance. Two years after loan issuance I find that a one-year increase in the borrower-lender relationship increases the odds of getting upgraded and decreases the odds of getting downgraded with 11%. Five years after loans issuance I find that a one-year longer relationship implies a 34% decrease and increase in the odds of downgrade and upgrade, respectively. The increasing relationship effect is consistent with rating agencies gradually learning the true quality of the firm, which was known to the lender already at loan issuance.

My second finding is that transaction prices of relationship loans are, on average, $1 higher per $100 notional than transaction prices of non-relationship loans when the two borrowers had the same Z-score at issuance date. Furthermore, I find that increasing the borrower-lender relationship by one year implies a relative price increase of 3 cents per $100 notional every month the loan trades. These results on transaction prices follow the results on rating changes. As relationship loans tend to be upgraded and non-relationship loans tend to be downgraded, the price difference between the two loan types increases, such that relationship loans trade at higher prices on the secondary market and non-relationship loans trade at lower prices.

My third finding is that transaction prices of relationship loans are less volatile than transaction prices of non-relationship loans. I find that increasing the borrower-lender relationship by one year decreases the price volatility 0.15-0.20 corresponding to 5% of the average volatility. Interest rates on syndicated loans are set such that loans trade at par when the loan is issued, implying that the fair value of a loan equals $100 at loan issuance as well as at loan maturity, provided that the borrower has not defaulted on the debt. Loans in my sample pay variable interest rate which means that fair value deviations from $100 during the lifespan of the loan arise due to changes in the borrower's credit risk. I measure the root-mean-squared-error (RMSE) of the difference between the observed transaction prices and $100 and find that increasing the borrower-lender relationship by one year decreases the RMSE with 0.28 corresponding to 5% of the average RMSE.

While I am the first to use secondary market transactions, Drucker and Puri (2009) consider secondary market quotes and find that loans traded on the secondary market have more covenants. The string of literature most related to my paper is that of relationship lending and firm performance. Bolton, Freixas, Gambacorta, and Mistrulli (2016), Schafer (2016), and Calcagnini, Cole, Giombini, and Grandicelli (2018) study small and medium size firms and find that relationship loans are less likely to default and less likely to become delinquent than non-relationship loans. My paper contributes to their findings by examining a different segment of the market – large corporations. Furthermore, I do not examine defaults but rating changes. Rating changes are linked to defaults but give a considerably finer indication of changes in the borrowers' performance. Hoshi, Kashyap, and Scharfstein (1990) show, in a Japanese sample, that firms with a relationship bank sell more and invest more when in distress. Fok, Chang, and Lee (2004) study a sample of Taiwan firms and find a negative relation between the number of domestic-bank relationships and firm performance, but a positive relation between the number of foreign-bank relationships and firm performance. Botsch and Vanasco (2017) show that banks charge lower rates to firms who outperform in the future. Other papers have considered what the banks gain from maintaining relationships with their clients. Bharath, Dahiya, Saunders, and Srinivasan (2007) show that banks are more likely to win subsequent loan business from borrowers with which they have strong relationships. Another string of the literature argues that the private information associated with lending relationships provides the bank with a competitive advantage, allowing the banks to extract excess rent from high-quality borrowers, see, for example, Sharpe (1990), Petersen and Rajan (1995), Degryse and Ongena (2005), and Schenone (2010).

2 The Syndicated Loan Market

Syndicated loans are large corporate loans where a group of lenders (called the syndicate) come together to finance the loan. The syndicate is led by one or more lead arranging banks. Before the syndication process starts the lead arranging bank conducts due diligence on the borrower and sets up loan contracting terms. The lead arranging bank then searches the market for other banks and institutional investors to co-finance the loan while communicating the quality of the borrower to potential investors.[1] After syndication, the lead bank is in charge of monitoring the borrower. The lead arranging bank is the only bank that directly monitors the borrower, therefore I only consider the lead arranging bank to have a relationship with the borrower.

The purpose of syndication is to diversify and diminish idiosyncratic credit risk in the individual bank's balance sheet. Nonetheless, Ivashina (2009) finds that the lead arranging bank, on average, retains 27% of the loan notional on its own balance sheet.[2] This motivates the lead arranger to keep an eye on the borrower not only for reputational reasons (of which Gopalan, Nanda, and Yerramilli (2011) highlights the importance) but also to ensure his own investment.

A syndicated loan is structured as a loan package consisting of one or more facil-

[1] See Ivashina and Sun (2011) for a detailed description of the syndication procedure.

[2] Sufi (2007) finds that the lead arranging bank retains more when the borrower requires more intense monitoring.

ities. Each facility is considered as separate units with different features, terms, and potentially different investors. For example, on June 5, 2006, Constellation Bands (a liquor-producing firm) borrowed 3.5 billion dollars with the purpose of acquiring Vincor International (wine company). The notional was split between three facilities:

Facility	Notional	Maturity
Term loan A	1.2 bill	5 years
Term loan B	1.8 bill	7 years
Revolving line of credit	500 mill	5 years

A total of 22 banks participated in the syndicate, of which all 22 banks invested in the revolving line of credit, and 8 banks invested in the term A loan and in the term B loan. The difference between term loans A and B is that term A loans are fully amortized and term B loans are only partially amortized.

When two facilities of the same loan package have the same lead arranging bank they will be categorized as having the same borrower-lender relationship. Even so, I will consider each facility as a separate unit. First of all, the facilities are different in terms of loan characteristics and in terms of performance after issuance. Second, the nature of the loan performance data is such that often only one facility of a loan package is observed at a time. Of the facilities in the final sample, 87% are part of a package deal including two or more facilities, but in the regression analyses, 77% to 87% of observations are the only observations from a given package at a given time.

The data used in this study is a subset of facilities that are held by collateralized loan obligations (CLOs). CLOs are structured finance products where the collateral is risky syndicated loans commonly referred to as leveraged loans. CLOs primarily invest in certain types of facilities, most common is term loan B, which is a loan type specifically designed for institutional investors. Syndicated loans are traditionally held by banks, but Ivashina and Sun (2011) document that since 2005, institutional investors, and in particular CLOs, have held more than half of all newly issued term B loans. This makes CLOs one of the largest investors in the syndicated loan market. However, limiting the sample to facilities traded by CLOs creates a bias in the sample. CLOs are prone to invest in high-yield loans because they carry a well-diversified portfolio of corporate loans which diminishes idiosyncratic risk. Furthermore, term B loans often pay a higher interest rate spread than term A loans (150 basis points on LIBOR versus 125 basis points on LIBOR in the Constellation Brands example). The interest differential is induced by the longer maturity in term B loans, less amortization, and an institutional loan premium (Lim, Minton, and Weisbach (2014)). It is therefore likely that this study is tilted towards a riskier segment of the corporate loan market. This will become clear when we look at summary statistics of the sample.

3 Data

I get information on loan performance from CreditFlux CLOi, a detailed database on collateralized loan obligations (CLOs). CLOs are structured finance products where the collateral is syndicated loans. From CreditFlux CLOi I collect information on the CLOss collateral. The database provides monthly reports of collateral holdings of a large sample of both European and US CLOs. These reports include credit ratings of the syndicated loans held by CLOs which allow me to track the credit rating of the loans after issuance. CLOs are active investors and they frequently update their loan portfolio by buying and selling loans on the secondary market. CreditFlux CLOi publishes these secondary market transaction as well, which I, in addition to the credit ratings, use to measure loan performance after loan issuance. Fabozzi, Klingler, Mølgaard, and Nielsen (2017) is, to the best of my knowledge, the only paper that has used CreditFlux's data on CLO collateral prior to this paper.

The advantage of this dataset is that it allows me to continuously track the loans in my sample after issuance. This is illustrated in Figure 2.1 and in Figure 2.2. Figure 2.1 plots time series of transaction prices and credit ratings of term loan A and term loan B mentioned in the Constellation Brands example in Section 2. The two loans experience a rating downgrade and price drop around 2007-2008 but later recover to a credit rating above what it was at issuance. Figure 2.2 plots prices and credit rating of two loans made to Walter Energy in 2011. The loans are downgraded three rating notches two years after issuance. This is followed by further downgrades and a steep drop in prices, before Walter Energy finally files for bankruptcy in July 2015. These two examples demonstrate the strength of the data used in this paper. Not only does the data captures the final downgrades and upgrades of the loans, it also captures the intermediate variation in loan performance.

The loan performance sample is matched with DealScan where I collect issuance information on each loan including loan amount, coupon, maturity, and most importantly I collect information on the relationship between the borrower and the lead arranger of the loan. Construction of the relationship measure is described below. Merging DealScan and CLOi is not a straightforward process. CLOi provides little information on the loans, limited to the name of the borrower, loan type, and loan maturity. Matching on these three items often leads to more than one match in DealScan. I only accept a match between a CLOi loan and a DealScan loan when the loan is uniquely identified in DealScan based on the CLOi characteristics. The majority of loans in CLOi are either term loans, revolving lines of credit, or standby letters of credit issued after 2002 and denominated in USD, EUR, or GBP. I limit the sample to loans with these characteristics. The final sample has 3,785 unique loans made to 2,060 unique borrowers.

Moody's and S&P credit ratings are specified for a subsample of the loans. I use Moody's credit ratings in this paper, because they take the cost of default into account while S&P ratings are merely based on the probability of default. However, all results are robust to using S&P credit ratings instead of Moody's credit ratings. For each loan, I define a quarterly credit rating as the median credit rating observed in the quarter and convert it to numerical values according to Table 2.1. Quarterly ratings are then used to calculate rating changes after 1, 2, 3, 4, and 5 years from loan issuance. Credit ratings are only available to me at times where the loan is held by a CLO, thus credit ratings are not available over the course of a full lifetime for all loans. I have Moody's credit rating at loan issuance on 1,948 of the loans, and for a subsample of these I can determine subsequent rating changes. Figure 2.3 plots the relative distribution of upgrades, no rating change, and downgrades one year after issuance, for loans issued in each calendar year. Downgrades are more frequent in the first part of the sample and upgrades are more frequent in the last part of the sample.

I collect monthly average prices of 2,632 loans from the CLO collateral transaction sample. Transaction prices have been cleaned according to Fabozzi, Klingler, Mølgaard, and Nielsen (2017). Figure 2.4 plots a time series of the cross-sectional average of available monthly loan prices. A large drop in prices is seen around the peak of the financial crisis.

Finally, a subsample of the borrowers are in Compustat. I use the linkage table provided by Chava and Roberts (2008) to merge with Compustat. The linkage table was last updated in 2012, I extend it to 2017 by extending established links between DealScan's borrower IDs and Compustat's GVKEYs. From Compustat, I find the size of the borrowing firm measured as the firm's total assets and compute Altman's Z-score. Altman (1968) shows that firms that file for bankruptcy share some commonalities summarized by Altman's Z-score:[3]

$$\begin{aligned} Z =& 0.012\frac{\text{Working capital}}{\text{Total assets}} + 0.014\frac{\text{Retained earnings}}{\text{Total assets}} + 0.006\frac{\text{Market value equity}}{\text{Book value of total debt}} \\ &+ 0.033\frac{\text{Earnings before interest and taxes}}{\text{Total assets}} + 0.999\frac{\text{Sales}}{\text{Total assets}} \end{aligned} \tag{2.1}$$

Firms with high Altman's Z-score are more likely to default than firms with low Altman's Z-score.

3.1 Descriptive Statistics

Panel A of Table 2.2 reports summary statistics of the loan sample. First, the table reports three pieces of loan issuance information: loan amount, maturity in months, and interest payment. Interest payment is only reported for loans that pay variable interest rate linked to LIBOR, which is more than 80% of loans in the sample. The remaining loans pay a spread on EURIBOR or a fixed interest rate. The loan amount is, on average, 430 million dollars, the maturity of the loan is, on average, 6 years, and the average spread on LIBOR is almost 400 basis points. Next, borrower characteristics are reported for the subsample of loans that are matched with Compustat. The average borrower has an Altman's Z-score of 1.61 and assets worth $10 billion. Finally, loan performance measures are reported. For loans where rating information is available at the appropriate time, I find rating at loan issuance and compute rating changes after 1, 2, and 3 years. Finally, I compute the lifetime average price for each loan in the

[3]The formula for Altman's Z-score using Compustat variables is

$$Z = 1.2\frac{ACT - LCT}{AT} + 1.4\frac{RE}{AT} + 3.3\frac{NI + XINT + TXT}{AT} + 0.6\frac{CSHO \cdot PRCC_F}{LT} + 0.999\frac{SALE}{AT}.$$

transactions sample. The average transaction price is $95.30 and the average credit rating at issuance is 7.63 which corresponds to Moody's credit rating B1. Loans in the sample tend to be downgraded more than they are upgraded. Loans are, on average, downgraded close to half a rating notch 3 years after issuance.

Panel B of Table 2.2 reports loan and borrower characteristics of all loans in DealScan issued after 2002 that comply with the filters on currency and loan type. This allows for a comparison of characteristics of loans in the sample to the full universe of similar loans in DealScan. The average loan amount of all DealScan loans is 268 mill USD, the average maturity is 5 years and the average spread on loans that are linked to LIBOR is 276 basis points. Furthermore, the Altman's Z-score of the average borrowing firm is 2.56 and the average borrowing firm has total assets worth $17 billion. This implies strong biases in the sample towards riskier loans issued by riskier corporations. Loans in the merged sample are significantly larger than loans in general, have longer maturities, and pay higher interest rates. Furthermore, borrowers in the sample are smaller and have higher Altman's Z-scores. This bias is expected since CLOs prefer to hold high-yielding syndicated loans.

The risky loans, which are overrepresented in this sample, are naturally harder to value (Diamond (1991)). This means that there is more private information to be extrapolated for these loans and therefore stronger benefits to the bank from establishing and maintaining a relationship with the client. Therefore, this study might find stronger results of relationship lending than a similar study focusing on less risky syndicated loans would do. Furthermore, rating changes are relatively common in the risky corporate loans which create more variation in the observations and therefore a more powerful statistical test.

3.2 Lending Relationship Measures

I construct two different lending relationship measures. Both measures describe the relationship between the borrower and the lead arranger of the loan. When a loan has more than one lead arranger I use the relationship to the lead arranger with the strongest relationship. The two relationship measures are:

Relationship Length

Measures the number of years between the loan issuance date and the date the lead arranger first facilitated a loan to the borrower. If the lead arranger and the borrower stop collaborating temporarily, the relationship length is reset to zero. I define a stop in collaboration when two conditions are met: (1) The lead arranger has not facilitated a loan to the borrower in more than five years, and (2) The last loan facilitated by the lead arranger matured more than 1 year prior to the start date of the new loan.

Relationship Intensity

Just before loan issuance, I look at the borrower's outstanding loans. The measure equals the total amount of outstanding loans with the same lead arranger relative to the total amount of all outstanding loans.

Relationship length is a common way to measure lending relationships in the literature, used for instance by Petersen and Rajan (1994) and Berger and Udell (1995). The measure is truncated for loans issued close to DealScan's start date. However, this is not an issue here since my sample starts in 2002 which is 15 years after DealScan's sample starts. Relationship intensity is similar to other relationship measures used in the literature (see e.g. Bharath, Dahiya, Saunders, and Srinivasan (2007), Bharath, Dahiya, Saunders, and Srinivasan (2011), Schenone (2010)). The purpose of this measure is to capture the lead arranging bank's investment in the borrower relative to other banks' investment. The original measure by Bharath, Dahiya, Saunders, and Srinivasan (2007) considers loans issued within the past five years. This includes short maturity loans issued relatively long ago and excludes long maturity loans issued more than five years ago even if they have not yet matured. In that sense, my measure is more precise because I consider loans outstanding just before the issuance date of the new loan. Relationship intensity is only defined if the borrower has outstanding syndicated loans around the issuance date of the new loan. Relationship length is defined for all loans and is therefore available for a larger sample than Relationship intensity.

The correlation between the two relationship measures is only 0.54.[4] This highlights that the two metrics capture something different in the relationship between

[4] Excluding non-relationship loans, the correlation is only 0.08.

the borrower and the lender. Relationship length captures that a bank becomes more informed the longer it has done business with its client. However, the measure does not take into account that the bank has more incentive to collect private information if it is more invested in the firm. This dimension is then captured by the relationship intensity, where a strong relationship means that the bank is heavily invested in the firm relative to other banks. In most of the following tests, both of the relationship measures will be considered, such that both dimensions of the relationship between the borrower and the lender are captured.

4 Predictions on Loan Performance

Hoshi, Kashyap, and Scharfstein (1990) find that firms with strong bank relationships perform better after a period of financial distress. This suggests that there is something special about firms that borrow money from the same bank repeatedly. They are generally in better shape and are more capable to sustain financial turmoil. Presumably, this effect holds for loans as well, such that relationship loans are less likely to default than non-relationship loans. In this section, I develop hypotheses on how relationship and non-relationship loans differ in terms of credit ratings and when they trade in the secondary market.

Sharpe (1990) and Rajan (1992) argue that it is optimal for high quality firms to borrow from the same bank repeatedly but the same is not true for low-quality firms. Sharpe puts it like this: "high quality firms are, in a sense, 'informationally captured'." This rationale stems from adverse selection. Outside banks cannot identify high quality borrowers and therefore they cannot offer competitive rates to high quality firms. Low quality firms are offered high interest rates by their relationship bank, matching how risky they are, these interest rates the outside bank can match. This implies that high quality firms borrow from the same bank repeatedly and that low quality firms borrow from different banks. This is empirically supported by Botsch and Vanasco (2017) who find that high quality firms receive lower interest rates as their bank acquires information though repeated lending. Whereas low quality borrowers' interest rates do not change as their bank becomes more informed. High and low quality refer to the *true* quality of the firm which differs from the public signal the outside banks observe.

The public signal includes credit rating and accounting information which an outside bank can access relatively easily. The theory of Sharpe and Rajan implies that amongst a group of firms with the same public signal, e.g., the same credit rating, firms that repeatedly borrow from the same bank will be of higher quality than firms that borrow from a non-relationship bank. After loan issuance new information will reach the public, e.g., when annual reports are released. These events are likely to be of good nature for high quality firms and of bad nature for low quality firms. If the news are unexpected and provides sufficiently new information, the credit rating of the firm's outstanding loan may change. This leads to my first hypothesis on relationship and non-relationship loan performance.

Hypothesis 1. *Relationship loans are more likely to be upgraded and less likely to be downgraded than non-relationship loans.*

Lending-relationship in the syndicated loan market is special in the sense that only the lead arranging bank is strictly monitoring the borrower. This means that only the lead arranging bank has private information. Around loan issuance the lead bank then seeks to convince the participating banks and institutional investors of what private information it holds. If the lead bank is successful the loan is granted at the appropriate interest rate chosen by the lead bank. The private information released during the lead bank's quest for co-investors is likely to spill out into the market including other investors than those who participated in the initial loan deal, such that when the loan is traded in the secondary market, market participants might be aware that the borrower is of higher quality than what the public signal suggests.

Hypothesis 2. *Relationship loans trade at higher prices on the secondary market than non-relationship loans given that they had the same public available default probability at loan issuance.*

When the lead bank communicates with the rest of the market, it is likely that not all of its private information is conveyed to the public. The release of new public information can then move prices as well as credit ratings. Good news can raise prices because the credit risk component of the price decreases and bad news can result in a price decrease. If the true quality is higher than the relationship bank convinced the market, new information will generally be good and cause prices to increase. News about borrowers with non-relationship loans are more likely to be negative as discussed above. Such news will cause loan prices to drop. A drop in prices is likely to be especially steep if the news reveal the firm to be close to default.

Hypothesis 3. *Secondary market prices of relationship loans are likely to increase over time relative to secondary market prices of non-relationship loans. Or, equivalently, secondary market prices of non-relationship loans are likely to decrease over time relative to secondary market transactions of relationship loans.*

Many and large changes in prices create uncertainty which a risk-averse investor dislikes. Everything else equal it is safe to assume that an investor prefers to hold assets with low volatility.

When new information is revealed, which changes the public's presumption of a borrower's credit risk, prices will move and volatility increase. Good news that result in a negative shock to the borrower's credit risk decreases the rate at which cash flows of the borrower's outstanding loans are discounted. Consequently, loan prices will raise. The loans in my sample are typically callable, implying that if the news are good enough, the firm will call the loan and negotiate a new loan with better terms. The positive shock to prices is therefore bounded upwards. Bad news resulting in a positive shock to the borrower's credit risk increases the discount rate and prices drop. The drop in prices is bounded below by zero. However, the lower bound leaves much more room for price changes than the upper bound.

In the limit prices can, therefore, drop to zero. Hence, bad news, which is assumed to be more common for non-relationship loans, can create more price volatility than good news.

Continuing on the notion that the market is more informed about the true fundamental value of relationship loans implies that news on borrowers with relationship loans are less surprising than news on borrowers with non-relationship loans. This would cause secondary market prices of non-relationship loans to react more to news events than secondary market prices of relationship loans. Furthermore, if the market is well informed about the true fundamental value of an asset, prices of this asset will deviate less from par value.

Hypothesis 4. *Secondary market prices of relationship loans are less volatile and closer to par value than secondary market prices of non-relationship loans.*

The hypotheses are tested in the following section.

5 Empirical Analysis

5.1 Unconditional Results

This section compares firm characteristics, loan characteristics, and loan performance of relationship and non-relationship loans, respectively. Loans are characterized as relationship loans if the relationship length of the loan is positive and non-relationship loans if the relationship length of the loan is zero. The average relationship length of relationship loans is 3.5 years and the average relationship intensity of relationship loans is 0.78. Relationship length and relationship intensity are defined in Section 3.2.

Table 2.3 reports for different characteristics the unconditional mean for relationship loans and the unconditional mean for non-relationship loan. Significance of the difference between relationship and non-relationship loans is tested with standard errors clustered at the borrower level. First, firm characteristics of relationship and non-relationship borrowers are compared. I find no difference in firm size or firm risk, measured as the Altman Z-score of the firm. In terms of firm age, I find that firms which obtain relationship loans are 19 years on average and that firms which obtain non-relationship loans are 16.7 years on average. The difference of 2.3 years is significant. However, none of the firms in the sample are what we would characterize as young firms, implying that age will not drive differences between relationship and non-relationship loans.

Next, the table compares loan characteristics. All loan characteristics are significantly different for the two loan types. Relationship loans are 70% larger than non-relationship loans, they have slightly shorter maturity, and pay 40 basis points less in interest rate. These indicative results are in line with the existing literature that has found relationship loans to be larger and cheaper. Furthermore, I find the average numerical rating at issuance of relationship loans to be 7.82 corresponding to Moody's credit rating B1. The average numerical rating of non-relationship loans is 7.42 corresponding to B2. The difference of 0.4 rating notch is significantly greater than zero which means that relationship loans are, on average, better rated at loan issuance than non-relationship loans.

Next Table 2.3 compares post-issuance performance measures of relationship loans and non-relationship loans which is the focus of this study. I find that all loans are more likely to be downgraded than upgraded, but, in line with Hypothesis 1, non-relationship loans are significantly more often downgraded than relationship loans, this holds both 1, 2, and 3 years after issuance. Finally, I compare prices of relationship loans and non-relationship loans. For each loan, I compute the average of available monthly prices and compare the unconditional mean for relationship and non-relationship loans. Relationship loans trade at a price that, on average, is \$1.78 per \$100 notional higher than non-relationship loans. This price difference is significant at the 1% confidence level. Furthermore, I compute the volatility in monthly prices for each loan and find that prices of relationship loans are significantly less volatile than prices of non-relationship loans.

5.2 Relationship Lending and Loan Contract Terms

This section focuses on loan terms of relationship loans and non-relationship loans. The previous literature has found that loans with stronger bank-borrower relationships are bigger (easier access to credit) and pay lower interest rate spread (cheaper credit) see for instance Bharath, Dahiya, Saunders, and Srinivasan (2011) and Berger and Udell (1995). The objective of this analysis is to see if the same is true in the smaller sample of relative risky loans considered in this study. I focus on the cost of credit. The full sample contains loans with different interest payment structures. In this analysis, I will only look at the 86% of the loans that pay interest rate spread linked to LIBOR.

I test if borrowers with similar credit risk but different relationships with their credit provider pay different interest rate spreads on their loans, by regressing interest rate spreads on relationship measures, borrower characteristics, and loan characteristics:

$$r_{i,b,\tau} = \beta Relationship_{b,\tau} + BorrowerControl_{b,\tau} + LoanControls_{i,b,\tau} + \delta_y + \varepsilon_{i,b,\tau}, \quad (2.2)$$

where $r_{i,b,\tau}$ is the interest rate spread over LIBOR of loan i, with borrower b, issued at date τ. I use the two measures of lending relationship: Relationship length and

Relationship intensity which are unique to borrower b at loan issuance date τ. Borrower controls include log of total assets and the firm's Z-score. Loan controls consist of dummies indicating if the loan is secured or not and the type of the loan (term loan, revolving line of credit, standby letter of credit). Finally, year fixed effects are included.

Results of regression (2.2) are reported in the first two columns of Table 2.4. The results show that borrowers with strong relationships obtain significantly lower interest rate spreads. A one year longer relationship implies a 5-6 basis points lower spread. Furthermore, increasing the relationship intensity from 0% to 100% decreases the interest rate spread by 37 basis points. As expected I find that large borrowers and borrowers with high Altman's Z-score pay lower interest rates. Surprisingly, secured loans are associated with higher interest payments. Very few loans are listed as unsecured and in many observations, the secured field is left empty, which can explain this inconsistency in the result. Another explanation can be correlation between loans being unsecured and having strong lending relationships, which Bharath, Dahiya, Saunders, and Srinivasan (2011) find in their sample. To rule out this explanation I run the analysis again excluding dummies for secured and unsecured. These results are in the last two columns of Table 2.4. Coefficients on the relationship measures remain unchanged, refuting that the relationship effect is dependent on the secured/unsecured status of the loans.

The results of Table 2.4 are in line with the previous literature and show that bank relationships have real effects to the borrowers, also in the relatively small sample considered in this study. Specifically, borrowers with strong bank-relationships pay up to 37 basis points less in interest rate. This difference is both economically and statistically significant. The following sections look at the difference in post-issuance performance of relationship loan and non-relationship loans. This helps us to understand why banks charge lower rates from clients with which they have strong relationships.

5.3 Relationship Lending and Loan Credit Ratings

This is the first of two sections where I investigate the post-issuance performance of relationship and non-relationship loans. Earlier studies have focused on differences in relationship loans and non-relationship loan at issuance, with a few exceptions where loan default rates are considered (DeYoung, Glennon, and Nigro (2008), Jimenez and Saurina (2004)). I am the first to look at the dynamic loan performance. I measure the loan performance on two parameters: credit ratings and transaction prices. This section investigates credit rating changes of relationship loans and non-relationship loans. Credit ratings are ultimately a means of measuring default probability and costs associated with defaults, which makes this analysis similar to studies that look at loan defaults. However, rating changes can go both up and down and be more or less radical, which allow me to study broader aspects of the credit quality of the loan than a simple defaulted or non-defaulted dummy.

Figure 2.5 shows that the relative issuance of relationship loans to non-relationship loans is much higher in the years before the financial crisis. This is likely to create a bias in the sample. Not only do we observe that downgrades were more frequent during the financial crisis but from Figure 2.3 we know that downgrades are also more common in the years preceding the crisis and that upgrades are more common after 2012. This suggests that we will observe more downgrades and fewer upgrades in non-relationship loans simply because they are over-represented in the sample in periods where downgrades are more common and upgrades less common. This highlights the importance of including time fixed effects in the formal test.

To better understand what happens in the different periods of the sample, I compute the percentage of relationship and non-relationship loans downgraded and upgraded 1 year after issuance in 2005-2008 (many downgrades), 2009-2012 (quiet period), and 2013-2016 (many upgrades) respectively. Figure 6 (a) shows the issuance of relationship and non-relationship loans, where 1-year rating change information is available, in the three periods. Non-relationship loans are overrepresented in the first period, where downgrades are more frequent, and relationship loans are overrepresented in the other two periods, where upgrades are more frequent. Next, Figure 6 (b) plots the percentage of loans downgraded 1 year after issuance, for loans issued in each of the three periods. In the first two periods, there is not much difference in the percentage of downgrades for relationship loan and non-relationship loans. In the last period, the downgrade percentage is considerably higher for non-relationship loans than relationship loans. Finally, Figure 6 (c) plots the percentage of loans upgraded 1 year after issuance. For the first period there is not much difference but in the last two periods upgrades are considerably more common for relationship loans than for non-relationship loans. This suggests that even when time-varying market conditions are controlled for, non-relationship loans are more likely to be downgraded and less likely to be upgraded than relationship loans.

I now move to the formal test of the effect of lending relationship on loan rating changes. First, I test the effect of relationship on the probability of getting downgraded and the probability of getting upgraded separately in a logistic regression setup:

$$\text{logit}(p_{i,b,\tau,t}) = \beta Relationship_{b,\tau} + LoanControls_{i,b,\tau,t} + BorrowerControls_{b,\tau} + \delta_{yq} + \varepsilon_{i,b,\tau,t}, \tag{2.3}$$

where $p_{i,b,\tau,t}$ is the modeled probability of downgrade/upgrade of loan i, t years after issuance and where the loan is issued at date τ to borrower b. $Relationship_{b,\tau}$ is the relationship between the borrower and lead bank at the time the loan is issued. I use two measures of lending relationship: relationship length and relationship intensity. Loan controls include a dummy if the loan is secured or unsecured, the age of the loan measured as years since issuance, and dummies for loan type.[5] Borrower controls include the logarithm of the size of the firm and the firm's Z-score at the time the loan was issued. Finally, I include year-quarter fixed effects to pick up variation in the propensity of downgrades and upgrades over time.

Table 2.5 shows results of the logistic regression in equation (2.3). Specification (1) to (4) models the probability of getting downgraded and specification (5) to (8) models the probability of getting upgraded. Specification (1), (2), (5), and (6) excludes borrower controls, but the credit risk of the borrower is still controlled for to some extent since the credit rating of the loans at issuance is implicitly included. For both relationship measures, I find that strong relationships are associated with lower probability of getting downgraded and increased probability of getting upgraded. Increasing the relationship length by one year decreases the odds of getting downgraded with 7% and increases the odds of getting upgraded with 14%. Specification (3), (4), (7), and (8) include borrower controls. This causes the sample size to decrease significantly since links to Compustat are only established for a subset of the borrowing firms. The coefficient on relationship becomes insignificant on the probability of downgrades, but,

[5] Loan types include term loan, revolver, and standby letter of credit.

for the probability of upgrade, the relationship remains significant and the coefficient even increases in size. Increasing the relationship length by one year increases the odds of getting upgraded with 17% in this specification. The coefficient on loan age is positive for both upgrades and downgrades, naturally, since longer time allows for the credit risk of the borrower to change and therefore we observe more upgrades and more downgrades. The coefficient on Altman's Z-score is positive on the probability of upgrade and significantly negative on downgrades, implying that better-shaped firms, within the same rating group, are less likely to get downgraded.

I now test the relationship effect on rating changes 1, 2, 3, 4, and 5 years after issuance separately.[6] This setting allows us to investigate the effect of relationships on the term structure of rating changes. For the purpose of this test, upgrades and downgrades are combined into an ordered logistic regression with three levels: 1 = downgrade, 2 = no rating change, and 3 = upgrade. Upgrade is the highest category meaning that positive coefficients imply higher probability of upgrade and lower probability of downgrades. Furthermore, borrower controls are excluded. Results are reported in Table 2.6. The first column is rating changes 1 year after issuance, the second column is rating changes two years after issuance continuing to column five which is rating changes five years after issuance. Unsecured and secured dummies are excluded in column five because all loans in this sample are secured. The coefficient on relationship is positive for all five specifications and significant in four out of the five. The size of the coefficient is increasing in years since issuance. A one-year longer relationship between the borrower and lender increases the odds of getting upgraded and decreases the odds of getting downgraded with 11% two years after loan issuance. Five years after loan issuance the effect of lending relationship has gone up such that a one-year longer relationship increases the odds of getting upgraded and decreases the odds of getting downgraded with 34%. That is, the effect of the loan's relationship status becomes stronger the further we are from the issuance date.

Overall, the results of Table 2.5 and Table 2.6 tell us that loans with strong borrower-lender relationships are less likely to be downgraded and more likely to be

[6]The logistic regression in Table 2.5 includes several observations of the same loan. Hence, we can be concerned that correlation in the observations is driving the result. Splitting the sample in years since issuance ensures that only one observation per loan is included in each regression, eliminating such concerns.

upgraded as expected in Hypothesis 1. Furthermore, the effect of relationship becomes stronger the further we are from issuance date.

5.4 Relationship Lending and Secondary Market Transactions

This section examines the effect of lending relationship on transaction prices when loans are traded on the secondary market. This test serves two purposes. First, it assesses the effects caused by the difference in rating changes of relationship and non-relationship loans when the loan is sold before maturity on the secondary market. Rating changes do not affect the loan's cash flows as long as the borrower does not default on his or her debt. It is therefore not clear that investors should care about rating changes. However, investors might need to sell the loan before maturity for liquidity needs. In this case, a rating change is likely to affect the price of the loan and therefore the cash flow the investor receives. Second, prices are available for a larger set of loans than rating changes, thus this analysis serves as an alternative test of the effect of lending relationship on loan performance.

I run several tests on the relationship effect on transaction prices. First, I examine the effect of relationship on the level of prices, then I look at changes in prices, and finally, I consider dispersion in transaction prices. As explained in Section 4, I expect that prices of relationship loans are higher on average, increasing in time relative to non-relationship loans, and less volatile.

As an initial motivation, I plot the unconditional mean of transaction prices for loans issued with different relationship lengths in Figure 2.7. There is a clear positive linear relation between the two. I also plot the unconditional volatility of transaction prices for loans issued with different relationship lengths in Figure 2.8 and find a clear negative linear relation between volatility and relationship length. This supports the hypothesis that loans with strong relationships trade at higher prices on the secondary market and have less disperse transaction prices.

To test the relationship effect on the price level, I regress transaction prices on the relationship of the loan and on traditional credit characteristics, furthermore, I include year-month fixed effects to capture moving market conditions including the large drop in prices around the financial crises:

$$P_{i,b,\tau,t} = \beta Relationship_{i,b,\tau} + LoanControls_{i,b,\tau} + BorrowerControls_{b,\tau} + \delta_{ym} + \varepsilon_{i,b,\tau,t}. \quad (2.4)$$

$P_{i,b,\tau,t}$ is the average transaction price in month t of loan i, where loan i is issued to borrower b at time τ. Controls at the borrower level include log of the borrower's total assets and the borrower's Altman's Z-score at the time the loan was issued. On the loan level controls include secured/unsecured dummies, loan type dummies, and currency dummies.

Results of regression (2.4) are in the first two columns of Table 2.7. The coefficient on both relationship measures is positive and it is significant on Relationship intensity. That is, the secondary market price of loan A will be \$1 (per \$100 notional) higher than the secondary market price of loan B if the two loans are equally risky at issuance, but loan A has Relationship intensity of 100% and loan B has Relationship intensity of 0%.

This result is somewhat surprising. The price of a loan is constructed as the sum of discounted cash flows. Cash flows consist of interest payments and a final repayment of the principal. In Section 5.2 I document that relationship loans are issued with lower interest rate spreads than non-relationship loans. We would then expect that, if a relationship and a non-relationship loan are equally risky, i.e., have the same discount rate, then the relationship loan should have a lower price, given that it pays a lower interest rate spread. However, this is not the case, which means that the market adjusts the discount rate of relationship loans downwards relative to non-relationship loans, i.e., realizations reveal the relationship loans to be safer than non-relationship loans. For completeness, I run regressions including the interest rate spread and report results in column (3) and (4) of Table 2.7. Interest rate spread is found to be insignificant and the coefficients on other variables do not change. This suggests that interest payments do not affect the price otherwise than what is captured by the at issuance credit risk of the loan.

Next, I look at changes in transaction prices. For this purpose I regress transaction price in month t, of loan i, on relationship measure and on the transaction price the last month the loan traded. Furthermore I include year-month fixed effects:

$$P_{i,b,\tau,t} = \beta Relationship_{i,b,\tau} + \delta P_{i,b,\tau,t-1} + f_{ym} + \varepsilon_{i,b,\tau,t}. \tag{2.5}$$

Observations, where the loan did not trade within the past year, are excluded.[7] Borrower and loan controls are excluded since the credit risk of the loan is included in the lagged transaction price. Results of regression (2.5) are in the final two columns of Table 2.7. The coefficients on Relationship length and Relationship intensity are both positive and the coefficient on Relationship length is significant. This implies that relationship loans are less likely to decrease in price and more likely to increase in price relative to non-relationship loans. Specifically, increasing the relationship length by one year implies a relatively higher price increase of 3 cents (per \$100 notional) every month the loan trade.

The results of Table 2.7 suggest that, after issuance, the market learns that relationship loans are safer than non-relationship loans, that were otherwise considered equally risky at issuance. This is illustrated by the fact that prices of relationship loans go up relative to prices of non-relationship loan trading in the same month. Furthermore, the realization of the improved credit quality of relationship loans implies that investors of relationship loans earn \$1 more, per \$100 notional, when they sell loans prematurely than investors of non-relationship loans.

After having shown that expected prices of relationship loans are higher than expected prices of, at issuance, equally risky non-relationship loans I move on to examine the dispersion of transaction prices. When dispersion in prices of a particular loan is high, it means that an investor of this loan is uncertain of what his gain will be when he sells the loan. I construct three measures of price dispersion for each loan where I have at least 6 monthly price observations.

First, I compute the raw sample standard deviation of the monthly prices for each loan

$$\text{Raw volatility}_i = \hat{\sigma}_i = \sqrt{\frac{1}{N_i - 1} \sum_{j \in \{1,\ldots,N_i\}} (P_{i,t_j} - \bar{P}_i)^2}, \tag{2.6}$$

[7] Results are robust to excluding observations where the loan did not trade within the past 6 months or the past quarter as well.

where $P_{i,t}$ is the price of loan i observed in month t, N_i is the number of observation of loan i, and $\bar{P}_i$ is the average price of loan i. The volatility estimate in (2.6) assumes that all $P_{i,t}$'s have the same distribution. This assumption is potentially inaccurate since price observations are unevenly spaced. A simple assumption on the price distribution is

$$P_{i,t_j} \sim \mathcal{N}\left(P_{i,t_{j-1}}, \sigma_i^2(t_j - t_{j-1})\right). \tag{2.7}$$

The maximum likelihood estimator of σ_i in (2.7), and my second dispersion measure, is

$$\text{Adj. volatility}_i = \tilde{\sigma}_i = \sqrt{\frac{1}{N_i - 1} \sum_{j \in \{2,\ldots,N_i\}} \frac{(P_{i,t_j} - P_{i,t_{j-1}})^2}{t_j - t_{j-1}}}. \tag{2.8}$$

The average distance between two consecutive prices in my sample is about two months indicating that the raw volatility measure resembles a two-month price volatility. The adjusted volatility is, by definition, a monthly volatility measure.

The fair value of a loan equals \$100 at loan issuance as well as just before loan maturity, provided that the borrower has not defaulted. All loans in this analysis pay variable interest rates, thus price deviations from \$100 over the course of the lifetime of the loan are linked to the borrower's credit risk. A way to measure price dispersion is, therefore, the price deviation from \$100. My third and final price dispersion measure is the root-mean-squared-error (RMSE) of the price deviation from \$100:

$$\text{RMSE}_i = \sqrt{\frac{1}{N_i} \sum_{j \in \{1,\ldots,N_i\}} (P_{i,t_j} - \$100)}. \tag{2.9}$$

I regress each dispersion measure on the length of the relationship between the borrower and lender at loan issuance. Price volatility tends to be high for risky assets, hence the borrower's Z-score at loan issuance is included. Furthermore, loans issued before the credit crisis of 2007-2008 are more likely to experience a large price drop and consequently high dispersion. Therefore, I include a dummy equal to one for loans issued before July 2007.

$$dispersion_i = \alpha + \beta Relationship_{i,b,\tau} + BorrowerControls_{b,\tau} + D(PreCrisis)_i + \varepsilon_i \tag{2.10}$$

Table 2.8 reports results of regression (2.10). All specifications demonstrate that prices of loans with longer relationships have lower dispersion, also when the borrower's credit risk at loan issuance is controlled for. Increasing the borrower-lender relationship by one year decreases the volatility with 0.15-0.20 (median volatility = 1.52), decreases the adjusted volatility with 0.08-0.09 (median adjusted volatility = 1.11), and decreases the RMSE with 0.28 (median RMSE = 1.90). That is, if the relationship length of a median adjusted volatility loan is increased by one year the adjusted volatility will decrease from 1.11 to 1.03. This is a relatively large decrease in volatility.

Table 2.8's takeaway is that prices of relationship loans are more stable than prices of non-relationship loans. This implies that investors of relationship loans can sell the loans at prices that are both higher in expectation and less volatile than investors of non-relationship loans.

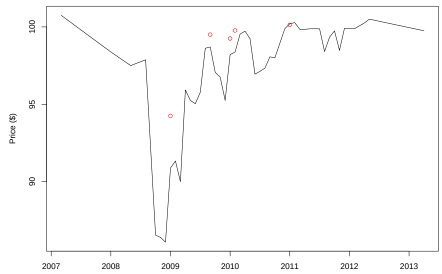
6 Conclusion

This paper examines post-issuance performance of loans, a topic which is relatively unexplored in the relationship lending literature. Using a novel dataset of collateral holdings and collateral transaction of collateralized loan obligation (CLOs) I collect detailed loan performance measures including rating changes and secondary market transaction prices.

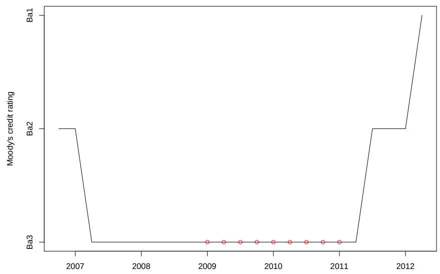
The paper has three main findings all supporting the hypothesis that a strong borrower-lender relationship provides the bank with valuable private information on the borrower's credit quality. First, I show that loans with stronger borrower-lender relationship are less likely to be downgraded and more likely to be upgraded. The effect is stronger the further away we are from loan issuance. Second, relationship loans trade at higher prices on the secondary market than non-relationship loans. Finally, transaction prices of loans with longer borrower-lender relationship are less volatile and deviate less from the principal value.

My results highlight that investors of relationship loans gain compared to investors of non-relationship loans when they sell loans on the secondary market. Investors of relationship loans earn more in expectation when the loans are sold before maturity than investors of non-relationship loans, given that the loans were view equally risky at loan issuance. Furthermore, their investment is less risky as prices of relationship loans are less volatile.

7 Figures and Tables

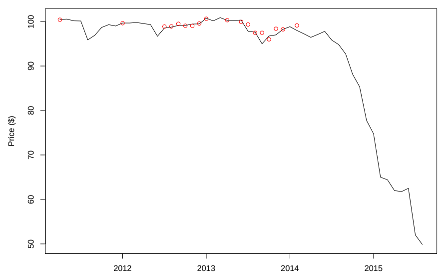


(a) Prices

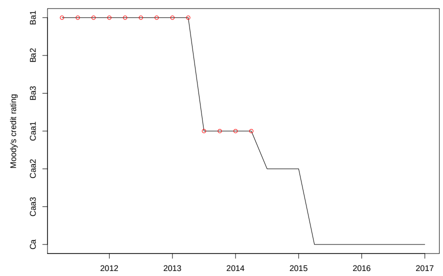


(b) Credit ratings

Figure 2.1: **Price and credit rating development of two loans made to Constellation Brands on June 5, 2006.** This figure shows the performance of two loans made to Constellation Brands on June 5, 2006. Figure (a) plots a times series of monthly average transaction price and Figure (b) plots quarterly Moody's credit ratings. The two loans are Term Loan A maturing on June 5, 2011 (red circles) and Term Loan B maturing on June 5, 2013 (black line).



(a) Prices



(b) Credit ratings

Figure 2.2: **Price and credit rating development of two loans made to Walter Energy, Inc. on April 1, 2011.** This figure shows the performance of two loans made to Walter Energy on April 1, 2011. Figure (a) plots a times series of monthly average transaction price and Figure (b) plots quarterly Moody's credit ratings. The two loans are Term Loan A maturing on April 1, 2016 (red circles) and Term Loan B maturing on April 1, 2018 (black line).

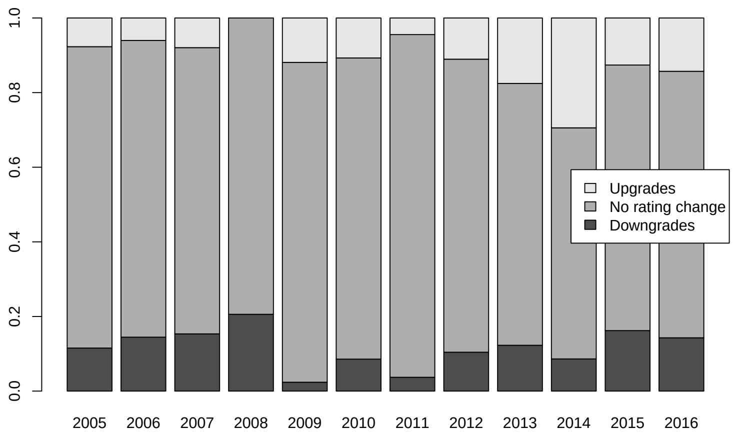


Figure 2.3: **Distribution of One-year rating changes.** The figure shows the ratio of loans, issued in each calendar year, that are downgraded (in dark), has not changed rating (in grey), and upgraded (in light) one year after issuance.

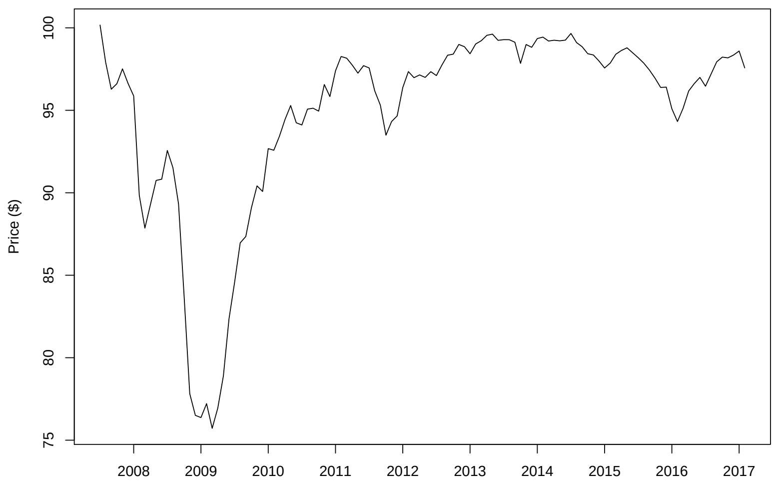


Figure 2.4: **Monthly average loan prices.** Each month I compute the average monthly transaction price of all loans in the sample that are traded in the given month.

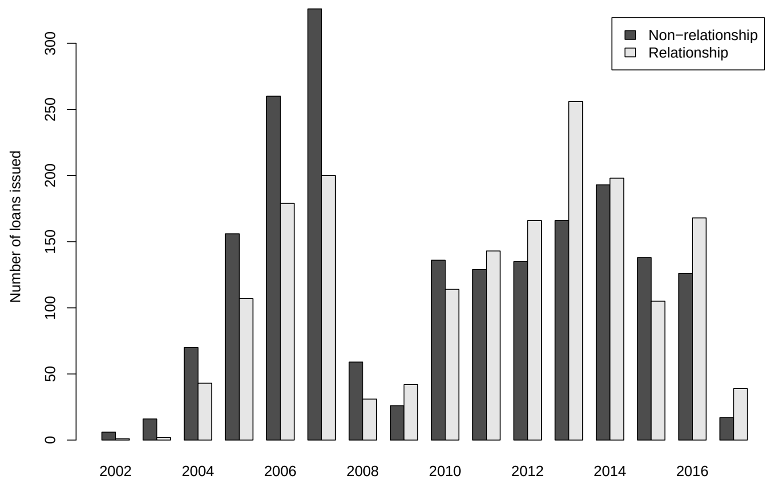
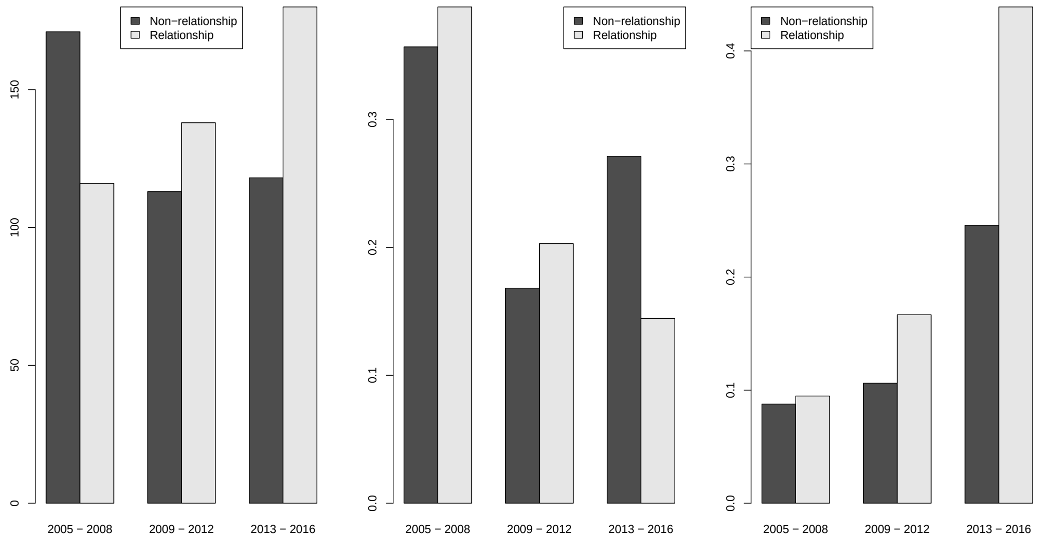


Figure 2.5: **Issuance of relationship and non-relationship loans.** The figure shows the number of non-relationship loans and the number of relationship loans issued each calendar year. A loan is classified as a relationship loan if the lead arranging bank of the loan has lent money to the borrower within the past five years, or if the lead arranging bank's previous loan to the borrower matured less than one year prior to the start date of the current loan.



(a) Issuance (b) Percentage downgraded (c) Percentage upgraded

Figure 2.6: **Issuance and percentage downgraded of relationship and non-relationship loans by period.** Figure (a) plots the number of newly issued relationship and non-relationship loans with one-year rating changes available. Loans are classified as relationship loans if the lead arranging bank of the loan has lent money to the borrower within the past five years or if the last loan from the lead arranging bank to the borrower matured less than one year prior to the start date of the current loan. The sample is split into three periods, loans issued in 2005-2008, loans issued in 2009-2012, and loans issued in 2013-2016. Figure (b) plots the percentage of relationship and non-relationship loans downgraded 1 year after issuance in each issuance period and Figure (b) plots the percentage of relationship and non-relationship loans upgraded 1 year after issuance in each issuance period.

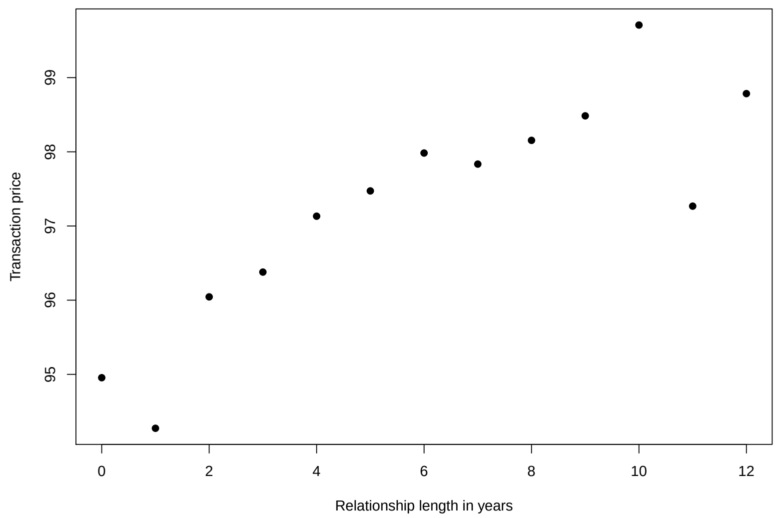


Figure 2.7: **Transaction prices of loans with different relationship lengths.** I group loans by relationship length in buckets from 0 to 12 years. The figure shows the average transaction price in each bucket.

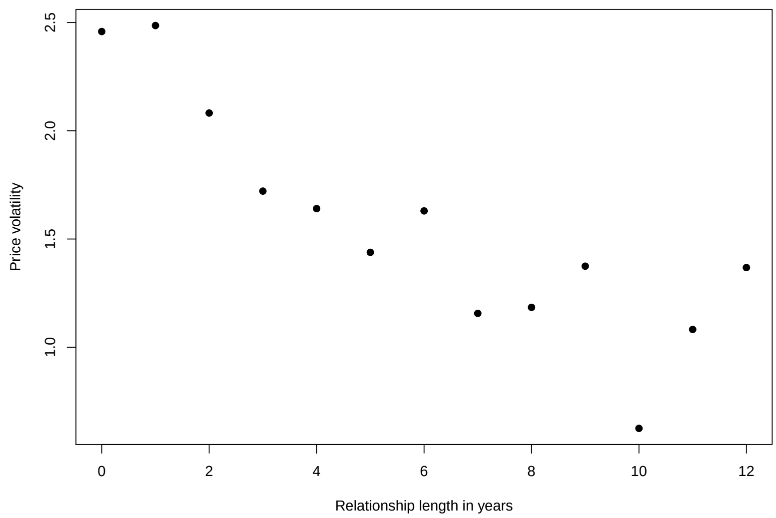


Figure 2.8: **Adjusted volatilities of loans with different relationship lengths.** I group loans by relationship length in buckets from 0 to 12 years. I compute the adjusted volatility defined in equation 2.8 for loans with at least 6 monthly price observations. The figure shows the average adjusted volatility of loans in each relationship length bucket.

Table 2.1: **Moody's credit ratings converted to numerical values.** This table shows how Moody's credit ratings are converted to numerical values.

Investment Grade		Speculative Grade	
Credit rating	Numerical value	Credit rating	Numerical value
Aaa	21	Ba1	11
Aa1	20	Ba2	10
Aa2	19	Ba3	9
Aa3	18	B1	8
A1	17	B2	7
A2	16	B3	6
A3	15	Caa1	5
Baa1	14	Caa2	4
Baa2	13	Caa3	3
Baa3	12	Ca	2
		C	1

Table 2.2: **Summary statistics of loans in the sample.** This table reports mean, standard deviation, 10% quantile, median, 90% quantile, and number of observations of different loan characteristics. Panel A reports information on the sample of loans that are matched with Creditflux CLOi. First, information on loan amount, maturity, and spread on LIBOR (for loans that pay a variable interest rate linked to LIBOR) are reported. These items are all obtained from DealScan. For loans where the borrower is identified in Compustat, the size of the borrowing firm in the form of total assets and the borrowing firm's Altman's Z-score is reported. Finally, performance measure of the loans are reported. Specifically, rating at issuance, rating change after 1, 2, and 3 years, and average transaction price. Panel B reports information on all loans in DealScan issued after 2002 that are of the same type (term loan, revolver, standby letter of credit) and same currency (USD, EUR, GBP) as loans in the merged sample. This panel includes loan characteristics and borrower characteristics.

Panel A: Loans in merged sample

	mean	sd	10%	50%	90%	# obs
Loan amount (mill $)	430.32	524.94	58.74	250.00	1000.00	3785
Maturity (months)	72.36	15.23	58.00	72.00	84.00	3785
Spread on LIBOR (bps)	396.30	174.62	200.00	375.00	625.00	3426
Altman's Z-score	1.61	1.47	0.21	1.53	3.20	781
Firm size (bill $)	10252.58	36400.14	617.28	3047.00	19605.80	1057
Loan rating at issuance	7.62	1.54	6.00	7.00	10.00	1952
1 year rating change	0.02	0.82	-0.60	0.00	1.00	1349
2 year rating change	-0.20	1.34	-2.00	0.00	1.00	842
3 year rating change	-0.44	1.69	-2.00	0.00	1.00	501
Price	95.30	9.11	86.79	98.89	100.23	2632

Panel B: All DealScan Loans

	mean	sd	10%	50%	90%	# obs
Loan amount (mill $)	268.36	470.37	13.00	100.00	672.00	126727
Maturity (months)	60.55	37.87	24.00	60.00	84.00	126856
Spread on LIBOR (bps)	276.00	172.62	90.00	250.00	500.00	81929
Altman's Z-score	2.56	2.25	0.48	2.20	5.21	21478
Firm size (bill $)	17169.15	55759.47	217.69	2325.46	30283.00	29201

Table 2.3: **Relationship vs. non-relationship loans.** This table compares the mean of characteristics of relationship and non-relationship loans. A loan is classified as a relationship loan if the lender has borrowed money from the same lead arranger within the past 5 years, or if a loan from the same lead arranger matured less than 1 year ago. Difference is the mean of relationship loans minus the mean of non-relationship loans. Standard errors are clustered at the borrower level, * is 10%, ** is 5%, and *** is 1% significance.

	Relationship loans	Non-relationship loans	Difference	[t-stat]
Relationship Length	3.52	0		
Relationship Intensity	0.78	0		
Firm characteristics				
Firm size (bill $)	11072.71	8854.43	2218.28	1.40
Age (years)	19.04	16.71	2.32^{**}	2.55
Z-score	1.60	1.64	-0.04	-0.32
Loan characteristics				
Loan size (mill $)	549.82	321.26	228.56^{***}	10.09
Maturity (months)	71.10	73.52	-2.42^{***}	-4.03
Coupon (LIBOR)	375.28	415.40	-40.12^{***}	-5.99
Loan rating at issuance	7.82	7.42	0.40^{***}	5.09
Post issuance performance				
1 year rating change	0.06	-0.03	0.09^{*}	1.90
2 year rating change	-0.08	-0.33	0.25^{**}	2.49
3 year rating change	-0.27	-0.64	0.37^{**}	2.21
Average price	96.30	94.52	1.78^{***}	4.66
Price volatility	3.12	4.22	-1.10^{***}	-4.09

Table 2.4: **Relationship loans have lower interest rates.** This table reports results from a linear regression of the interest rate spread on relationship measure and credit controls. Two measures of lending relationship are included: Relationship length and Relationship intensity. Borrower firm controls include Altman's Z-score and firm size at the time the loan is issued. At the loan level, dummies are included for secured/unsecured loans and loan type. The sample consists of loans (term loans, revolving loans, and standby letter of credits) that are issued after 2002 in USD, EUR, or GBP. Furthermore, the borrower must be matched in Compustat and the loan must pay a variable interest rate linked to LIBOR. Standard errors are clustered at the firm level and displayed in parentheses.

	Dependent variable:			
	Interest Rate over LIBOR (bps)			
	(1)	(2)	(3)	(4)
Relationship length	−5.708***		−5.626***	
	(1.654)		(1.710)	
Relationship intensity		−36.804**		−37.261**
		(14.784)		(14.923)
Z-score	−16.192***	−17.014***	−16.915***	−17.532***
	(4.524)	(4.727)	(4.601)	(4.844)
log(Total assets)	−25.970***	−23.689***	−29.071***	−27.530***
	(4.465)	(4.226)	(4.529)	(4.359)
Unsecured	−41.743	−34.056		
	(27.766)	(27.922)		
Secured	41.521*	51.499**		
	(21.569)	(22.124)		
Revolving line of credit	−18.713	−19.580	−23.658*	−23.728*
	(13.120)	(13.443)	(13.423)	(13.932)
Standby letter of credit	−18.512	−18.908	−17.150	−17.720
	(16.344)	(15.962)	(16.757)	(15.775)
Year FE	Yes	Yes	Yes	Yes
Observations	826	728	826	728
R^2	0.315	0.317	0.301	0.297
Adjusted R^2	0.297	0.297	0.284	0.279
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 2.5: **Relationship loans are more likely to be upgraded and less likely to be downgraded.** This table shows results of a logistic regression of the probability of downgrade and upgrade respectively on relationship measures and credit controls. Two relationship measures are used: Relationship Length and Relationship intensity. Borrower firm controls include Altman's Z-score and firm size at the time the loan is issued. At the loan level, loan age measured in years since issuance and dummies for secured/unsecured loans, loan type, and currency are included. Standard errors are clustered at the firm level and displayed in parentheses.

	Dependent variable:							
	Probability of Downgrade				Probability of Upgrade			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Relationship length	-0.076^{**}		0.003		0.135^{***}		0.160^{***}	
	(0.034)		(0.059)		(0.027)		(0.058)	
Relationship intensity		-0.134		0.104		0.553^{***}		0.983^{**}
		(0.220)		(0.437)		(0.191)		(0.455)
Years after loan issuance	0.554^{***}	0.556^{***}	0.436^{***}	0.451^{***}	0.344^{***}	0.370^{***}	0.530^{***}	0.527^{***}
	(0.050)	(0.060)	(0.106)	(0.111)	(0.053)	(0.061)	(0.103)	(0.109)
Unsecured	1.447^{*}	1.334	1.227	1.255	-1.045	-0.783	-2.638^{*}	-2.302
	(0.797)	(0.831)	(1.147)	(1.178)	(0.902)	(0.927)	(1.587)	(1.556)
Secured	0.249	0.234	0.628	0.734	0.142	0.203	-0.589	-0.386
	(0.268)	(0.338)	(0.834)	(0.868)	(0.379)	(0.399)	(1.235)	(1.053)
log(Total assets)			0.048	0.081			0.235	0.263^{*}
			(0.141)	(0.150)			(0.146)	(0.147)
Z-score			-0.367^{***}	-0.263^{*}			0.095	0.087
			(0.141)	(0.150)			(0.120)	(0.140)
Year-quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Currency FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan type FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
McFadden's R2	0.123	0.142	0.197	0.212	0.108	0.112	0.201	0.201
Observations	3,045	2,351	832	740	3,045	2,351	832	740

Note: *p<0.1; **p<0.05; ***p<0.01

Table 2.6: **Relationship loans are more likely to be upgraded and less likely to be downgraded 1, 2, 3, 4, and 5 years after issuance.** This table shows results of an ordered logistic regression of rating changes on relationship measures and credit controls. The dependent variable is ordered as follows: 1 = downgrade, 2 = no rating change, and 3 = upgrade. Borrower-lender relationships are measured as the number of coherent years the borrower and the lead arranging bank has interacted. At the loan level dummies are included for secured/unsecured loans and loan type. Standard errors are clustered at the firm level and displayed in parentheses.

	Dependent variable:				
	Rating Change After				
	1 Year	2 Years	3 Years	4 Years	5 Years
	(1)	(2)	(3)	(4)	(5)
Relationship Length	0.048	0.107***	0.166***	0.263***	0.293**
	(0.030)	(0.037)	(0.047)	(0.071)	(0.148)
SecuredNo	−0.644	−1.874**	−1.468	1.160	
	(0.949)	(0.953)	(1.609)	(0.774)	
SecuredYes	0.082	−0.576**	0.697	0.682	
	(0.306)	(0.254)	(0.554)	(0.666)	
Year-quarter FE	Yes	Yes	Yes	Yes	Yes
Currency FE	Yes	Yes	Yes	Yes	Yes
Loan type FE	Yes	Yes	Yes	Yes	Yes
McFadden's R2	0.051	0.082	0.078	0.138	0.154
Observations	1,340	836	498	250	121
Note:			*p<0.1; **p<0.05; ***p<0.01		

Table 2.7: **Relationship loans trade at higher prices on the secondary market than non-relationship loans.** This table reports results of regressing monthly loan prices on relationship measures and controls. I use two different measures of borrower-lender relationship: Relationship length and Relationship intensity. Controls include dummies indicating whether the loan is secured or not, the borrower's Z-score and log size at the time the loan is issued. Specification (5) and (6) includes the lagged transaction price, provided that the loan traded within the past year.

	Dependent variable:					
	Price					
	(1)	(2)	(3)	(4)	(5)	(6)
Relationship length	0.041		0.040		0.031***	
	(0.030)		(0.031)		(0.011)	
Relationship intensity		1.020***		1.067***		0.017
		(0.221)		(0.227)		(0.072)
lagPrice					0.838***	0.850***
					(0.004)	(0.004)
Unsecured	1.863**	0.833	1.931**	0.746		
	(0.820)	(0.833)	(0.839)	(0.851)		
Secured	0.939**	−0.187	0.980*	−0.250		
	(0.476)	(0.493)	(0.504)	(0.519)		
log(Total assets)	−0.270***	−0.290***	−0.281***	−0.349***		
	(0.080)	(0.082)	(0.084)	(0.086)		
Z-score	0.822***	0.826***	0.864***	0.855***		
	(0.073)	(0.077)	(0.075)	(0.079)		
Interest rate spread			0.001	−0.001		
			(0.001)	(0.001)		
Year-month FE	Yes	Yes	Yes	Yes	Yes	Yes
Currency FE	Yes	Yes	Yes	Yes	Yes	Yes
Loan type FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,156	6,456	6,946	6,274	22,308	17,530
R^2	0.363	0.365	0.362	0.365	0.791	0.811
Adjusted R^2	0.351	0.352	0.350	0.352	0.790	0.810
Note:					*p<0.1; **p<0.05; ***p<0.01	

Table 2.8: **Transaction prices of relationship loans are less volatile.** This table reports results of a linear regression of price dispersion measures on relationship length between the borrower and lender. Relationship length is the number of years the lender has acted as credit supplier for the borrower at the time the loan is issued. Pre crisis is a dummy equal to 1 if the loan is issued before July 2007. Total asset and Z-score is the size and Altman's Z-score of the borrower at the time the loan is issued.

	Dependent variable:					
	Volatility		Adj. volatility		RMSE	
	(1)	(2)	(3)	(4)	(5)	(6)
Relationship length	−0.197***	−0.154*	−0.086***	−0.080**	−0.283***	−0.155
	(0.048)	(0.079)	(0.023)	(0.037)	(0.078)	(0.127)
D(PreCrisis)	6.597***	5.410***	2.632***	2.366***	10.870***	8.899***
	(0.305)	(0.517)	(0.149)	(0.245)	(0.495)	(0.830)
log(Total assets)		0.098		0.063		0.315
		(0.205)		(0.097)		(0.329)
Z-score		−0.570***		−0.254***		−1.260***
		(0.193)		(0.091)		(0.309)
Constant	3.064***	2.956*	1.700***	1.476*	4.174***	3.123
	(0.179)	(1.772)	(0.088)	(0.841)	(0.291)	(2.843)
Observations	1,249	351	1,249	351	1,249	351
R^2	0.300	0.281	0.224	0.254	0.303	0.286
Adjusted R^2	0.299	0.273	0.223	0.246	0.302	0.278
Note:						*p<0.1; **p<0.05; ***p<0.01

Chapter 3

Revisiting the Lead-Lag Relationship Between Corporate Bonds and Credit Default Swaps

with Peter Feldhütter and David Lando

Abstract:
In a simulation study, we show that prevailing lead-lag tests in the literature, i.e. Granger causality, the Hasbrouck measure, and the Gonzalo Granger measure, are biased if asset prices include a microstructural noise component, in the form of a bid-ask spread or a time-varying liquidity component. The microstructural noise component creates negative autocorrelation in price increments which biases the tests in favor of finding that information flows from the market without microstructural noise to the market with microstructural noise. Testing the lead-lag relationship between CDS and corporate bonds, we find that price discovery increases in the corporate bond market when we use a method that is not prone to this bias. Furthermore, when using end-of-day corporate bond transactions, we demonstrate the importance of taking into account what time during the day the transaction is executed.

We are grateful for helpful comments from seminar participants at Copenhagen Business School. All authors gratefully acknowledge support from the FRIC Center for Financial Frictions (grant no. DNRF102).

1 Introduction

The yield of a firm's corporate bond and the spread of a CDS written on the same firm both reflect the credit risk of the firm. An arbitrage argument dictates that the yield of the bond must equal the CDS spread with the same maturity plus a risk free rate. Empirically this has been true up until the financial crisis of 2007-2009 as illustrated in Figure 3.1. The widening of the basis between the CDS and the corporate bond spread (corporate bond yield minus risk free rate) during the financial crises has largely been driven by a steep drop in corporate bond liquidity.[1] After the crises the CDS-bond basis has contracted when we consider the average of the cross-section of firms, however there's still a disconnect between the two markets when we look at individual entities, illustrated by the large band between the 25% and 75% quantiles in Figure 3.1.

The disconnect between the two markets raises the question on which market first incorporates new information on the credit risk of the underlying, or put in other words, which market is price leading? Are corporate bond investors watching the CDS market for price changes or are dealers in the CDS market watching the corporate bond market for price changes. The so called lead-lag relationship between the two markets can be tested in several ways. Most recognized is Granger causality, Hasbrouck's measure and Gonzalo Granger's measure. In this paper we show how these methods can produce biased results when financial data is exposed to microstructural noise. This has implications for earlier papers studying the lead-lag relationship in financial markets such as Blanco, Brennan, and Marsh (2005). We repeat the analysis of Blanco et. al. using a longer sample period and including both quotes and transaction data. First, using the same method as Blanco et. al. we find results similar to theirs. Next, using an unbiased test, we find – in contrast to Blanco et. al. – that the corporate bond market price leads the CDS market in some periods. This result is driven by the methodology – not the sample selection.

To illustrating how microstructural noise in financial data can bias the results of traditional price discovery methodologies, we run two simulation studies. In the paper we focus on the Granger causality test and report results of the Hasbrouck measure and the Gonzalo Granger measure in the appendix. First, we simulate two time series

[1] See for example Bao, Pan, and Wang (2011) and Bai and Collin-Dufresne (2013).

of prices where one series represents transaction data with a bid-ask spread incorporated. We find an overwhelming tendency to attribute price discovery to the market without a bid-ask spread, though the two time series are simulated such that they both reflect the contemporaneous risk. Second, we run a simulation experiment where one time series mimics bid quotes with a time-varying bid-ask spread. Again, we find that the times series without a microstructural noise element is price leading, though the two time series are simulated such that they both reflect the contemporaneous risk. Common for the time series with a bid-ask spread and the time series of time-varying bid quotes is that their increments both are negatively autocorrelated. We show that this negative autocorrelation is the direct driver of the biased results. Furthermore, we document that time series of corporate bond spread increments have negative autocorrelation independent of whether we consider transaction data or daily quotes. We find no evidence of CDS spread increments having negative autocorrelation. It is therefore possible that earlier findings of the CDS market price leading the corporate bond market documented with Granger causality, Hasbrouck, or Gonzalo Granger are mechanically driven by a negative autocorrelation in corporate bond spread increments.

Next, we test for price discovery in the two markets using a Granger causality test and an approach that is not affected by negative autocorrelation in the time series. In the pre-crisis sample period (2002-2005) we find that the CDS is price leading in 20% of the firms and that the bond is price leading in 24% of the firms according to the unbiased test. That is, the corporate bond market is more often price leading than the CDS market. Furthermore, the difference between price discovery is statistically significant in 2004 and 2005. The results of the Granger causality test shows on the other hand that CDS spreads lead for 27% of the firms and that the corporate bond market only price leads for 20% of the firms. This result is in line with those of Blanco, Brennan, and Marsh (2005), Zhu (2006), and Norden and Weber (2009). We conclude that the corporate bond market price leads in this period, but that a biased test incorrectly concludes the opposite. In the remainder of the sample we find that the CDS market price leads the corporate bond market. However, using the Granger causality test leads to over-estimation of the contribution to price discovery from the CDS market with more than 100%.

The first analysis is done on a sample of CDS and corporate bonds quotes. While

CDS transaction prices are hard to come around, corporate bond transaction prices are publicly available through the Trade Reporting and Compliance Engine (TRACE). Next we include these corporate bond transaction prices in the sample by substituting corporate bond quotes with end-of-day transaction prices on days where the corporate bond traded. We find that price discovery in the corporate bond market increases when we utilize information from corporate bond transactions. The contribution to price discovery was on average 3.5%-points higher in the CDS market than in the corporate bond market in the sample consisting of only corporate bond quotes. The average contribution to price discovery from the CDS market is only 1.5%-points higher than the contribution from the corporate bond market in the sample which includes corporate bond transactions.

Most of the data points in the corporate bond quotes plus transactions sample are quoted data, since many bonds do not trade very often. To test the information flow from transaction data directly we run the test again but considering only days where the corporate bond was traded. We now find that the bond market price leads 3%-points more often than the CDS market on average in the full sample period. This difference is significant at the 10% level. Some of the end-of-day transactions are executed early during the day while all CDS quotes are committed at 5pm. This implies that some corporate bond prices are lagged a few hours compared to the CDS spreads they are tested against. To run a fair test of the relative price discovery in the CDS market and the corporate bond market we repeat the test including only days where the bond traded after 3 pm. This test finds that the bond is price leading 9%-points more often than the CDS on average across the full sample period. This difference is significant at the 5% level. Very few bonds trade often enough for one to rely completely on transaction data for updates on price movements. Hence we consider the sample consisting of corporate bond quotes augmented with transaction data as the optimal data to search for price movements in corporate bond market.

It is possible that the increase in price discovery in the corporate bond market, we find when we use transaction dates, is partly driven by a selection bias in the sample we examine. When we examine transaction data we are simultaneously narrowing down to a sample of the most liquid bonds – those bonds that trade often, and often after 3 pm. To reject the notion that the result is completely driven by a selection bias we next investigate the relation between the liquidity of the bond and the CDS market and the relative price discovery in each of the markets. We sort the sample into portfolios based on relative liquidity in the two markets and find that price discovery in the CDS market significantly increases when CDS liquidity increases. The results are insignificant and inconclusive for the corporate bond market. These results suggest that while liquidity is important for price discovery in the CDS market, it does not seem to be the main factor for price discovery in the corporate bond market.

Our finding, that prevailing price discovery methods are prone to biases, has large implication for earlier papers studying the lead-lag relationship between CDS and bonds. Blanco, Brennan, and Marsh (2005), Zhu (2006), Norden and Weber (2009), and Forte and Pena (2009) study the lead-lag relationship between CDS and corporate bonds. All of these papers find that the CDS market dominates the price discovery process, however as they are all using Granger causality, Hasbrouck, or Gonzalo Granger their results are possibly biased. Ammer and Cai (2011) and Aktug, Vasconcellos, and Bae (2012) study the lead-lag relationship between government bonds and CDS. Both papers find that the bond market is price leading which is in contrast to the corporate studies. Government bonds are more liquid than corporate bonds which implies that microstructural noise components such as a time-varying bid-ask spreads is less significant in government bond data and a lead-lag test are therefore less likely biased.

Moreover, our result has implications for studies that, using Granger causality, Hasbrouck, or Gonzalo Granger, quantify the lead-lag relationship between other markets. Narayan, Sharma, and Thuraisamy (2014), Hilscher, Pollet, and Wilson (2015), Marsh and Wagner (2016), and Kryzanowski, Perrakis, and Zhong (2017) study the lead-lag relationship between the CDS and equity market. The direction of a potential methodology bias is not clear in this case but depends on the respective autocorrelation pattern in these markets. Acharya and Johnson (2007) study the lead lag relationship between CDS and equity as well, but use CDS innovations in their regression which by construction are orthogonal to the equity return. Their test is therefore not prone to the bias we describe. Finally, Ronen and Zhou (2013) study the lead-lag relationship between the corporate bond and equity market. Closely related to our paper they find that price discovery switches from the equity market to the bond market if bond trading features are accounted for.

2 Biases in Traditional Price Discovery Methods

The most common method to assess whether information incorporate into one market faster than the other is Granger causality Granger (1969). This method is used among others by Blanco, Brennan, and Marsh (2005) and Zhu (2006) to study the lead-lag relationship between corporate bonds and CDS. In this section we run two simulation experiments showing how market microstructure effects in financial data can lead us to conclude that one market is price leading when in fact it is not.[2]

Before we move on to the simulation experiment we will briefly go though the concept of price discovery and the methodology behind Granger causality.

2.1 The Granger Causality Test

Consider two time series driven by the same underlying process, say a time series of CDS spread and a time series of corporate bond spreads. The purpose of the Granger causality test is to test which of the two assets reacts fastest to new information, i.e., in which market price discovery takes place. If the Granger causality finds that one asset – say the CDS spread – Granger causes the other asset, an increase in the CDS spread today will in expectation be followed by an increase in the corporate bond spread one period from now.

To test for Granger causality between CDS spreads and corporate bond spreads we estimate a VAR model on CDS spread increment and corporate bond spread increments:

$$\Delta CDS_t = \alpha^{CDS} + \sum_{j=1}^{p} \beta^{bond,j} \Delta bond_{t-j} + \sum_{j=1}^{p} \gamma^{CDS,j} \Delta CDS_{t-j} + \varepsilon_t^{CDS} \tag{3.1}$$

$$\Delta bond_t = \alpha^{bond} + \sum_{j=1}^{p} \beta^{CDS,j} \Delta CDS_{t-j} + \sum_{j=1}^{p} \gamma^{bond,j} \Delta bond_{t-j} + \varepsilon_t^{bond}, \tag{3.2}$$

where CDS_t is the CDS spread at time t, $bond_t$ is the spread between the corporate bond yield and the risk free rate at time t, Δ denotes first differences, and p is the number of lags included in the regression. As a rule we use 5 lags in the regression

[2] Gonzalo and Granger's measure and Hasbrouck's measure are two other popular methods for assessing price discovery. In Appendix A we show that these measures are biased in the same way as the Granger causality test.

implying that we allow one of the markets to lead by up to 5 business days. Changing the number of lags in the regression to 10 or 1 does not change the empirical results.

The Granger causality test concludes that the corporate bond Granger causes the CDS if the sum of $\beta^{bond,j}$'s is significant according to an F-test and likewise that the CDS Granger causes the corporate bond if the sum of $\beta^{CDS,j}$'s is significant according to an F-test.

Granger causality can, and often does, go both ways in which case we conclude that both markets are price leading. In such cases Blanco, Brennan, and Marsh (2005) deduce the relative contribution to the price discovery process from each market by comparing the sum of $\beta^{bond,j}$ to the sum of $\beta^{CDS,j}$. The largest sum the corresponds to the market that contributes most to the price discovery process. However, the size of the β coefficient is highly sensitive to the relative volatility of the two time series as well as potential microstructural noise in the data, as will become apparent in the simulation study. Therefore, we find that it is not meaningful to compare the sizes of the β coefficients.

2.2 Simulation Studies

Our simulation studies are based on a corporate bond and CDS price model similar to that of Blanco, Brennan, and Marsh (2005). The so called unobserved "efficient" credit spread follows a random walk

$$m_t = m_{t-1} + u_t, \tag{3.3}$$

where u_t is i.i.d. normally distributed with mean 0 and variance σ^2. For simplicity, we assume that the CDS market has no microstructural noise, and that the bond market has one noise component, s_t.[3]

$$CDS_t = m_t, \tag{3.4}$$

$$bond_t = m_t + s_t, \tag{3.5}$$

[3] Blanco, Brennan, and Marsh (2005) let market prices of both corporate bond and CDS spreads be equal to m_t plus a market specific transient and a market specific non-transient microstructural noise component.

The noise component, s_t, represents some market microstructural friction in financial data.

We run two simulation studies that each incorporate one microstructural friction that is common in financial data. In the first simulation study we let *bond* be transaction prices that alternate between being executed at the bid and the ask price. The fact that bond prices jump between bid and ask prices will generate negative autocorrelation in corporate bond spread increments which transmits into a biased Granger causality test. In the second simulation study we let *bond* be bid quotes in a setting with time-varying and mean reverting bid-ask spread. The mean reversion in the bid-ask spread implies negative autocorrelation in bond spread increments which again implies a biased Granger causality test. The connection between the negative autocorrelation in bond spreads and the biased Granger causality test is explained in detail in section 2.3.

Simulation study with transaction data executed at the bid-ask spread

Acharya and Johnson (2007) use transaction data to study price discovery in the CDS and stock market. In this section we illustrate how the structure of transaction data can bias the result of a Granger causality test.

We simulate s_t such that it takes the value k with probability 1/2 and $-k$ with probability 1/2. That is, s_t represents transaction data when prices are executed at the bid or ask at random with a bid-ask spread equal to $2k$. The structure of s_t implies a negative autocorrelation in s_t's increments which transmits into a negative autocorrelation in corporate bond spread increments.

We simulate paths of m and s that are 365 observations long – corresponding to the average CDS and corporate bond time series length in Blanco, Brennan, and Marsh (2005) – and test for Granger causality between CDS and *bond*. We set the volatility of the efficient credit spread, σ, equal to 16 basis points, which corresponds to the median time series standard deviation of daily changes in 5 year CDS quotes in Markit - the leading database on CDS spreads. Dick-Nielsen, Feldhütter, and Lando (2012) find the upper quartile, median, and lower quartile of bid-ask spreads in corporate bond transactions to be 41 basis points, 22 basis points, and 12 basis points. As k is the half spread we select k equal to 20 basis points, 11 basis points, and 6 basis points. For each set of parameters we run 10,000 simulation and test for Granger causality by estimating equation (3.1) and (3.2) with number of lags, p, equal to 5.

Results of the first simulation study are summarized in Panel A of Table 3.1. The base case with bid-ask spread set to the median empirical value (22 basis points) implies autocorrelation of $\Delta bond$ to be -0.24. The Granger causality test finds that the CDS Granger causes *bond* in all simulations and that *bond* is Granger causing in 5% of the simulations matching the expected false positive rate. The table also shows the median sum of the estimated β coefficients in each simulation. The median sum of β^{CDS}'s equals 2.5 and the median sum of β^{bond}'s equals 0 which furthermore indicates that CDS is price leading. Increasing the bid-ask spread increases the autocorrelation of $\Delta bond$, and likewise decreasing the bid-ask spread decreases the autocorrelation of $\Delta bond$. In both cases CDS is still Granger causing in all simulations. However, CDS and *bond* is simulated such that both time series reflect the contemporaneous credit risk, implying that none of the assets price lead the other in the way price lead-lag relationships are suppose to be understood.

The test is highly sensitive to the length of the simulated time series. Adding more observations to the time series increases the power of the test and the test will more often conclude that *CDS* price leads. Even with a very small bid ask spread, *CDS* will always be price leading as long as we have long enough time series.

Simulation study with bid quotes and time-varying bid-ask spread

Several papers that study the lead-lag relationship in the corporate bond market use quote data instead of transaction data. Most databases with corporate bond quotes provides bid quotes, including the Lehman Brothers Fixed Income database (Warga (1998) and Lin, Wang, and Wu (2014)) and the Merrill Lynch data used in this paper (Feldhütter and Schaefer (2017)). Our second simulation experiment illustrates how a time series of bid quotes can have negative autocorrelation if bid-ask spreads are time-varying, and how the negative autocorrelation bias the result of a Granger causality test.

We simulate a time-varying bid-ask spread as an AR(1) process and impose a positivity condition

$$\text{BA}_t = \mu + \rho\text{BA}_{t-1} + \epsilon_t, \quad \epsilon_t \sim N(0, \sigma^{BA}) \tag{3.6}$$

$$\text{Bid-ask}_t = \max\{\text{BA}_t; 0\} \tag{3.7}$$

The long term mean and volatility of this process is determined by the parameters μ, ρ, and σ^{BA}. Dick-Nielsen, Feldhütter, and Lando (2012) find that the median bond has average bid-ask spread equal to 22 basis points and that the volatility of the bid-ask spread is 22 basis points. We examine the bid-ask spread process for different values of the persistence parameter, ρ, and adjust μ and σ^{BA} to fit the empirical values observed in Dick-Nielsen, Feldhütter, and Lando (2012).

We repeat the 10,000 simulations of *CDS* and *bond* from the first simulation experiment, but now s_t is equal to Bid-ask$_t/2$, and test for Granger causality between *CDS* and *bond*. The autocorrelation of Bid-ask is positive but the autocorrelation of ΔBid-ask is negative. Hence, we expect a negative autocorrelation in $\Delta bond$.

Panel B of Table 3.1 summarizes results of the second simulation experiment. With the persistence parameter, ρ, equal to 0.9, the autocorrelation of $\Delta bond$ is -0.05. The percentage of tests where CDS price leads is 20% and the percentage of tests where *bond* price leads is 5% matching the expected false positive rate. The sum of β^{CDS}'s equals 0.355 and the sum of β^{bond}'s is close to 0. As in the simulation experiment with transaction prices the conclusion of the Granger causality is biased towards CDS spreads leading corporate bond spreads. However, the bias of the test is smaller in this simulation study due to the modest autocorrelation of $\Delta bond$.

Decreasing the persistence parameter, ρ, amplifies the negative autocorrelation of Δs and thereby the negative autocorrelation of $\Delta bond$. Furthermore, the higher the negative autocorrelation is, the higher is the percentage of tests where *CDS* is Granger causing and the higher is the sum of $\beta^{CDS,j}$s. The percentage of tests where *bond* Granger causes and the sum of $\beta^{bond,j}$s remain unchanged.

As in the first simulation experiment, the Granger causality test is biased towards finding price discovery in the CDS market rather than in the corporate bond market, though there is no cross-correlation between the two time series and both time series reflect the contemporaneous risk. Furthermore, this simulation experiment illustrates the connection between the negative autocorrelation of $\Delta bond$ and the results of the Granger causality test. The more negative the autocorrelation of $\Delta bond$ is, the more biased is the Granger causality test.

2.3 Testing the Lead-Lag Relationship when Autocorrelations of the Input Series are Non-Zero

The bias in the Granger causality test stems from the negative autocorrelation in $\Delta bond$. As the autocorrelation of $\Delta bond$ becomes more negative the test becomes more biased (see Table 3.1). To understand the connection between the negative autocorrelation and this bias consider the Granger causality test in a setting with just one lag.

$$\Delta CDS_t = \alpha^{CDS} + \beta^{bond} \Delta bond_{t-1} + \gamma^{CDS} \Delta CDS_{t-1} + \varepsilon_t^{CDS} \quad (3.8)$$

$$\Delta bond_t = \alpha^{bond} + \beta^{CDS} \Delta CDS_{t-1} + \gamma^{bond} \Delta bond_{t-1} + \varepsilon_t^{bond}. \quad (3.9)$$

Inserting $CDS_t = m_t$ and $bond_t = m_t + s_t$ into Equation (3.9) we get:

$$\begin{aligned} \Delta m_t + \Delta s_t &= \alpha^{bond} + \beta^{CDS} \Delta m_{t-1} + \gamma^{bond} (\Delta m_{t-1} + \Delta s_{t-1}) + \varepsilon_t^{bond} \\ &= \alpha^{bond} + (\beta^{CDS} + \gamma^{bond}) \Delta m_{t-1} + \gamma^{bond} \Delta s_{t-1} + \varepsilon_t^{bond} \end{aligned} \quad (3.10)$$

Estimating equation (3.10) yields $\gamma^{bond} = \theta$, where θ is the autocorrelation of Δs_t. As m_t is Markov, the autocorrelation of Δm_t is 0 which implies $(\beta^{CDS} + \gamma^{bond}) = 0$ and we get $\beta^{CDS} = -\theta$. The autocorrelation of Δs_t in the above simulation studies is negative which means that β^{CDS} is positive and significant as long as we have sufficiently many observations. Estimating (3.8) gives $\beta^{bond} = \gamma^{CDS} = 0$. Hence the Granger causality test concludes that CDS_t price leads $bond_t$. Alternatively, if the autocorrelation of Δs_t is positive we get that β^{CDS} is negative and significant. The significance of β^{CDS} implies that changes in CDS_t predict changes in $bond_t$ but the negative sign implies that an increase in CDS_t implies a decrease in $bond_t$ which is unintuitive in terms of lead-lag relationships. However, focusing only on the significance of β^{CDS} which is the criteria for concluding on the lead-lag relationship, the Granger causality test concludes again that CDS_t price leads $bond_t$.

The lead-lag results we find in the above examples have nothing to do with what we normally think of as lead-lag relationships. The above results stem only from the negative autocorrelation in Δs_t and not from movements in one market, induced by a changes in the fundamental value of the asset, being followed by similar movements in the other market. Hence, instead of using one of the prevailing methods for testing the lead-lag relationship which all are biased by the negative autocorrelation in Δs_t, as documented above (Granger causality) and in the appendix (Hasbrouck and Gonzales Granger), we will asses price discovery using a similar specification to that of Stoll and Whaley (1990), Chan (1992), and Kwan (1996). We regress current changes of one asset on lagged changes of the other asset:

$$\Delta CDS_t = \alpha^{CDS} + \sum_{j=1}^{p} \beta^{bond,j} \Delta bond_{t-j} + \eta_t^{CDS} \tag{3.11}$$

$$\Delta bond_t = \alpha^{bond} + \sum_{j=1}^{p} \beta^{CDS,j} \Delta CDS_{t-j} + \eta_t^{bond}. \tag{3.12}$$

As with Granger causality we conclude that the CDS market is price leading if $\beta^{CDS,j}$s are jointly significant and vice versa that the bond market price leads if $\beta^{bond,j}$s are jointly significant according to a F-test. The difference between this specification and Granger causality is that we do not have the lagged values of the dependent variable on the right-hand side of the equation. Hence, autocorrelation in the time series will not affect the test results in this model. For now on we will refer to this model as the *unbiased model*.

If the autocorrelation of changes in the efficient price of credit risk, Δm, is non zero and if both CDS and bond reflect the underlying risk perfectly, then the test will find that both markets price leads, when in fact the two market are perfectly correlated. This can lead to overestimation of the price discovery, but the overestimation will always be the same in both markets. This means that as long as we consider the relative price discovery in the CDS and the corporate bond markets – which is standard – the overestimation will not affect our conclusions.

3 Data

CDS spreads are from Markit, the leading database in providing CDS spreads. Markit receives data from more than 50 global banks and each contributor provides pricing data from its books of record and from feeds to automated trading systems. These data are aggregated into composite numbers after filtering out outliers and stale data and a price is published only if a minimum of three contributors provide data.

The sample of CDS spreads is matched with bonds issued by the same firms. Bond information is obtained from Mergent FISD. We restrict the sample to senior unsecured bonds that pay fixed interest. We use two sources of corporate bond data. First, we employ a sample of daily corporate bond quotes provided by Merrill Lynch. This dataset is used by Schaefer and Strebulaev (2008), Acharya, Amihud, and Bharath (2013), and Feldhütter and Schaefer (2017). Furthermore, corporate bond transactions data are obtained from Financial Industry Regulatory Authority's (FINRA) Trade Reporting and Compliance Engine (TRACE). Since July 1, 2002, all dealers have been required to report their secondary over-the-counter corporate bond transactions through TRACE. We apply standard filters (Dick-Nielsen (2009) and Dick-Nielsen (2014)) to clean the dataset for errors and exclude transactions of volumes below $100.000 as suggested in Bessembinder, Kahle, Maxwell, and Xu (2009).

Finally, we obtain swap rates from the Federal Reserve Bank's webpage and U.S. Treasury yields from the Federal Reserve Bank's CMT rates.[4] Corporate bond spreads are calculated as the corporate bond yield minus the swap or Treasury yield with the same maturity and where the swap or Treasury yield is interpolated from the closest yields that have a shorter and longer maturity.

The final sample consists of 1244 firms and runs from 2002 to 2012 where the bond quote sample ends. We split the sample in calendar years and have 5391 firm-year observations in total. We always use the 5 year maturity CDS spread. When more than one bond is available, we use the yield of the most recently issued bond which Ronen and Zhou (2013) show are the most informative.

[4]The data is available on http://www.federalreserve.gov/releases/h15/data.htm.

3.1 The Riskfree Rate

To calculate the corporate bond yield spread, we need a riskfree rate. Treasury yields have typically been used in the past, but Hull, Predescu, and White (2004), Feldhütter and Lando (2008), and Krishnamurthy and Vissing-Jørgensen (2012) show that swap rates are – although not perfect – a better proxy than Treasury yields. To a large extent this is due to Treasury bonds enjoying a convenience yield that pushes their yields below riskfree rates (Feldhütter and Lando (2008), Krishnamurthy and Vissing-Jørgensen (2012), and Nagel (2016)).

Our sample period includes the 2008-2009 crisis; a period where LIBOR, the underlying rate in swap contracts, was high because of credit risk. It may be that in this particular period swap rates became somewhat disconnected from the riskfree rate. To test the extent to which swap rates are appropriate to use as riskfree rates during 2008-2009 we examine a set of government guaranteed bonds issued by financial institutions in the US. On October 13th 2008 the Federal Deposit Insurance Corporation started the Temporary Liquidity Guarantee Program (TLGP) as a reaction to the financial crisis. The program was one of many programs to improve funding possibilities of financial institutions in the US. It was optional for financial institutions to enter the program and debt issued by members of the program would, in a limited period ending in 2012, be guaranteed by the US government. This implied that the bonds were free from default risk (or more precisely had the same default risk as US Treasury bonds). For this service financial institutions would pay a fee. In total 169 guaranteed bonds were issued by 31 financial institutions in the period November 2008 to October 2009 and the bonds matured in the period April 2009 to December 2012.

To examine the liquidity of the guaranteed bonds we compute roundtrip costs (RTC) for corporate bonds. For each corporate bond transaction, TRACE makes available whether the transaction refers to a bond bought by an investor from a dealer, sold by an investor to dealer, or an inter-dealer trade. We compute RTC of bond i on day t as

$$RTC_{it}^{daily} = \frac{P_{it}^{buy} - P_{it}^{sell}}{P_{it}^{buy}} \tag{3.13}$$

where P_{it}^{buy} is the average of all investor buy prices of bond i on day t and P_{it}^{sell} is the average of investor sell prices of bond i on day t. As in Feldhütter, Hotchkiss, and Karakas (2016), we define the RTC of a bond as the median of available daily RTCs over the past two weeks.

We plot average roundtrip costs (RTC) in Figure 3.2 for the guaranteed bonds along with average RTCs for bonds issued by the same financial institutions and that were not guaranteed. We see that RTCs are much smaller for the guaranteed bonds compared to the unguaranteed bonds; the average RTC for unguaranteed bonds is 0.38% in the period January 2009-December 2012 while the average RTC for guaranteed bonds in the same period is 0.05%. Thus, guaranteed bonds are more liquid compared to unguaranteed bonds when measured as the cost of trading the bonds. Using the same methodology to compute transaction costs, Chakravarty and Sarkar (2003) estimate average RTC for U.S. Treasury bonds in the period 1995-1997 to be 0.08%.[5] This suggests that the liquidity of the guaranteed bonds is comparable to the liquidity of U.S. Treasury bonds.

The guaranteed bonds are liquid and free of default risk, but nevertheless are corporate bonds and therefore do not enjoy the convenience yield of U.S. Treasuries.[6] These bonds are therefore a near-ideal measure of the appropriate riskfree rate when calculating corporate bond spreads. Figure 3.3 shows a time series of the guaranteed bond yield, swap rate, and Treasury yield. Guaranteed bond yield is calculated as the average of the daily yields on all fixed coupon guaranteed bonds where daily yields are calculated as the median over daily values. Swap rates and Treasury yields are similarly calculated as the average of rates maturity matched to all guaranteed bonds in our sample. We see that the swap rate tracks the yield on guaranteed bonds quite closely while there is a gap between the yields on guaranteed bonds and Treasury bonds. The average yield on the guaranteed bonds during the period covered by the graph (November 2008 - May 2011) is 1.18%, the average swap rate is 1.22%, and the average Treasury yield is 0.85%. This shows that even during the 2008-2009 crisis swap rates are more appropriate than Treasury yields to use as riskfree rates when

[5]Chakravarty and Sarkar (2003) measure RTC as $P_{it}^{buy} - P_{it}^{sell}$ while we measure RTC as $\frac{P_{it}^{buy} - P_{it}^{sell}}{P_{it}^{buy}}$ but since most bonds likely trade close to par value due to their relatively short maturity, the difference between the measures is small.

[6]Benefit of Treasury bonds compared to guaranteed corporate bonds are for example lower risk weights and broader collateral eligibility.

calculating corporate bond yield spreads.[7]

4 Price Discovery in the Corporate Bond and CDS Market

Blanco, Brennan, and Marsh (2005), Zhu (2006), and Norden and Weber (2009) test the lead-lag relationship between CDS and corporate bond spreads using the Granger causality test, Hasbrouck's measure, and Gonzalo and Granger's measure and find that CDS leads the corporate bond market. In Section 2 we show that results of these methods are biased when autocorrelation of one of the tested time series is non-zero. Figure 3.4 shows histograms of autocorrelation in changes in CDS spreads and changes in corporate bond quotes of the 1244 firms in our sample with bonds quoted by Merrill Lynch, and a histogram of changes in end-of-day corporate bond transactions for the 763 firms with bonds trading persistent enough for us to utilize TRACE transaction. The median autocorrelation for CDS spread, Merrill Lynch corporate bond spread, and TRACE corporate bond spreads is 0.01, -0.13, and -0.37 respectively. That is, autocorrelation of the CDS spreads is close to zero, but the autocorrelation of bond spreads is negative. If the autocorrelation pattern is the same in samples used in the above mentioned papers, it is likely that their results are biased towards favoring price discovery in the CDS market.

We test the lead-lag relationship between CDS and corporate bond spreads using a Granger causality test and using the unbiased model presented in Section 2.3 in which results are unaffected by negative autocorrelation in corporate bond spreads. Our sample covers 11 years from 2002 to 2012. We split the sample into calendar years such that we can capture time variation in the relative price discovery in the corporate bond and CDS markets. Each year we use the yield spreads of the most recently issued corporate bond which Ronen and Zhou (2013) show are the most informative. The unbiased model builds on estimating Equation (3.11) and (3.12), and the Granger causality test builds on estimating Equation (3.1) and (3.2). To make our analysis simple and transparent we choose to estimate the models with five lags ($p = 5$) for all firms.[8]

[7] Preferably we would use the guaranteed yield as the risk free rate in our further analyses. However, this rate is only available for the period 2008-2012 and only for short maturities, thus we are left with the swap rate as the best proxy the risk free rate.

[8] We have run the tests with 1 and 10 lags as well and get similar results.

Table 3.2 shows, for each calendar year and for both tests, the percentage of firms where CDS price leads, the percentage of firms where bond price leads and the difference between the two. In the first four years of the sample the unbiased model finds that the CDS market price leads for 20% of the firms on average and that the corporate bond market price leads for 24% of the firms on average. Hence the corporate bond market is 4% more often price leading than the CDS market. This result suggest a small tendency towards the corporate bonds marked being more price leading than CDS market in the first part of the sample. This contradicts findings of Blanco, Brennan, and Marsh (2005), Zhu (2006), and Norden and Weber (2009) who study a sample covering the same period. Interestingly, their findings are in line with the result of the Granger causality test. The Granger causality test finds that CDS price leads for 27% of the firms on average and that bond price leads for only 20% of firms on average. That is, the Granger causality test both overestimates the contribution to price discovery from the CDS market and underestimates the contribution to price discovery from the bond market. This finding illustrates that it is not a sample selection that give us a different result from those in earlier studies, it is the methodology used for testing price discovery.

After 2005 the relative price discovery between the CDS and the corporate bond market changes such that the CDS market becomes more price leading relative to the corporate bond market. According to the unbiased test, the difference between price discovery in the CDS market and price discovery in the bond market is 8% on average. The difference is 17% on average in the Granger causality test. Though, we conclude in both analyses that most price discovery arises in the CDS market, we overestimate the contribution from the CDS market more than 100% if we rely on the Granger causality test.

Next, we investigate if price discovery differs between the financial sector and non-financial sectors and if price discovery differs between investment grade and speculative grade rated firms. Panel A of Table 3.3 show that CDS is relatively more price leading for financials than for non-financials in all sub periods, in line with the fact that the CDS market is far more developed for financials than other corporates. Panel B of Table 3.3 shows that CDS is relative more price leading for speculative grade rated firms than for investment grade rated firms.

4.1 Improving Price Discovery in the Corporate Bond Market with Transaction Data

The above analysis uses quotes on both CDS spreads and corporate bond yields. These quotes are non-executable and may not represent the most updated information in the respective markets. A better way to obtain the most recent information is from executed transaction prices. However, executed transaction prices are not publicly available for CDS as they are for corporate bonds. In this section, we examine what happens to the lead-lag relationship between the CDS and the corporate bond market if we utilize publicly available transactions data on corporate bonds. We hypothesize that price discovery in the corporate bond market improves as transaction prices are never stale and as they represent the exact market value of the respective asset. This sample of CDS quotes and corporate bond transaction data combined with corporate bond quotes represents a data sample that is accessible to individuals.

We create a corporate bond spread sample by augmenting the corporate bond quote sample with transaction data. Specifically, on days where the corporate bond has traded two days in a row we substitute the yield spread change in corporate bond quotes with the yield spread change in end-of-day transactions. This sample allow us to to utilize the excess information in transaction data without losing information from the bond market on days where the bond did not trade. Results of the unbiased lead-lag test are reported in the first 6 columns of Panel A in Table 3.4. Comparing these results to those of the analysis using only quoted data we find that the relative lead-lag relationship between CDS and corporate bonds is roughly unchanged in the first five years of the sample. In the financial crisis from 2007 to 2009 the difference between price discovery in the CDS market and the corporate bond market drops from 7% on average to 3.7% on average when we include transaction data. Finally, in the last three years of the sample the average difference drops from 10% to 6.3%. Furthermore, significance of the difference between price discovery in the two markets disappears in 2007 and 2012. All in all we find that price discovery in the corporate bond market increases relative to price discovery in the CDS market when information from publicly available corporate bond transactions are utilized.

Changes in corporate bond transaction prices are only available for 17% of observations and for 25% of the individual bonds it is less than 5% of dates with quoted yields where the bond has traded two days in a row. The scarcity of transaction data implies that information in the bond data still primarily comes from quotes. Next, we test how the relative price discovery in the CDS and corporate bond markets changes if we only consider days where the bond traded. That is, on each day where the bond has traded three days in a row, we compute the change in bond spread and the lagged change in bond spread. All other days where the bond traded less than than three consecutive days are discarded. If a bond traded three consecutive days less than 20 times within a calendar year, the firm-year is discarded. Equation (3.11) and (3.12) are then estimated with only one lagged variable on the right-hand side ($p = 1$) on each firm on the subsamples of dates where the bond traded three consecutive days. We choose $p = 1$ instead of $p = 5$, as used in the earlier analyses, because the sample of firms with bonds trading often enough to estimate the equation with $p = 5$ is very small.

The second part of Panel A in Table 3.4 summarizes the results of the lead-lag tests with transactions data. The number of firms and trading days is lower than in the analyses with corporate bond quotes reflecting that some corporate bonds trade rarely. The difference between the percentage of firms where the CDS market price leads and the percentage of firms where the bond market price leads is negative or close to 0 all years except for 2010, and we conclude that corporate bond transactions contribute more to the price discovery than CDS quotes on days where the corporate bond traded.

Next, we compare the relative price discovery in the CDS and corporate bond markets when bond information stems from transaction data to when bond information stems from quote data (Table 3.2). In the first five years of the sample the average difference between price discovery in the CDS market and price discovery in the bond market drops from -4% on average to -6.2% on average. In the years covering the financial crisis the relative difference in price discovery drops from 7% to -9.7% and in the last three years of the sample the difference in price discovery drops from 10% to 3.7%. Comparing the three choices of corporate bond data sources; quotes, quotes combined with transactions, and transactions, the relative price discovery in the corporate bond market becomes – as expected – increasingly better. The improvement in price discovery in the bond market when going from quote date to transaction data is especially steep in the years of the financial crisis from 2007 to 2009. This result shows that in this period either corporate bond transactions are particular informative and/or corporate bond quotes are particularly uninformative.

The CDS quotes are all registered at 5 pm each date, whereas the end-of-day transaction can take place almost any time during the day. In the corporate bond transaction sample 40% of end of day transactions – i.e. the last observed transaction of the day – occur before 3 pm and 19% of end of day transactions occur before 1 pm. An end of day transaction at 1 pm will not reflect all information of that day to the same extent as CDS spread quoted at 5 pm. We examine the importance of the asynchronous transaction data by testing the lead-lag relationship on a subsample of the observations. First we include all transactions. Then we look at the subsample of transactions executed after 1pm, that is days, where any of the transactions used to compute the current change or the lagged change in corporate bond spreads are executed before 1 pm, are deleted. Finally, we consider the smaller subsample of transactions executed after 3pm. For this purpose we do not split the sample into calendar years.

Panel B of Table 3.4 reports the number of tested firm-years in each sample, the percentage of firm-years where CDS lead, the percentage of firm-years where bond leads and the difference between the percentage of firm-years where the CDS leads and the percentage of firm-years where the corporate bond leads. When including all observations we find that the CDS price leads for 16% of the firms and that the corporate bond price leads for 19% of the firms. The difference of 3 percentage points is weakly significant at the 10% level. This means that the corporate bond market contributes more to the price discovery process than the CDS market on days where the bond traded, even though some of the end-of-day transactions where executed earlier than the time of the CDS quote. The percentage of firms where bond price leads increases from 19% when we include all transactions to 27% in the subsample which includes end-of-day transactions executed after 3pm. The percentage of tests where CDS price leads is roughly unchanged. That is, the relative difference between corporate bond and CDS price discovery increases to 9%-points in the "after 3pm" sample. Furthermore, the difference in price discovery is now significant at the 5%

level. We conclude that being aware of the time trades are executed is important and controlling for transaction time changes the results. This finding is consistent with Ronen and Zhou (2013) showing that corporate bonds lead stocks when bond trading features are accounted for.

The subsample of bonds we are left with in this analysis are the most liquid bonds. Therefore, the apparent improvement in price discovery in the bond market is, possibly, not only driven by the fact that we are considering transaction data, but also to the fact that we are testing the most liquid corporate bonds. In the next session we examine how relative price discovery in the corporate bond and CDS market varies with the liquidity of both the CDSs and the corporate bonds.

4.2 Price Discovery and Relative Liquidity of the CDS and Corporate Bond Market

Price discovery is closely related to liquidity. Ammer and Cai (2011) study the lead-lag relationship between government bonds and CDS and find that the CDS market is less price leading for sovereigns that issue more bonds, suggesting that the relative liquidity of the two markets is a key determinant for where price discovery occurs. Presumably, the more informed investors that actively participate in a market, the closer prices will be to the fundamental value. In this section we investigate the link between how active investors are, i.e., how liquid the market for an asset is, and the relative price discovery between the CDS and the corporate bond.

We approximate the liquidity of each CDS each year by the average number of dealers who have contributed to the CDS quote. For bonds we use two proxies for liquidity. First, we measure liquidity as the average of daily round-trip costs (RTC) (defined in Equation (3.13)) over the calendar year. The drawback of this measure is that the RTC is not defined for all bonds. We assign high illiquidity to bonds where the RTC measure is not defined. As an alternative we also measure bond liquidity as the number of trading days within the calendar year. The problem with this measure is that we cannot disentangle liquidity from data quality. Above we showed that price discovery improves when we utilize transaction data. The bonds that trade most often are, therefore, also the bonds with the best data quality.

We use the sample of CDS quotes and corporate bond quotes augmented with transaction data and test the lead-lag relationship between CDS and corporate bond spreads using the unbiased test. We then compare the test results between portfolios with different CDS and corporate bond liquidity. Each calendar year we double sort the firm sample into nine portfolios. First we sort the sample into three portfolios based on the liquidity of the CDS written on the firm. Next we sort each of these portfolios into three buckets based on the liquidity of the firm's corporate bond. We then collapse all years which give us 9 buckets in total with 610-620 firm-years in each bucket.

Table 3.5 reports the percentage of test where CDS price leads minus the percentage of test where corporate bond price leads for each of the 9 portfolios. For example, the 1% in the top left corner of Panel B in the table means that CDS price leads corporates bond in 1 percentage point more tests than the number of tests where corporate bond price leads CDS. In Panel A of the table bonds are sorted by their RTC and in Panel B of the table bonds are sorted by number of trading days. In both panels we see that the relative price discovery in the CDS market increases when liquidity of the CDS increases. This is illustrated by the consistently positive values in the bottom rows of the panels, which indicates the difference between the most and the least liquid CDS portfolio. Furthermore, four out of six of the differences between the most liquid CDS portfolio and the least liquid CDS portfolio are statistically significant. Moving to bond liquidity we cannot make the same conclusion. None of the differences between the most liquid bond portfolios and the least liquid bond portfolios are statistically significant. When bonds are sorted by RTC, the values for high CDS liquidity minus low CDS liquidity have both negative and positive signs. When bonds are sorted by number of trading days, the values for high CDS liquidity minus low CDS liquidity are all negative suggesting that increased bond liquidity implies increased price discovery in the bond market. However, the values are not statistically significant and could also reflect the fact that the bonds that trade most often are also the bonds with the most informative spreads, independent of the bonds' liquidity.

The result of Table 3.5 implies a link between CDS liquidity and the relative price discovery in the CDS market compared to the price discovery in the corporate bond market, but the same is not true for the corporate bond market. We see a hint of a link between bond trading days and price discovery in the corporate bond market but no link between bond RTC and price discovery. Based on this we conclude that there is no evidence for a connection between corporate bond liquidity and price discovery in the corporate bond market. Furthermore, we conclude, based on this result, that the improvement in price discovery we find when we subsample the data based on transaction data is not driven by higher liquidity of the remaining bonds but is rather driven by higher data quality.

5 Conclusion

We run two simulation studies, each showing that prevailing lead-lag tests in the literature, i.e., Granger causality, the Hasbrouck measure, and the Gonzalo Granger measure, are biased if asset prices include a microstructural noise component. In the first simulation study, we let one of the time series represent transaction prices that jump between the bid and the ask price. In the second simulation study, we let one of the time series represent bid quotes in a setting with time-varying bid-ask spreads. Many different financial data possess one of these two features. In both simulation studies we find that the microstructural noise component creates negative autocorrelation in price increments. We then show algebraically that the negative autocorrelation creates a bias in the lead-lag tests in favor of finding that information flow from the market without microstructural noise to the market with microstructural noise. This is the case even though the two time series are simulated with no cross-correlation.

Next, we test for autocorrelation in the data and find no signs of consistent non-zero autocorrelation in CDS spread increments, but a strong tendency towards negative autocorrelation in corporate bond spread increments derived from both end-of-day transaction prices and daily bid quotes. This raises the question whether earlier papers, that test the lead-lag relationship between CDS and corporate bonds, using Granger causality, Hasbrouck or Gonzalo Granger, are prone to this bias. The vast literature on this subject agrees that the majority of price discovery takes place in the CDS market. We test the lead-lag relationship between CDS and corporate bonds using both the Granger causality test and a test that is not prone to this bias and find that price discovery increases significantly in the corporate bond market when we use the unbiased test.

The first part of the analysis is done using corporate bond quotes. Utilizing information from public end-of-day transactions of corporate bonds, we find that price discovery in the corporate bond market increases. Furthermore, we point out the importance of taking into account what time during the day the transaction took place, by showing that price discovery in the corporate bond market increases further if we only consider transactions that are executed late in the afternoon. Finally, to reject the notion that the last result is driven by a subsample selection, we look at the interaction between relative liquidity in the CDS and bond market and the relative contribution to price discovery. We find that high CDS liquidity improves the relative contribution to price discovery from the CDS market, but no clear evidence of such a link in the corporate bond market.

6 Figures and Tables

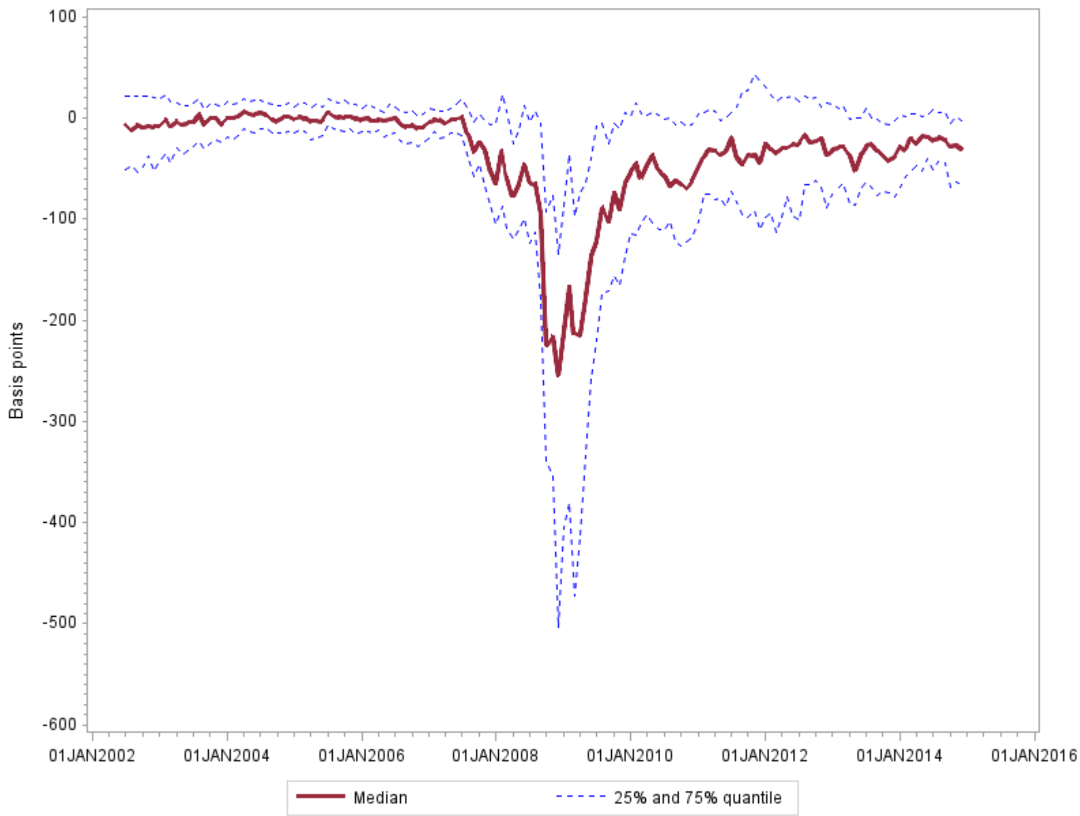


Figure 3.1: **CDS-bond-basis.** For each firm and each month we subtract the firm's corporate bond spread from (on the last day of the month where the bond had a transaction) a maturity matched CDS spread. If a reference entity has more than one bond trading in a month we choose the most recently issued bond. Each month we compute the cross-sectional median basis in red, and the 25% and 75% quantiles in blue.

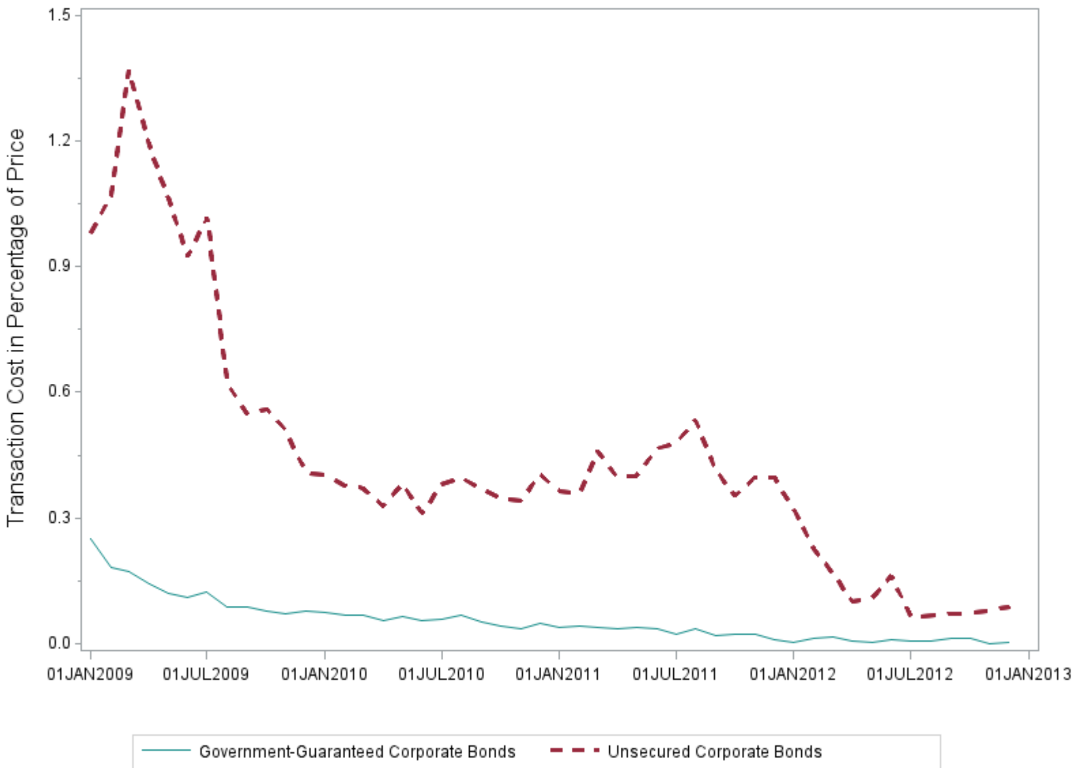


Figure 3.2: **Average transaction costs of government-guaranteed corporate bonds and corporate bonds with no guarantee**. For each day and bond we calculate roundtrip costs (as a percentage of the price) as the median daily roundtrip cost observed over the past 14 days. The figure shows for government-guaranteed corporate bonds the average monthly roundtrip costs. Government-guaranteed bonds consist of 169 bonds issued by 31 financial institutions as part of the TLGP program. The guaranteed bonds matured between April 2009 and December 2012. The figure also shows the average monthly roundtrip costs for 1571 bonds not part of the TLGP program issued by the same 31 financial institutions and with maturities within the same period as the guaranteed bonds.

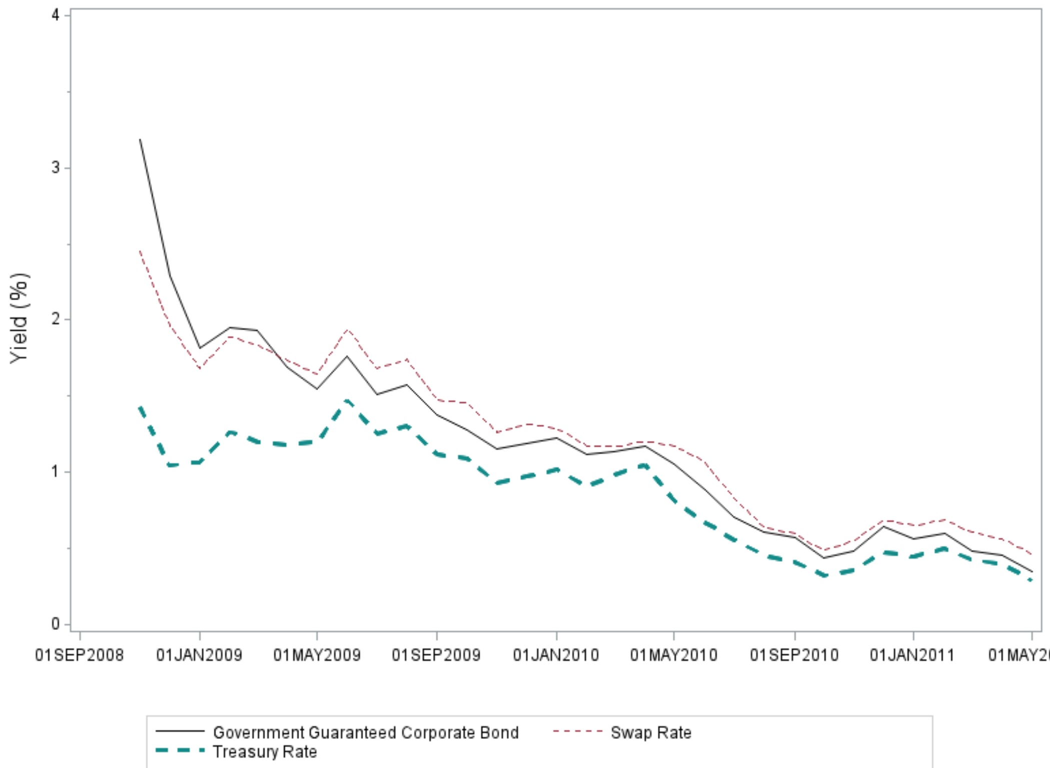


Figure 3.3: **Yields on government-guaranteed corporate bonds, swap rates, and U.S. Treasury bond yields**. For each fixed coupon government guaranteed bond we calculate on each day where there is at least one transaction as the median yield across all transactions on that day. For each day and guaranteed bond in our sample we construct a swap rate and Treasury yield with the same maturity. The figure shows monthly averages of government guaranteed yields, swap rates, and Treasury yields. We exclude bonds when they have less than one year to maturity.

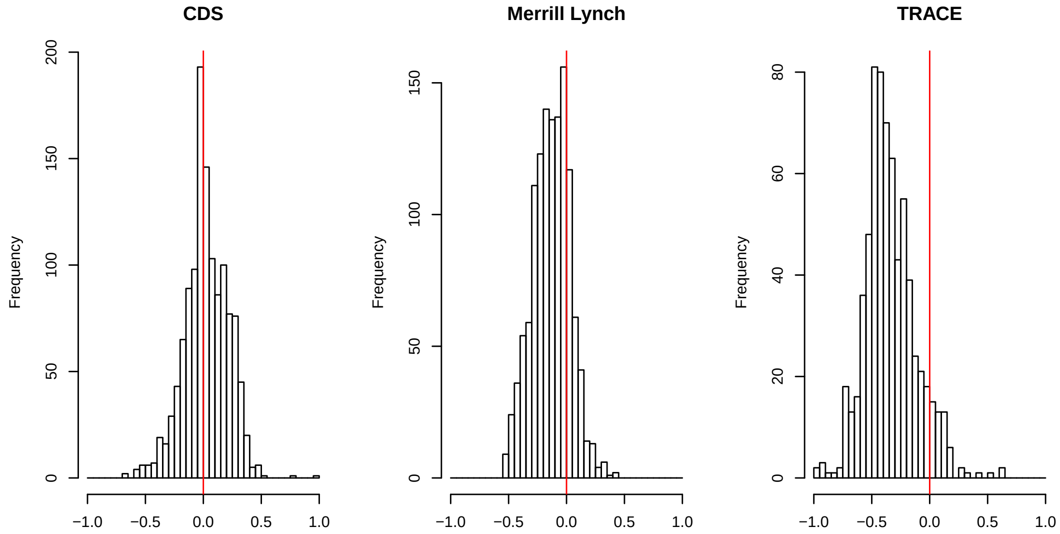


Figure 3.4: **Histograms of time series autocorrelation in CDS spreads and corporate bond spread**. For each firm-year in the sample we compute the autocorrelation of changes in the daily 5 year maturity CDS spread and changes in the daily corporate bond yield quotes. Furthermore, we also compute the autocorrelation of changes in end of day transactions for the 2729 firm years where the firms most recently issues corporate bond traded three consecutive days at least 20 times during the calendar year. We then plot histograms of the computed autocorrelations from each dataset.

Table 3.1: **Simulation studies showing the effect of negative autocorrelation in bond yield increments on Granger causality results.** We first simulate a random walk, $m_t \sim N(m_{t-1}, \sigma^2)$, representing the underlying risk. We then define CDS and $bond$ as

$$CDS_t = m_t$$

$$bond_t = m_t + s_t$$

and test for Grange causality between CDS and $bond$. In Panel A s_t reflects that bond transactions are executed at the bid or the ask price at random. Such that s_t equals k with probability 1/2 and s_t equals $-k$ with probability 1/2 where $2k$ is the bid-ask spread. In panel B s_t reflects that bond prices are quoted at the bid price with a time-varying bid-ask spread. The bid-ask spread is simulated as an AR(1) process with persistence parameter ρ. s_t is then equal to half the simulated bid-ask spread. We repeat each simulation 10,000 times for different parameter choices. The table reports the median autocorrelation in the simulated CDS and bond increments, the percentage of simulations where CDS and $bond$ is Granger causing, and the median sum of β parameter estimated in the Granger causality test.

Panel A: Simulation study with bond transaction executed and the bid or the ask price

				H_0: CDS causes bond		H_0: bond causes CDS	
σ (bps)	bid-ask spread (bps)	autocorrelation ΔCDS	$\Delta bond$	significant tests	sum of β^{CDS}'s	significant tests	sum of β^{bond}'s
16	22	-0.00	-0.24	100%	2.486	5%	-0.002
16	12	-0.00	-0.11	100%	2.472	5%	0.007
16	40	-0.00	-0.38	100%	2.477	5%	-0.000

Panel B: Simulation study with bond bid quotes and time-varying bid-ask spread

					H_0: CDS causes bond		H_0: bond causes CDS	
ρ	bid-ask spread mean (bps)	vol (bps)	autocorrelation ΔCDS	$\Delta bond$	significant tests	sum of β^{CDS}'s	significant tests	sum of β^{bond}'s
0.90	22	22	-0.00	-0.05	20%	0.355	5%	-0.000
0.80	22	22	-0.00	-0.06	40%	0.602	5%	0.003
0.70	22	22	-0.00	-0.07	61%	0.835	5%	-0.004

Table 3.2: **lead-lag relationship between CDS and corporate bonds.** This table reports results from two tests of the lead-lag relationship between CDS and corporate bonds. The first test – the unbiased test – consist of estimating the following regressions for each firm in the sample:

$$\Delta CDS_t = \alpha^{CDS} + \sum_{j=1}^{5} \beta^{bond,j} \Delta bond_{t-j} + \varepsilon_t^{CDS}$$

$$\Delta bond_t = \alpha^{bond} + \sum_{j=1}^{5} \beta^{CDS,j} \Delta CDS_{t-j} + \varepsilon_t^{bond},$$

where ΔCDS_t is the change in quoted 5 year CDS spreads on day t and $\Delta bond_t$ is the change in quoted corporate bond spreads on day t. The test concludes that bond price leads if $\beta^{bond,j}$'s are jointly significant according to a F-test and that CDS price leads if $\beta^{CDS,j}$'s are jointly is significant according to a F-test. On the same sample of firms we also test for Granger causality between the CDS and corporate bond spreads. We split the sample in calendar years, N is the number of firms where we test the lead-lag relationship, and days is the average number of days in our time series. Furthermore, the table reports, for each test, the percentage of firms where CDS leads, the percentage of firms where bond leads and the difference. Significance of the difference is computed assuming that the lead-lag test results are Bernoulli distributed, *** indicates 1% significance, ** is 5%, and * is 10%.

			Unbiased test			Granger causality test		
			percentage of firms where:			percentage of firms where:		
year	N	days	CDS leads	bond leads	difference	CDS leads	bond leads	difference
2002	242	211	23%	23%	0%	26%	24%	2%
2003	350	213	13%	15%	−2%	20%	16%	4%
2004	416	218	17%	25%	−8%***	24%	22%	2%
2005	509	219	27%	33%	−6%**	38%	26%	12%***
2006	512	227	19%	16%	3%	28%	14%	14%***
2007	550	218	29%	23%	7%***	34%	18%	15%***
2008	580	230	50%	40%	10%***	52%	36%	17%***
2009	549	227	32%	29%	4%	34%	27%	7%***
2010	590	232	31%	19%	12%***	40%	15%	25%***
2011	562	230	35%	21%	14%***	46%	17%	29%***
2012	531	195	19%	15%	4%*	22%	10%	11%***

Table 3.3: **Lead-lag relationship between CDS and corporate bonds in subsamples.** We estimate the following regressions and concluding that corporate bond is price leading if $\beta^{bond,j}$s are jointly significant and that CDS is price leading if $\beta^{CDS,j}$s are jointly significant:

$$\Delta CDS_t = \alpha^{CDS} + \sum_{j=1}^{5} \beta^{bond,j} \Delta bond_{t-j} + \varepsilon_t^{CDS}$$

$$\Delta bond_t = \alpha^{bond} + \sum_{j=1}^{5} \beta^{CDS,j} \Delta CDS_{t-j} + \varepsilon_t^{bond}.$$

Panel A shows results of the sample split in financials and non-financials. Panel B shows results of the sample split in investment grade rated firms and speculative grade rated firms. The table reports, for each subsample, the number of firm-years in the sample (N), the percentage of firms where CDS leads, the percentage of firms where bond leads, and the difference between the percentage CDS leads and the percentage bond leads. Significance of the difference is computed assuming that the lead-lag test results are Bernoulli distributed, *** indicates 1% significance, ** is 5%, and * is 10%.

Panel A: Sample split into financials and non-financials

	financials				non-financials			
		percentage of firms where:				percentage of firms where:		
	N	CDS leads	bond leads	difference	N	CDS leads	bond leads	difference
2002-2006	328	16%	17%	−1%	1781	20%	24%	−4%***
2007-2009	271	41%	29%	12%***	1442	36%	30%	6%***
2010-2012	292	33%	16%	17%***	1439	27%	19%	8%***

Panel B: Sample split into Investment grade and speculative grade

	investment grade				speculative grade			
		percentage of firms where:				percentage of firms where:		
	N	CDS leads	bond leads	difference	N	CDS leads	bond leads	difference
2002-2006	973	17%	23%	−6%***	1095	21%	22%	−1%
2007-2009	831	38%	34%	4%*	854	36%	27%	9%***
2010-2012	749	25%	20%	5%**	965	31%	17%	14%***

Table 3.4: **Improving price discovery with transaction data.** We test the lead-lag relationship between corporate bond and CDS spreads using two different sources of corporate bond prices. In the first test we use end-of-day transaction prices to compute changes in corporate bond spread on days where the bond has traded two consecutive days. On days where the bond has not traded we use quotes. We test the lead-lag relationship by estimating the following regressions with $p = 5$

$$\Delta CDS_t = \alpha^{CDS} + \sum_{j=1}^{p} \beta^{bond,j} \Delta bond_{t-j} + \varepsilon_t^{CDS}$$

$$\Delta bond_t = \alpha^{bond} + \sum_{j=1}^{p} \beta^{CDS,j} \Delta CDS_{t-j} + \varepsilon_t^{bond}.$$

Column 2 to 6 of Panel A reports the number of firms where we test lead-lag-relationship, the percentage of firms where CDS price lead, the percentage of firms where bond price leads, and the difference between the two. Next we use a corporate bond sample consisting solely of end-of-day transactions. That is, days where we cannot compute the current or lagged change in bond spreads from transaction data are excluded from the sample. Furthermore, firm-years with less than 20 days where current and lagged changes can be computed are excluded. In this test we only include one lag on the right-hand side in the above regression ($p = 1$). Column 7 to 11 of Panel A reports lead-lag results of the second test. Panel B shows results of the lead-lag test on the transaction sample with all years collapsed. We recursively run test on a smaller set of end-of-day transactions based on what time the transaction is executed. Significance of differences are computed assuming that the lead-lag test results are Bernoulli distributed, *** indicates 1% significance, ** is 5%, and * is 10%.

Panel A: Split by year

	corporate bond quotes augmented with transactions					corporate bond transactions				
			percentage of firms where:					percentage of firms where:		
year	N	days	CDS leads	bond leads	difference	N	days	CDS leads	bond leads	difference
2002	242	211	21%	20%	1%	43	77	14%	21%	−7%
2003	350	213	10%	13%	−3%	98	113	9%	8%	1%
2004	416	218	13%	22%	−9%***	81	106	7%	15%	−8%
2005	509	219	22%	27%	−5%*	71	106	11%	28%	−17%***
2006	512	227	17%	14%	3%	72	90	11%	11%	0%
2007	550	218	25%	23%	2%	63	93	14%	29%	−15%**
2008	580	230	46%	39%	7%**	83	118	33%	41%	−8%
2009	549	227	30%	28%	2%	132	112	13%	19%	−6%
2010	590	232	24%	14%	10%***	141	105	25%	15%	10%**
2011	562	230	28%	19%	9%***	120	110	18%	18%	0%
2012	531	195	14%	14%	0%	117	100	12%	11%	1%

Panel B: Subsamples of transactions based on execution time

	corporate bond transactions				
			percentage of firms where:		
	N	days	CDS leads	bond leads	difference
all transactions	1021	105	16%	19%	−3%*
transactions executed after 1 pm	493	94	18%	23%	−5%*
transactions executed after 3 pm	205	79	18%	27%	−9%**

Table 3.5: **Relative price discovery in the CDS and corporate bond market sorted by CDS and corporate bond liquidity.** We test the lead-lag relationship between CDS and corporate bond spreads by estimating the following regressions:

$$\Delta CDS_t = \alpha^{CDS} + \sum_{j=1}^{5} \beta^{bond,j} \Delta bond_{t-j} + \varepsilon_t^{CDS}$$

$$\Delta bond_t = \alpha^{bond} + \sum_{j=1}^{5} \beta^{CDS,j} \Delta CDS_{t-j} + \varepsilon_t^{bond},$$

where ΔCDS_t is the change in quoted 5 year CDS spreads on date t and $\Delta bond_t$ is the change in end-of-day transaction prices on dates where the bond traded two consecutive days, on other dates $\Delta bond_t$ is the change in quotes obtained from Merrill Lynch. Each year we double sort firms into three buckets based on CDS liquidity, measured as the average number of dealers quoting the CDS, and thereafter into three buckets based on bond liquidity, measured as the yearly average RTC (in Panel A) or as the number of trading days within the year (in Panel B) – 9 buckets in total per year. We then collapse buckets across years. The main part of the table reports the percentage of firm-years where the CDS is price leading minus the percentage of firm-years where the bond is price leading in each bucket. The last column and the last row is the difference between the most and least liquid buckets. *** indicates 1% significance, ** is 5%, and * is 10%.

Panel A: Bonds sorted by RTC

	Corporate bond liquidity			
CDS liquidity	low	mid	high	high − low
low	0%	−3%	0%	0%
mid	2%	0%	5%	3%
high	8%	3%	2%	−6%
high − low	8%***	6%***	2%	

Panel B: Bonds sorted by number of trading days

	Corporate bond liquidity			
CDS liquidity	low	mid	high	high − low
low	1%	0%	−3%	−4%
mid	3%	2%	1%	−2%
high	5%	5%	4%	−1%
high − low	4%	5%*	7%**	

7 Appendix: Simulation Study with Alternative Price Discovery Measures

In Section 2.2 we simulate different market setting that creates artificial negative autocorrelation in corporate bond spread increment and tested for Granger causality. In this appendix test the lead-lag relationship between *CDS* and *bond* via two alternative methods, Hasbrouck's measure Hasbrouck (1995) and Gonzalo and Granger's measure Gonzalo and Granger (1995).

To compute the price discovery measures we must first estimates from the following VECM:

$$\Delta CDS_t = \lambda_1(CDS_{t-1} - bond_{t-1}) + \gamma_1 \Delta CDS_{t-1} + \rho_1 \Delta bond_{t-1} + \varepsilon_{1,t} \tag{3.14}$$

$$\Delta bond_t = \lambda_2(CDS_{t-1} - bond_{t-1}) + \gamma_2 \Delta CDS_{t-1} + \rho_2 \Delta bond_{t-1} + \varepsilon_{2,t} \tag{3.15}$$

A negative and significant λ_1 indicates that *bond* contributes to the price discovery process and if λ_2 is significant and positive *CDS* contributes to the price discovery process. The relative contribution of the CDS market and the bond market is measured by Hasbrouck's lower and upper bound and by the Gonzalo Granger's measure. Figures above 50% indicates that *CDS* contributes most to price discovery and figures below 50% indicates that *bond* contributes most to price discovery.

$$\text{HAS}_1 = \frac{\lambda_2^2\left(\sigma_1^2 - \frac{\sigma_{12}^2}{\sigma_2^2}\right)}{\lambda_2^2\sigma_1^2 - 2\lambda_1\lambda_2\sigma_{12} + \lambda_1^2\sigma_2^2}, \qquad \text{HAS}_2 = \frac{\left(\lambda_2\sigma_1 - \lambda_1\frac{\sigma_{12}}{\sigma_1}\right)^2}{\lambda_2^2\sigma_1^2 - 2\lambda_1\lambda_2\sigma_{12} + \lambda_1^2\sigma_2^2}, \tag{3.16}$$

$$\text{GG} = \frac{\lambda_2}{\lambda_2 - \lambda_1}. \tag{3.17}$$

Following Blanco, Brennan, and Marsh (2005) we focus on the mid point of HAS_1 and HAS_2.

We run the same two simulation studies as in Section 2.2. First *bond* resembles transaction prices executed at the bid and the ask at random, next, *bond* resembles bid quotes in a setting with time-varying bid-ask spreads. In each simulation study we simulate 10,000 paths for different parameter choices and compute the price discovery measures.

Results of the first simulation study are in Panel A of Table 3.6 and results of the second simulation study are in Panel B of Table 3.6. The median λ_2 is equal to 1 for all bid-ask spread in the first simulation experiment. The percentage of λ_2's that are significant increases with the bid-ask spread indicating that *CDS* contributes to price discovery in 70% to 100% of the simulations. on the contrary *bond* only contributes to price discovery i 5% of the simulations (the expected false positive rate). This is picked up by the Gonzalo Granger measure that, in the median observation, asses that 100% of price discovery happens in the CDS market. The Hasbrouck measure is more conservative and asses that 56% to 80% of price discovery happen in the CDS market. Similar results are found in the second simulation study. The percentage of λ_2's that are significant is lower, but Hasbrouck and Gonzalo Granger still estimate that respectively 70% and 100% of price discovery happens in the CDS market.

These simulation experiment highlights that the most common methods for measuring price discovery produce biased results when the autocorrelation of one time series is negative. Especially Gonzalo and Granger's measure produce misleading results, but computing Hasbrouck's measure also lead to biased results.

Table 3.6: **Simulation studies showing the effect of negative autocorrelation in bond yield increments on Hasbrouck's and Gonzalo and Granger's measures.** We first simulate a random walk, $m_t \sim N(m_{t-1}, \sigma^2)$, representing the underlying risk. We then define CDS and $bond$ as

$$CDS_t = m_t$$

$$bond_t = m_t + s_t$$

We estimate a VECM of *CDS* and *bond* and compute Hasbrouck and Gonzalo Granger price discovery measures. In Panel A s_t reflects that bond transactions are executed at the bid or the ask price at random. Such that s_t equals k with probability 1/2 and s_t equals $-k$ with probability 1/2 where $2k$ is the bid-ask spread. In panel B s_t reflects that bond prices are quoted at the bid price with a time-varying bid-ask spread. The bid-ask spread is simulated as an AR(1) process with persistence parameter ρ. s_t is then equal to half the simulated bid-ask spread. We repeat each simulation 10,000 times for different parameter choices. The table reports the estimated parameters λ_1 and λ_2 and the percentage of simulations where the parameters are significantly different from 0, and finally the median values of estimated Hasboruck and Gonzalo and Granger measures. median autocorrelation in the simulated CDS and bond increments, the percentage of simulations where CDS and $bond$ is Granger causing, and the median β parameter estimated in the Granger causality test.

Panel A: Simulation study with bond transaction executed and the bid or the ask price

		autocorrelation						Hasbrouck			
σ (bps)	BA (bps)	ΔCDS	$\Delta bond$	λ_1	% sign.	λ_2	% sign.	lower	upper	mid	GG
16	12	-0.00	-0.11	-0.00	5%	1.00	77%	0.12	0.99	0.56	1.00
16	22	-0.00	-0.24	0.00	5%	1.00	100%	0.32	0.99	0.66	1.00
16	40	-0.00	-0.38	-0.00	5%	1.00	100%	0.61	0.99	0.80	1.00

Panel B: Simulation study with bond bid quotes and time-varying bid-ask spread

	bid-ask spread		autocorrelation						Hasbrouck			
ρ	mean (bps)	vol (bps)	ΔCDS	$\Delta bond$	λ_1	% sign.	λ_2	% sign.	lower	upper	mid	GG
0.90	22	22	0	-0.05	0	5	0.08	85	0.56	0.97	0.78	1
0.80	22	22	0	-0.06	0	5	0.13	90	0.43	0.98	0.71	1
0.70	22	22	0	-0.07	0	5	0.16	91	0.36	0.99	0.68	1

Bibliography

Acharya, Viral V., Yakov Amihud, and Sreedhar T. Bharath, 2013, Liquidity risk of corporate bond returns: conditional approach, *Journal of Financial Economics* 110, 358–386.

Acharya, Viral V., and Timothy C. Johnson, 2007, Insider trading in credit derivatives, *Journal of Financial Economics* 84, 110 – 141.

Aktug, Rahmi E., Geraldo Vasconcellos, and Youngsoo Bae, 2012, The dynamics of sovereign credit default swap and bond markets: empirical evidence from the 2001 to 2007 period, *Applied Economics Letters* 19, 251–259.

Altman, Edward I., 1968, Financial ratios, discriminant analysis and the prediction of corporate bankruptcy, *The Journal of Finance* 23, 589–609.

Altunbas, Yener, Alper Kara, and David Marques-Ibanez, 2010, Large debt financing: syndicated loans versus corporate bonds, *European Journal of Finance* 16, 437–458.

Ammer, John, and Fang Cai, 2011, Sovereign cds and bond pricing dynamics in emerging markets: Does the cheapest-to-deliver option matter?, *Journal of International Financial Markets, Institutions and Money* 21, 369–387.

Bai, Jennie, and Pierre Collin-Dufresne, 2013, The cds-bond basis, *Working paper.*

Bao, Jack, Jun Pan, and Jiang Wang, 2011, The illiquidity of Corporate Bonds, *Journal of Finance* 66, 911–946.

Benmelech, Efraim, and Jennifer Dlugosz, 2009, The alchemy of CDO credit ratings, *Journal of Monetary Economics* 56, 617–634.

Benmelech, Efraim, Jennifer Dlugosz, and Victoria Ivashina, 2012, Securitization without adverse selection: The case of CLOs, *Journal of Financial Economics* 106, 91–113.

Berger, Allen N., and Gregory F. Udell, 1995, Relationship lending and lines of credit in small firm finance, *The Journal of Business* 68, 351–381.

Berk, Jonathan B., and Richard C. Green, 2004, Mutual fund flows and performance in rational markets, *Journal of Political Economy* 112, 1269–1295.

Bessembinder, Hendrik, Kathleen M. Kahle, William F. Maxwell, and Danielle Xu, 2009, Measuring abnormal bond performance, *Review of Financial Studies* 22, 4219–4258.

Bharath, Sreedhar T., Sandeep Dahiya, Anthony Saunders, and Anand Srinivasan, 2007, So what do i get? the bank's view of lending relationships, *Journal of Financial Economics* 85, 368–419.

Bharath, Sreedhar T., Sandeep Dahiya, Anthony Saunders, and Anand Srinivasan, 2011, Lending relationships and loan contract terms, *The Review of Financial Studies* 24, 1141–1203.

Blanco, Roberto, Simon Brennan, and Ian W. Marsh, 2005, An Empirical Analysis of the Dynamic Relationship between Investment Grade Bonds and Credit Default Swaps, *Journal of Finance* 60, 2255–2281.

Bolton, Patrick, Xavier Freixas, Leonardo Gambacorta, and Paolo Emilio Mistrulli, 2016, Relationship and transaction lending in a crisis, *The Review of Financial Studies* 29, 2643–2676.

Bord, Vitaly, and Joao A.C. Santos, 2015, Does securitization of corporate loans lead to riskier lending?, *Journal of Money, Credit and Banking* 47, 415–444.

Botsch, Matthew, and Victoria Vanasco, 2017, Learning by lending, *Working paper.*

Busse, Jeffrey A., Lin Tong, Qing Tong, and Zhe Zhang, 2016, Trading frequency and fund performance, Gabelli School of Business, Fordham University Research

Paper No. 2834591. Available at SSRN: https://ssrn.com/abstract=2834591 or http://dx.doi.org/10.2139/ssrn.2834591.

Calcagnini, Giorgio, Rebel Cole, Germana Giombini, and Gloria Grandicelli, 2018, Hierarchy of bank loan approval and loan performance, *Econ Polit.*

Chakravarty, Sugato, and Asani Sarkar, 2003, Trading costs in three U.S. bond markets, *Journal of Fixed Income* 13, 39–48.

Chan, Kalok, 1992, A further analysis of the lead?lag relationship between the cash market and stock index futures market, *The Review of Financial Studies* 5, 123–152.

Chava, Sudheer, and Michael R. Roberts, 2008, How does financing impact investment? the role of debt covenants, *The Journal of Finance* 63, 2085–2121.

Chevalier, Judith, and Glenn Ellison, 1997, Risk taking by mutual funds as a response to incentives, *Journal of Political Economy* 105, 1167–1200.

Degryse, Hans, and Steven Ongena, 2005, Distance, lending relationships, and competition, *The Journal of Finance* 60, 231–266.

Denis, David J., and Vassil T. Mihov, 2003, The choice among bank debt, non-bank private debt, and public debt: evidence from new corporate borrowings, *Journal of Financial Economics* 70, 3–28.

DeYoung, Robert, Dennis Glennon, and Peter Nigro, 2008, Borrower–lender distance, credit scoring, and loan performance: Evidence from informational-opaque small business borrowers, *Journal of Financial Intermediation* 17, 113–143.

Diamond, Douglas W., 1991, Monitoring and reputation: the choice between bank loans and directly placed debt, *Journal of Political Economy* 99, 2763–2799.

Dick-Nielsen, Jens, 2009, Liquidity biases in TRACE, *Journal of Fixed Income* 19, 43–55.

Dick-Nielsen, Jens, 2014, How to Clean Enhanced TRACE Data, *Unpublished Manuscript.*

Dick-Nielsen, Jens, Peter Feldhütter, and David Lando, 2012, Corporate bond liquidity before and after the onset of the subprime crisis, *Journal of Financial Economics* 103, 471–492.

Drucker, Steven, and Manju Puri, 2009, On loan sales, loan contracting, and lending relationships, *Review of Financial Studies* 22, 2835–2872.

Eisele, Alexander, Tamara Nefedova, and Gianpaolo Parise, 2016, Are star funds really shining? Cross-trading and performance shifting in mutual fund families, BIS Working Paper No. 577. Available at SSRN: https://ssrn.com/abstract=2831690.

Fabozzi, Frank, Sven Klingler, Pia Mølgaard, and Mads Stenbo Nielsen, 2017, Active loan trading, *Working paper.*

Feldhütter, Peter, 2012, The same bond at different prices: Identifying search frictions and selling pressures, *Review of Financial Studies* 25, 1155–1206.

Feldhütter, Peter, Edith Hotchkiss, and Oguzhan Karakas, 2016, The value of creditor control in corporate bonds, *Journal of Financial Economics* 121, 1–27.

Feldhütter, Peter, and David Lando, 2008, Decomposing Swap Spreads, *Journal of Financial Economics* 88, 375–405.

Feldhütter, Peter, and Stephen Schaefer, 2017, The Myth of the Credit Spread Puzzle, *Review of Financial Studies, forthcomming.*

Fok, Robert C.W., Yuan-Chen Chang, and Wan-Tuz Lee, 2004, Bank relationships and their effects on firm performance around the asian financialcrisis: Evidence from taiwan, *Financial Management* 33, 89–112.

Forte, Santiago, and Juan I. Pena, 2009, Credit spreads: An empirical analysis on the informational content of stocks, bonds, and cds, *Journal of Banking and Finance* 33, 2013–2025.

Gatev, Evan, and Philip E. Strahan, 2009, Liquidity risk and syndicate structure, *Journal of Financial Economics* 93, 490 – 504.

Gonzalo, Jesus, and Clive Granger, 1995, Estimation of common long-memory components in cointegrated systems, *Journal of Business & Economic Statistics* 13, 27–35.

Gopalan, Radhakrishnan, Vikram Nanda, and Vijay Yerramilli, 2011, Does poor performance damage the reputation of financial intermediaries? evidence from the loan syndication market, *The Journal of Finance* 64, 2083–2120.

Granger, C. W. J., 1969, Investigating causal relations by econometric models and cross-spectral methods, *Econometrica* 37, 424–438.

Hasbrouck, Joel, 1995, One security, many markets: Determining the contributions to price discovery, *The Journal of Finance* 50, 1175–1199.

Hilscher, Jens, Joshua M. Pollet, and Mungo Wilson, 2015, Are credit default swaps a sideshow? evidence that information flows from equity to cds markets, *Journal of Financial and Quantitative Analysis* 50, 543–567.

Hoshi, Takeo, Anil Kashyap, and David Scharfstein, 1990, The role of banks in reducing the costs of financial distress in japan, *Journal of Financial Economics* 27, 67–88.

Hull, John, Mirela Predescu, and Alan White, 2004, The Relationship Between Credit Default Swap Spreads, Bond Yields, and Credit Rating Announcements, *Journal of Banking and Finance* 28, 2789–2811.

Ivashina, Victoria, 2009, Asymmetric information effects on loan spreads, *Journal of Financial Economics* 92, 300–319.

Ivashina, Victoria, and Zheng Sun, 2011, Institutional demand pressure and the cost of corporate loans, *Journal of Financial Economics* 99, 500–522.

Jimenez, Gabriel, and Jesus Saurina, 2004, Collateral, type of lender and relationship banking as determinants of credit risk, *Journal of Banking and Finance* 28, 2191–2212.

Krishnamurthy, Arvind, and Annette Vissing-Jørgensen, 2012, The Aggregate Demand for Treasury Debt, *Journal of Political Economy* 120, 233–267.

Kryzanowski, Lawrence, Stylianos Perrakis, and Rui Zhong, 2017, Price discovery in equity and cds markets, *Journal of Financial Markets* 35, 21–46.

Kwan, Simon H., 1996, Firm-specific information and the correlation between individual stocks and bonds, *Journal of Financial Economics* 40, 63–80.

Liebscher, Roberto, and Thomas Mählmann, 2016, Are professional investment managers skilled? evidence from syndicated loan portfolios, *Management Science* 63, 1892–1918.

Lim, Jongha, Bernadette A. Minton, and Michael A. Weisbach, 2014, Syndicated loan spreads and the composition of the syndicate, *Journal of Financial Economics* 111, 45–69.

Lin, Hai, Junbo Wang, and Chunchi Wu, 2014, Predictions of corporate bond excess returns, *Journal of Financial Markets* 21, 123 – 152.

LSTA, 2013, Leveraged loans: A primer, Available at http://www.leveragedloan.com/primer.

Marsh, Ian W., and Wolf Wagner, 2016, News-specific price discovery in credit default swap markets, *Financial Management* 45, 315–340.

Nadauld, Taylor D., and Michael S. Weisbach, 2012, Did securitization affect the cost of corporate debt?, *Journal of Financial Economics* 105, 332–352.

Nagel, Stefan, 2016, The Liquidity Premium of Near-Money Assets, *The Quarterly Journal of Economics* 131, 1927–1971.

Narayan, Paresh K., Susan S. Sharma, and Kannan S. Thuraisamy, 2014, An analysis of price discovery from panel data models of cds and equity returns, *Journal of Banking and Finance* 41, 167–177.

Norden, Lars, and Martin Weber, 2009, The co-movement of credit default swap, bond and stock markets: an empirical analysis, *European Financial Management* 15, 529–562.

Pastor, Lubos, Robert F. Stambaugh, and Lucian A. Taylor, 2017, Do funds make more when they trade more?, *Journal of Finance* 72, 1483–1528.

Petersen, Mitchell A., and Raghuram G. Rajan, 1994, The benefits of lending relationships: Evidence from small business data, *The Journal of Finance* 49, 3–37.

Petersen, Mitchell A., and Raghuram G. Rajan, 1995, The effect of credit market competition on lending relationships, *The Quarterly Journal of Economics* 110, 407–443.

Rajan, Raghuram G., 1992, Insiders and outsiders: The choice between informed and arm's-length debt, *The Journal of Finance* 47, 1367–1400.

Ronen, Tavy, and Xing Zhou, 2013, Trade and information in the corporate bond market, *Journal of Financial Markets* 16, 61–103.

Schaefer, Stephen, and Ilya Strebulaev, 2008, Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds, *Journal of Financial Economics* 90, 1–19.

Schafer, Larissa, 2016, Forgive but not forget: The behavior of relationship banks when firms are in distress, *Working paper*.

Schenone, Carola, 2010, Lending relationships and information rents: Do banks exploit their information advantages?, *The Review of Financial Studies* 23, 1149–1199.

Sharpe, Steven A., 1990, Asymmetric information, bank lending, and implicit contracts: A stylized model of customer relationships, *The Journal of Finance* 45, 1069–1087.

Shivdasani, Anil, and Yihui Wang, 2011, Did structured credit fuel the LBO boom?, *Journal of Finance* 66, 1291–1328.

Stoll, Hans R., and Robert E. Whaley, 1990, The dynamics of stock index and stock index futures returns, *Journal of Financial and Quantitative Analysis* 25, 441?468.

Sufi, Amir, 2007, Information asymmetry and financing arrangements: Evidence from syndicated loans, *The Journal of Finance* 62, 629–668.

Warga, Arthur, 1998, Fixed income data base, university of houston, houston, texas, .

Zhu, Haibin, 2006, An Empirical Comparison of Credit Spreads Between the Bond Market and Credit Default Swap Market, *Journal of Financial Services Research* 29, 211–235.

TITLER I PH.D.SERIEN:

2004

1. Martin Grieger
Internet-based Electronic Marketplaces and Supply Chain Management

2. Thomas Basbøll
LIKENESS
A Philosophical Investigation

3. Morten Knudsen
Beslutningens vaklen
En systemteoretisk analyse of moderniseringen af et amtskommunalt sundhedsvæsen 1980-2000

4. Lars Bo Jeppesen
Organizing Consumer Innovation
A product development strategy that is based on online communities and allows some firms to benefit from a distributed process of innovation by consumers

5. Barbara Dragsted
SEGMENTATION IN TRANSLATION AND TRANSLATION MEMORY SYSTEMS
An empirical investigation of cognitive segmentation and effects of integrating a TM system into the translation process

6. Jeanet Hardis
Sociale partnerskaber
Et socialkonstruktivistisk casestudie af partnerskabsaktørers virkelighedsopfattelse mellem identitet og legitimitet

7. Henriette Hallberg Thygesen
System Dynamics in Action

8. Carsten Mejer Plath
Strategisk Økonomistyring

9. Annemette Kjærgaard
Knowledge Management as Internal Corporate Venturing
– a Field Study of the Rise and Fall of a Bottom-Up Process

10. Knut Arne Hovdal
De profesjonelle i endring
Norsk ph.d., ej til salg gennem Samfundslitteratur

11. Søren Jeppesen
Environmental Practices and Greening Strategies in Small Manufacturing Enterprises in South Africa
– A Critical Realist Approach

12. Lars Frode Frederiksen
Industriel forskningsledelse
– på sporet af mønstre og samarbejde i danske forskningsintensive virksomheder

13. Martin Jes Iversen
The Governance of GN Great Nordic
– in an age of strategic and structural transitions 1939-1988

14. Lars Pynt Andersen
The Rhetorical Strategies of Danish TV Advertising
A study of the first fifteen years with special emphasis on genre and irony

15. Jakob Rasmussen
Business Perspectives on E-learning

16. Sof Thrane
The Social and Economic Dynamics of Networks
– a Weberian Analysis of Three Formalised Horizontal Networks

17. Lene Nielsen
Engaging Personas and Narrative Scenarios – a study on how a user-centered approach influenced the perception of the design process in the e-business group at AstraZeneca

18. S.J Valstad
Organisationsidentitet
Norsk ph.d., ej til salg gennem Samfundslitteratur

19. Thomas Lyse Hansen
Six Essays on Pricing and Weather risk in Energy Markets

20. Sabine Madsen
Emerging Methods – An Interpretive Study of ISD Methods in Practice

21. Evis Sinani
The Impact of Foreign Direct Investment on Efficiency, Productivity Growth and Trade: An Empirical Investigation

22. Bent Meier Sørensen
Making Events Work Or, How to Multiply Your Crisis

23. Pernille Schnoor
Brand Ethos
Om troværdige brand- og virksomhedsidentiteter i et retorisk og diskursteoretisk perspektiv

24. Sidsel Fabech
Von welchem Österreich ist hier die Rede?
Diskursive forhandlinger og magtkampe mellem rivaliserende nationale identitetskonstruktioner i østrigske pressediskurser

25. Klavs Odgaard Christensen
Sprogpolitik og identitetsdannelse i flersprogede forbundsstater
Et komparativt studie af Schweiz og Canada

26. Dana B. Minbaeva
Human Resource Practices and Knowledge Transfer in Multinational Corporations

27. Holger Højlund
Markedets politiske fornuft
Et studie af velfærdens organisering i perioden 1990-2003

28. Christine Mølgaard Frandsen
A.s erfaring
Om mellemværendets praktik i en transformation af mennesket og subjektiviteten

29. Sine Nørholm Just
The Constitution of Meaning – A Meaningful Constitution? Legitimacy, identity, and public opinion in the debate on the future of Europe

2005

1. Claus J. Varnes
Managing product innovation through rules – The role of formal and structured methods in product development

2. Helle Hedegaard Hein
Mellem konflikt og konsensus – Dialogudvikling på hospitalsklinikker

3. Axel Rosenø
Customer Value Driven Product Innovation – A Study of Market Learning in New Product Development

4. Søren Buhl Pedersen
Making space
An outline of place branding

5. Camilla Funck Ellehave
Differences that Matter
An analysis of practices of gender and organizing in contemporary workplaces

6. Rigmor Madeleine Lond
Styring af kommunale forvaltninger

7. Mette Aagaard Andreassen
Supply Chain versus Supply Chain
Benchmarking as a Means to Managing Supply Chains

8. Caroline Aggestam-Pontoppidan
From an idea to a standard
The UN and the global governance of accountants' competence

9. Norsk ph.d.

10. Vivienne Heng Ker-ni
An Experimental Field Study on the

Effectiveness of Grocer Media Advertising
Measuring Ad Recall and Recognition, Purchase Intentions and Short-Term Sales

11. Allan Mortensen
Essays on the Pricing of Corporate Bonds and Credit Derivatives

12. Remo Stefano Chiari
Figure che fanno conoscere
Itinerario sull'idea del valore cognitivo e espressivo della metafora e di altri tropi da Aristotele e da Vico fino al cognitivismo contemporaneo

13. Anders McIlquham-Schmidt
Strategic Planning and Corporate Performance
An integrative research review and a meta-analysis of the strategic planning and corporate performance literature from 1956 to 2003

14. Jens Geersbro
The TDF – PMI Case
Making Sense of the Dynamics of Business Relationships and Networks

15 Mette Andersen
Corporate Social Responsibility in Global Supply Chains
Understanding the uniqueness of firm behaviour

16. Eva Boxenbaum
Institutional Genesis: Micro – Dynamic Foundations of Institutional Change

17. Peter Lund-Thomsen
Capacity Development, Environmental Justice NGOs, and Governance: The Case of South Africa

18. Signe Jarlov
Konstruktioner af offentlig ledelse

19. Lars Stæhr Jensen
Vocabulary Knowledge and Listening Comprehension in English as a Foreign Language
An empirical study employing data elicited from Danish EFL learners

20. Christian Nielsen
Essays on Business Reporting
Production and consumption of strategic information in the market for information

21. Marianne Thejls Fischer
Egos and Ethics of Management Consultants

22. Annie Bekke Kjær
Performance management i Proces-innovation
– belyst i et social-konstruktivistisk perspektiv

23. Suzanne Dee Pedersen
GENTAGELSENS METAMORFOSE
Om organisering af den kreative gøren i den kunstneriske arbejdspraksis

24. Benedikte Dorte Rosenbrink
Revenue Management
Økonomiske, konkurrencemæssige & organisatoriske konsekvenser

25. Thomas Riise Johansen
Written Accounts and Verbal Accounts
The Danish Case of Accounting and Accountability to Employees

26. Ann Fogelgren-Pedersen
The Mobile Internet: Pioneering Users' Adoption Decisions

27. Birgitte Rasmussen
Ledelse i fællesskab – de tillidsvalgtes fornyende rolle

28. Gitte Thit Nielsen
Remerger
– skabende ledelseskræfter i fusion og opkøb

29. Carmine Gioia
A MICROECONOMETRIC ANALYSIS OF MERGERS AND ACQUISITIONS

30. Ole Hinz
Den effektive forandringsleder: pilot, pædagog eller politiker?
Et studie i arbejdslederes meningstilskrivninger i forbindelse med vellykket gennemførelse af ledelsesinitierede forandringsprojekter

31. Kjell-Åge Gotvassli
Et praksisbasert perspektiv på dynamiske
læringsnettverk i toppidretten
Norsk ph.d., ej til salg gennem Samfundslitteratur

32. Henriette Langstrup Nielsen
Linking Healthcare
An inquiry into the changing performances of web-based technology for asthma monitoring

33. Karin Tweddell Levinsen
Virtuel Uddannelsespraksis
Master i IKT og Læring – et casestudie i hvordan proaktiv proceshåndtering kan forbedre praksis i virtuelle læringsmiljøer

34. Anika Liversage
Finding a Path
Labour Market Life Stories of Immigrant Professionals

35. Kasper Elmquist Jørgensen
Studier i samspillet mellem stat og erhvervsliv i Danmark under 1. verdenskrig

36. Finn Janning
A DIFFERENT STORY
Seduction, Conquest and Discovery

37. Patricia Ann Plackett
Strategic Management of the Radical Innovation Process
Leveraging Social Capital for Market Uncertainty Management

2006

1. Christian Vintergaard
Early Phases of Corporate Venturing

2. Niels Rom-Poulsen
Essays in Computational Finance

3. Tina Brandt Husman
Organisational Capabilities, Competitive Advantage & Project-Based Organisations
The Case of Advertising and Creative Good Production

4. Mette Rosenkrands Johansen
Practice at the top
– how top managers mobilise and use non-financial performance measures

5. Eva Parum
Corporate governance som strategisk kommunikations- og ledelsesværktøj

6. Susan Aagaard Petersen
Culture's Influence on Performance Management: The Case of a Danish Company in China

7. Thomas Nicolai Pedersen
The Discursive Constitution of Organizational Governance – Between unity and differentiation
The Case of the governance of environmental risks by World Bank environmental staff

8. Cynthia Selin
Volatile Visions: Transactons in Anticipatory Knowledge

9. Jesper Banghøj
Financial Accounting Information and Compensation in Danish Companies

10. Mikkel Lucas Overby
Strategic Alliances in Emerging High-Tech Markets: What's the Difference and does it Matter?

11. Tine Aage
External Information Acquisition of Industrial Districts and the Impact of Different Knowledge Creation Dimensions

A case study of the Fashion and Design Branch of the Industrial District of Montebelluna, NE Italy

12. Mikkel Flyverbom
    Making the Global Information Society Governable
    On the Governmentality of Multi-Stakeholder Networks

13. Anette Grønning
    Personen bag
    Tilstedevær i e-mail som inter-aktionsform mellem kunde og med-arbejder i dansk forsikringskontekst

14. Jørn Helder
    One Company – One Language?
    The NN-case

15. Lars Bjerregaard Mikkelsen
    Differing perceptions of customer value
    Development and application of a tool for mapping perceptions of customer value at both ends of customer-suppli-er dyads in industrial markets

16. Lise Granerud
    Exploring Learning
    Technological learning within small manufacturers in South Africa

17. Esben Rahbek Pedersen
    Between Hopes and Realities: Reflections on the Promises and Practices of Corporate Social Responsibility (CSR)

18. Ramona Samson
    The Cultural Integration Model and European Transformation.
    The Case of Romania

2007

1. Jakob Vestergaard
   Discipline in The Global Economy
   Panopticism and the Post-Washington Consensus

2. Heidi Lund Hansen
   Spaces for learning and working
   A qualitative study of change of work, management, vehicles of power and social practices in open offices

3. Sudhanshu Rai
   Exploring the internal dynamics of software development teams during user analysis
   A tension enabled Institutionalization Model; "Where process becomes the objective"

4. Norsk ph.d.
   Ej til salg gennem Samfundslitteratur

5. Serden Ozcan
   EXPLORING HETEROGENEITY IN ORGANIZATIONAL ACTIONS AND OUTCOMES
   A Behavioural Perspective

6. Kim Sundtoft Hald
   Inter-organizational Performance Measurement and Management in Action
   – An Ethnography on the Construction of Management, Identity and Relationships

7. Tobias Lindeberg
   Evaluative Technologies
   Quality and the Multiplicity of Performance

8. Merete Wedell-Wedellsborg
   Den globale soldat
   Identitetsdannelse og identitetsledelse i multinationale militære organisatio-ner

9. Lars Frederiksen
   Open Innovation Business Models
   Innovation in firm-hosted online user communities and inter-firm project ventures in the music industry
   – A collection of essays

10. Jonas Gabrielsen
    Retorisk toposlære – fra statisk 'sted' til persuasiv aktivitet

11. Christian Moldt-Jørgensen
Fra meningsløs til meningsfuld evaluering.
Anvendelsen af studentertilfredshedsmålinger på de korte og mellemlange videregående uddannelser set fra et psykodynamisk systemperspektiv

12. Ping Gao
Extending the application of actor-network theory
Cases of innovation in the telecommunications industry

13. Peter Mejlby
Frihed og fængsel, en del af den samme drøm?
Et phronetisk baseret casestudie af frigørelsens og kontrollens sameksistens i værdibaseret ledelse!

14. Kristina Birch
Statistical Modelling in Marketing

15. Signe Poulsen
Sense and sensibility:
The language of emotional appeals in insurance marketing

16. Anders Bjerre Trolle
Essays on derivatives pricing and dynamic asset allocation

17. Peter Feldhütter
Empirical Studies of Bond and Credit Markets

18. Jens Henrik Eggert Christensen
Default and Recovery Risk Modeling and Estimation

19. Maria Theresa Larsen
Academic Enterprise: A New Mission for Universities or a Contradiction in Terms?
Four papers on the long-term implications of increasing industry involvement and commercialization in academia

20. Morten Wellendorf
Postimplementering af teknologi i den offentlige forvaltning
Analyser af en organisations kontinuerlige arbejde med informationsteknologi

21. Ekaterina Mhaanna
Concept Relations for Terminological Process Analysis

22. Stefan Ring Thorbjørnsen
Forsvaret i forandring
Et studie i officerers kapabiliteter under påvirkning af omverdenens forandringspres mod øget styring og læring

23. Christa Breum Amhøj
Det selvskabte medlemskab om managementstaten, dens styringsteknologier og indbyggere

24. Karoline Bromose
Between Technological Turbulence and Operational Stability
– An empirical case study of corporate venturing in TDC

25. Susanne Justesen
Navigating the Paradoxes of Diversity in Innovation Practice
– A Longitudinal study of six very different innovation processes – in practice

26. Luise Noring Henler
Conceptualising successful supply chain partnerships
– Viewing supply chain partnerships from an organisational culture perspective

27. Mark Mau
Kampen om telefonen
Det danske telefonvæsen under den tyske besættelse 1940-45

28. Jakob Halskov
The semiautomatic expansion of existing terminological ontologies using knowledge patterns discovered

on the WWW – an implementation and evaluation

29. Gergana Koleva
European Policy Instruments Beyond Networks and Structure: The Innovative Medicines Initiative

30. Christian Geisler Asmussen
Global Strategy and International Diversity: A Double-Edged Sword?

31. Christina Holm-Petersen
Stolthed og fordom
Kultur- og identitetsarbejde ved skabelsen af en ny sengeafdeling gennem fusion

32. Hans Peter Olsen
Hybrid Governance of Standardized States
Causes and Contours of the Global Regulation of Government Auditing

33. Lars Bøge Sørensen
Risk Management in the Supply Chain

34. Peter Aagaard
Det unikkes dynamikker
De institutionelle mulighedsbetingelser bag den individuelle udforskning i professionelt og frivilligt arbejde

35. Yun Mi Antorini
Brand Community Innovation
An Intrinsic Case Study of the Adult Fans of LEGO Community

36. Joachim Lynggaard Boll
Labor Related Corporate Social Performance in Denmark
Organizational and Institutional Perspectives

2008

1. Frederik Christian Vinten
Essays on Private Equity

2. Jesper Clement
Visual Influence of Packaging Design on In-Store Buying Decisions

3. Marius Brostrøm Kousgaard
Tid til kvalitetsmåling?
– Studier af indrulleringsprocesser i forbindelse med introduktionen af kliniske kvalitetsdatabaser i speciallægepraksissektoren

4. Irene Skovgaard Smith
Management Consulting in Action Value creation and ambiguity in client-consultant relations

5. Anders Rom
Management accounting and integrated information systems
How to exploit the potential for management accounting of information technology

6. Marina Candi
Aesthetic Design as an Element of Service Innovation in New Technology-based Firms

7. Morten Schnack
Teknologi og tværfaglighed
– en analyse af diskussionen omkring indførelse af EPJ på en hospitalsafdeling

8. Helene Balslev Clausen
Juntos pero no revueltos – un estudio sobre emigrantes norteamericanos en un pueblo mexicano

9. Lise Justesen
Kunsten at skrive revisionsrapporter.
En beretning om forvaltningsrevisionens beretninger

10. Michael E. Hansen
The politics of corporate responsibility: CSR and the governance of child labor and core labor rights in the 1990s

11. Anne Roepstorff
Holdning for handling – en etnologisk undersøgelse af Virksomheders Sociale Ansvar/CSR

12. Claus Bajlum
Essays on Credit Risk and Credit Derivatives

13. Anders Bojesen
The Performative Power of Competence – an Inquiry into Subjectivity and Social Technologies at Work

14. Satu Reijonen
Green and Fragile
A Study on Markets and the Natural Environment

15. Ilduara Busta
Corporate Governance in Banking
A European Study

16. Kristian Anders Hvass
A Boolean Analysis Predicting Industry Change: Innovation, Imitation & Business Models
The Winning Hybrid: A case study of isomorphism in the airline industry

17. Trine Paludan
De uvidende og de udviklingsparate
Identitet som mulighed og restriktion blandt fabriksarbejdere på det aftayloriserede fabriksgulv

18. Kristian Jakobsen
Foreign market entry in transition economies: Entry timing and mode choice

19. Jakob Elming
Syntactic reordering in statistical machine translation

20. Lars Brømsøe Termansen
Regional Computable General Equilibrium Models for Denmark
Three papers laying the foundation for regional CGE models with agglomeration characteristics

21. Mia Reinholt
The Motivational Foundations of Knowledge Sharing

22. Frederikke Krogh-Meibom
The Co-Evolution of Institutions and Technology
– A Neo-Institutional Understanding of Change Processes within the Business Press – the Case Study of Financial Times

23. Peter D. Ørberg Jensen
OFFSHORING OF ADVANCED AND HIGH-VALUE TECHNICAL SERVICES: ANTECEDENTS, PROCESS DYNAMICS AND FIRMLEVEL IMPACTS

24. Pham Thi Song Hanh
Functional Upgrading, Relational Capability and Export Performance of Vietnamese Wood Furniture Producers

25. Mads Vangkilde
Why wait?
An Exploration of first-mover advantages among Danish e-grocers through a resource perspective

26. Hubert Buch-Hansen
Rethinking the History of European Level Merger Control
A Critical Political Economy Perspective

2009

1. Vivian Lindhardsen
From Independent Ratings to Communal Ratings: A Study of CWA Raters' Decision-Making Behaviours

2. Guðrið Weihe
Public-Private Partnerships: Meaning and Practice

3. Chris Nøkkentved
Enabling Supply Networks with Collaborative Information Infrastructures
An Empirical Investigation of Business Model Innovation in Supplier Relationship Management

4. Sara Louise Muhr
Wound, Interrupted – On the Vulnerability of Diversity Management

5. Christine Sestoft
Forbrugeradfærd i et Stats- og Livsformsteoretisk perspektiv

6. Michael Pedersen
Tune in, Breakdown, and Reboot: On the production of the stress-fit self-managing employee

7. Salla Lutz
Position and Reposition in Networks – Exemplified by the Transformation of the Danish Pine Furniture Manufacturers

8. Jens Forssbæck
Essays on market discipline in commercial and central banking

9. Tine Murphy
Sense from Silence – A Basis for Organised Action
How do Sensemaking Processes with Minimal Sharing Relate to the Reproduction of Organised Action?

10. Sara Malou Strandvad
Inspirations for a new sociology of art: A sociomaterial study of development processes in the Danish film industry

11. Nicolaas Mouton
On the evolution of social scientific metaphors:
A cognitive-historical enquiry into the divergent trajectories of the idea that collective entities – states and societies, cities and corporations – are biological organisms.

12. Lars Andreas Knutsen
Mobile Data Services:
Shaping of user engagements

13. Nikolaos Theodoros Korfiatis
Information Exchange and Behavior
A Multi-method Inquiry on Online Communities

14. Jens Albæk
Forestillinger om kvalitet og tværfaglighed på sygehuse
– skabelse af forestillinger i læge- og plejegrupperne angående relevans af nye idéer om kvalitetsudvikling gennem tolkningsprocesser

15. Maja Lotz
The Business of Co-Creation – and the Co-Creation of Business

16. Gitte P. Jakobsen
Narrative Construction of Leader Identity in a Leader Development Program Context

17. Dorte Hermansen
"Living the brand" som en brandorienteret dialogisk praxis:
Om udvikling af medarbejdernes brandorienterede dømmekraft

18. Aseem Kinra
Supply Chain (logistics) Environmental Complexity

19. Michael Nørager
How to manage SMEs through the transformation from non innovative to innovative?

20. Kristin Wallevik
Corporate Governance in Family Firms
The Norwegian Maritime Sector

21. Bo Hansen Hansen
Beyond the Process
Enriching Software Process Improvement with Knowledge Management

22. Annemette Skot-Hansen
Franske adjektivisk afledte adverbier, der tager præpositionssyntagmer indledt med præpositionen à som argumenter
En valensgrammatisk undersøgelse

23. Line Gry Knudsen
Collaborative R&D Capabilities
In Search of Micro-Foundations

24. Christian Scheuer
Employers meet employees
Essays on sorting and globalization

25. Rasmus Johnsen
The Great Health of Melancholy
A Study of the Pathologies of Performativity

26. Ha Thi Van Pham
Internationalization, Competitiveness Enhancement and Export Performance of Emerging Market Firms:
Evidence from Vietnam

27. Henriette Balieu
Kontrolbegrebets betydning for kausativalternationen i spansk
En kognitiv-typologisk analyse

2010

1. Yen Tran
Organizing Innovationin Turbulent Fashion Market
Four papers on how fashion firms create and appropriate innovation value

2. Anders Raastrup Kristensen
Metaphysical Labour
Flexibility, Performance and Commitment in Work-Life Management

3. Margrét Sigrún Sigurdardottir
Dependently independent
Co-existence of institutional logics in the recorded music industry

4. Ásta Dis Óladóttir
Internationalization from a small domestic base:
An empirical analysis of Economics and Management

5. Christine Secher
E-deltagelse i praksis – politikernes og forvaltningens medkonstruktion og konsekvenserne heraf

6. Marianne Stang Våland
What we talk about when we talk about space:
End User Participation between Processes of Organizational and Architectural Design

7. Rex Degnegaard
Strategic Change Management
Change Management Challenges in the Danish Police Reform

8. Ulrik Schultz Brix
Værdi i rekruttering – den sikre beslutning
En pragmatisk analyse af perception og synliggørelse af værdi i rekrutterings- og udvælgelsesarbejdet

9. Jan Ole Similä
Kontraktsledelse
Relasjonen mellom virksomhetsledelse og kontraktshåndtering, belyst via fire norske virksomheter

10. Susanne Boch Waldorff
Emerging Organizations: In between local translation, institutional logics and discourse

11. Brian Kane
Performance Talk
Next Generation Management of Organizational Performance

12. Lars Ohnemus
Brand Thrust: Strategic Branding and Shareholder Value
An Empirical Reconciliation of two Critical Concepts

13. Jesper Schlamovitz
Håndtering af usikkerhed i film- og byggeprojekter

14. Tommy Moesby-Jensen
Det faktiske livs forbindtlighed
Førsokratisk informeret, ny-aristotelisk ἦθος-tænkning hos Martin Heidegger

15. Christian Fich
Two Nations Divided by Common Values
French National Habitus and the Rejection of American Power

16. Peter Beyer
Processer, sammenhængskraft og fleksibilitet
Et empirisk casestudie af omstillingsforløb i fire virksomheder

17. Adam Buchhorn
Markets of Good Intentions
Constructing and Organizing Biogas Markets Amid Fragility and Controversy

18. Cecilie K. Moesby-Jensen
Social læring og fælles praksis
Et mixed method studie, der belyser læringskonsekvenser af et lederkursus for et praksisfællesskab af offentlige mellemledere

19. Heidi Boye
Fødevarer og sundhed i senmodernismen
– En indsigt i hyggefænomenet og de relaterede fødevarepraksisser

20. Kristine Munkgård Pedersen
Flygtige forbindelser og midlertidige mobiliseringer
Om kulturel produktion på Roskilde Festival

21. Oliver Jacob Weber
Causes of Intercompany Harmony in Business Markets – An Empirical Investigation from a Dyad Perspective

22. Susanne Ekman
Authority and Autonomy
Paradoxes of Modern Knowledge Work

23. Anette Frey Larsen
Kvalitetsledelse på danske hospitaler
– Ledelsernes indflydelse på introduktion og vedligeholdelse af kvalitetsstrategier i det danske sundhedsvæsen

24. Toyoko Sato
Performativity and Discourse: Japanese Advertisements on the Aesthetic Education of Desire

25. Kenneth Brinch Jensen
Identifying the Last Planner System
Lean management in the construction industry

26. Javier Busquets
Orchestrating Network Behavior for Innovation

27. Luke Patey
The Power of Resistance: India's National Oil Company and International Activism in Sudan

28. Mette Vedel
Value Creation in Triadic Business Relationships. Interaction, Interconnection and Position

29. Kristian Tørning
Knowledge Management Systems in Practice – A Work Place Study

30. Qingxin Shi
An Empirical Study of Thinking Aloud Usability Testing from a Cultural Perspective

31. Tanja Juul Christiansen
Corporate blogging: Medarbejderes kommunikative handlekraft

32. Malgorzata Ciesielska
Hybrid Organisations.
A study of the Open Source – business setting

33. Jens Dick-Nielsen
Three Essays on Corporate Bond Market Liquidity

34. Sabrina Speiermann
Modstandens Politik
Kampagnestyring i Velfærdsstaten.
En diskussion af trafikkampagners styringspotentiale

35. Julie Uldam
Fickle Commitment. Fostering political engagement in 'the flighty world of online activism'

36. Annegrete Juul Nielsen
Traveling technologies and transformations in health care

37. Athur Mühlen-Schulte
Organising Development
Power and Organisational Reform in the United Nations Development Programme

38. Louise Rygaard Jonas
Branding på butiksgulvet
Et case-studie af kultur- og identitets-arbejdet i Kvickly

2011

1. Stefan Fraenkel
Key Success Factors for Sales Force Readiness during New Product Launch
A Study of Product Launches in the Swedish Pharmaceutical Industry

2. Christian Plesner Rossing
International Transfer Pricing in Theory and Practice

3. Tobias Dam Hede
Samtalekunst og ledelsesdisciplin
– en analyse af coachingsdiskursens genealogi og governmentality

4. Kim Pettersson
Essays on Audit Quality, Auditor Choice, and Equity Valuation

5. Henrik Merkelsen
The expert-lay controversy in risk research and management. Effects of institutional distances. Studies of risk definitions, perceptions, management and communication

6. Simon S. Torp
Employee Stock Ownership:
Effect on Strategic Management and Performance

7. Mie Harder
Internal Antecedents of Management Innovation

8. Ole Helby Petersen
Public-Private Partnerships: Policy and Regulation – With Comparative and Multi-level Case Studies from Denmark and Ireland

9. Morten Krogh Petersen
'Good' Outcomes. Handling Multiplicity in Government Communication

10. Kristian Tangsgaard Hvelplund
Allocation of cognitive resources in translation - an eye-tracking and key-logging study

11. Moshe Yonatany
The Internationalization Process of Digital Service Providers

12. Anne Vestergaard
Distance and Suffering
Humanitarian Discourse in the age of Mediatization

13. Thorsten Mikkelsen
Personligheds indflydelse på forretningsrelationer

14. Jane Thostrup Jagd
Hvorfor fortsætter fusionsbølgen udover "the tipping point"?
– en empirisk analyse af information og kognitioner om fusioner

15. Gregory Gimpel
Value-driven Adoption and Consumption of Technology: Understanding Technology Decision Making

16. Thomas Stengade Sønderskov
Den nye mulighed
Social innovation i en forretningsmæssig kontekst

17. Jeppe Christoffersen
Donor supported strategic alliances in developing countries

18. Vibeke Vad Baunsgaard
Dominant Ideological Modes of Rationality: Cross functional

integration in the process of product innovation

19. Throstur Olaf Sigurjonsson
Governance Failure and Icelands's Financial Collapse

20. Allan Sall Tang Andersen
Essays on the modeling of risks in interest-rate and inflation markets

21. Heidi Tscherning
Mobile Devices in Social Contexts

22. Birgitte Gorm Hansen
Adapting in the Knowledge Economy Lateral Strategies for Scientists and Those Who Study Them

23. Kristina Vaarst Andersen
Optimal Levels of Embeddedness The Contingent Value of Networked Collaboration

24. Justine Grønbæk Pors
Noisy Management A History of Danish School Governing from 1970-2010

25. Stefan Linder
Micro-foundations of Strategic Entrepreneurship Essays on Autonomous Strategic Action

26. Xin Li
Toward an Integrative Framework of National Competitiveness An application to China

27. Rune Thorbjørn Clausen
Værdifuld arkitektur Et eksplorativt studie af bygningers rolle i virksomheders værdiskabelse

28. Monica Viken
Markedsundersøkelser som bevis i varemerke- og markedsføringsrett

29. Christian Wymann
Tattooing The Economic and Artistic Constitution of a Social Phenomenon

30. Sanne Frandsen
Productive Incoherence A Case Study of Branding and Identity Struggles in a Low-Prestige Organization

31. Mads Stenbo Nielsen
Essays on Correlation Modelling

32. Ivan Häuser
Følelse og sprog Etablering af en ekspressiv kategori, eksemplificeret på russisk

33. Sebastian Schwenen
Security of Supply in Electricity Markets

2012

1. Peter Holm Andreasen
The Dynamics of Procurement Management - A Complexity Approach

2. Martin Haulrich
Data-Driven Bitext Dependency Parsing and Alignment

3. Line Kirkegaard
Konsulenten i den anden nat En undersøgelse af det intense arbejdsliv

4. Tonny Stenheim
Decision usefulness of goodwill under IFRS

5. Morten Lind Larsen
Produktivitet, vækst og velfærd Industrirådet og efterkrigstidens Danmark 1945 - 1958

6. Petter Berg
Cartel Damages and Cost Asymmetries

7. Lynn Kahle
Experiential Discourse in Marketing A methodical inquiry into practice and theory

8. Anne Roelsgaard Obling
Management of Emotions in Accelerated Medical Relationships

9. Thomas Frandsen
Managing Modularity of Service Processes Architecture

10. Carina Christine Skovmøller
CSR som noget særligt
Et casestudie om styring og meningsskabelse i relation til CSR ud fra en intern optik

11. Michael Tell
Fradragsbeskæring af selskabers finansieringsudgifter
En skatteretlig analyse af SEL §§ 11, 11B og 11C

12. Morten Holm
Customer Profitability Measurement Models
Their Merits and Sophistication across Contexts

13. Katja Joo Dyppel
Beskatning af derivater
En analyse af dansk skatteret

14. Esben Anton Schultz
Essays in Labor Economics
Evidence from Danish Micro Data

15. Carina Risvig Hansen
"Contracts not covered, or not fully covered, by the Public Sector Directive"

16. Anja Svejgaard Pors
Iværksættelse af kommunikation
- patientfigurer i hospitalets strategiske kommunikation

17. Frans Bévort
Making sense of management with logics
An ethnographic study of accountants who become managers

18. René Kallestrup
The Dynamics of Bank and Sovereign Credit Risk

19. Brett Crawford
Revisiting the Phenomenon of Interests in Organizational Institutionalism
The Case of U.S. Chambers of Commerce

20. Mario Daniele Amore
Essays on Empirical Corporate Finance

21. Arne Stjernholm Madsen
The evolution of innovation strategy
Studied in the context of medical device activities at the pharmaceutical company Novo Nordisk A/S in the period 1980-2008

22. Jacob Holm Hansen
Is Social Integration Necessary for Corporate Branding?
A study of corporate branding strategies at Novo Nordisk

23. Stuart Webber
Corporate Profit Shifting and the Multinational Enterprise

24. Helene Ratner
Promises of Reflexivity
Managing and Researching Inclusive Schools

25. Therese Strand
The Owners and the Power: Insights from Annual General Meetings

26. Robert Gavin Strand
In Praise of Corporate Social Responsibility Bureaucracy

27. Nina Sormunen
Auditor's going-concern reporting
Reporting decision and content of the report

28. John Bang Mathiasen
Learning within a product development working practice:
- an understanding anchored in pragmatism

29. Philip Holst Riis
Understanding Role-Oriented Enterprise Systems: From Vendors to Customers

30. Marie Lisa Dacanay
Social Enterprises and the Poor
Enhancing Social Entrepreneurship and Stakeholder Theory

31. Fumiko Kano Glückstad
Bridging Remote Cultures: Cross-lingual concept mapping based on the information receiver's prior-knowledge

32. Henrik Barslund Fosse
Empirical Essays in International Trade

33. Peter Alexander Albrecht
Foundational hybridity and its reproduction
Security sector reform in Sierra Leone

34. Maja Rosenstock
CSR - hvor svært kan det være?
Kulturanalytisk casestudie om udfordringer og dilemmaer med at forankre Coops CSR-strategi

35. Jeanette Rasmussen
Tweens, medier og forbrug
Et studie af 10-12 årige danske børns brug af internettet, opfattelse og forståelse af markedsføring og forbrug

36. Ib Tunby Gulbrandsen
'This page is not intended for a US Audience'
A five-act spectacle on online communication, collaboration & organization.

37. Kasper Aalling Teilmann
Interactive Approaches to Rural Development

38. Mette Mogensen
The Organization(s) of Well-being and Productivity
(Re)assembling work in the Danish Post

39. Søren Friis Møller
From Disinterestedness to Engagement
Towards Relational Leadership In the Cultural Sector

40. Nico Peter Berhausen
Management Control, Innovation and Strategic Objectives – Interactions and Convergence in Product Development Networks

41. Balder Onarheim
Creativity under Constraints
Creativity as Balancing 'Constrainedness'

42. Haoyong Zhou
Essays on Family Firms

43. Elisabeth Naima Mikkelsen
Making sense of organisational conflict
An empirical study of enacted sensemaking in everyday conflict at work

2013

1. Jacob Lyngsie
Entrepreneurship in an Organizational Context

2. Signe Groth-Brodersen
Fra ledelse til selvet
En socialpsykologisk analyse af forholdet imellem selvledelse, ledelse og stress i det moderne arbejdsliv

3. Nis Høyrup Christensen
Shaping Markets: A Neoinstitutional Analysis of the Emerging Organizational Field of Renewable Energy in China

4. Christian Edelvold Berg
As a matter of size
THE IMPORTANCE OF CRITICAL MASS AND THE CONSEQUENCES OF SCARCITY FOR TELEVISION MARKETS

5. Christine D. Isakson
Coworker Influence and Labor Mobility
Essays on Turnover, Entrepreneurship and Location Choice in the Danish Maritime Industry

6. Niels Joseph Jerne Lennon
Accounting Qualities in Practice
Rhizomatic stories of representational faithfulness, decision making and control

7. Shannon O'Donnell
Making Ensemble Possible
How special groups organize for collaborative creativity in conditions of spatial variability and distance

8. Robert W. D. Veitch
Access Decisions in a Partly-Digital World Comparing Digital Piracy and Legal Modes for Film and Music

9. Marie Mathiesen
Making Strategy Work An Organizational Ethnography

10. Arisa Shollo
The role of business intelligence in organizational decision-making

11. Mia Kaspersen
The construction of social and environmental reporting

12. Marcus Møller Larsen
The organizational design of offshoring

13. Mette Ohm Rørdam
EU Law on Food Naming The prohibition against misleading names in an internal market context

14. Hans Peter Rasmussen
GIV EN GED! Kan giver-idealtyper forklare støtte til velgørenhed og understøtte relationsopbygning?

15. Ruben Schachtenhaufen
Fonetisk reduktion i dansk

16. Peter Koerver Schmidt
Dansk CFC-beskatning I et internationalt og komparativt perspektiv

17. Morten Froholdt
Strategi i den offentlige sektor En kortlægning af styringsmæssig kontekst, strategisk tilgang, samt anvendte redskaber og teknologier for udvalgte danske statslige styrelser

18. Annette Camilla Sjørup
Cognitive effort in metaphor translation An eye-tracking and key-logging study

19. Tamara Stucchi
The Internationalization of Emerging Market Firms: A Context-Specific Study

20. Thomas Lopdrup-Hjorth
"Let's Go Outside": The Value of Co-Creation

21. Ana Alačovska
Genre and Autonomy in Cultural Production The case of travel guidebook production

22. Marius Gudmand-Høyer
Stemningssindssygdommenes historie i det 19. århundrede Omtydningen af melankolien og manien som bipolære stemningslidelser i dansk sammenhæng under hensyn til dannelsen af det moderne følelseslivs relative autonomi. En problematiserings- og erfarings-analytisk undersøgelse

23. Lichen Alex Yu
Fabricating an S&OP Process Circulating References and Matters of Concern

24. Esben Alfort
The Expression of a Need Understanding search

25. Trine Pallesen
Assembling Markets for Wind Power An Inquiry into the Making of Market Devices

26. Anders Koed Madsen
Web-Visions Repurposing digital traces to organize social attention

27. Lærke Højgaard Christiansen
BREWING ORGANIZATIONAL RESPONSES TO INSTITUTIONAL LOGICS

28. Tommy Kjær Lassen
EGENTLIG SELVLEDELSE En ledelsesfilosofisk afhandling om selvledelsens paradoksale dynamik og eksistentielle engagement

29. Morten Rossing
Local Adaption and Meaning Creation in Performance Appraisal

30. Søren Obed Madsen
Lederen som oversætter
Et oversættelsesteoretisk perspektiv på strategisk arbejde

31. Thomas Høgenhaven
Open Government Communities
Does Design Affect Participation?

32. Kirstine Zinck Pedersen
Failsafe Organizing?
A Pragmatic Stance on Patient Safety

33. Anne Petersen
Hverdagslogikker i psykiatrisk arbejde
En institutionsetnografisk undersøgelse af hverdagen i psykiatriske organisationer

34. Didde Maria Humle
Fortællinger om arbejde

35. Mark Holst-Mikkelsen
Strategieksekvering i praksis – barrierer og muligheder!

36. Malek Maalouf
Sustaining lean
Strategies for dealing with organizational paradoxes

37. Nicolaj Tofte Brenneche
Systemic Innovation In The Making
The Social Productivity of Cartographic Crisis and Transitions in the Case of SEEIT

38. Morten Gylling
The Structure of Discourse
A Corpus-Based Cross-Linguistic Study

39. Binzhang YANG
Urban Green Spaces for Quality Life - Case Study: the landscape architecture for people in Copenhagen

40. Michael Friis Pedersen
Finance and Organization:
The Implications for Whole Farm Risk Management

41. Even Fallan
Issues on supply and demand for environmental accounting information

42. Ather Nawaz
Website user experience
A cross-cultural study of the relation between users´ cognitive style, context of use, and information architecture of local websites

43. Karin Beukel
The Determinants for Creating Valuable Inventions

44. Arjan Markus
External Knowledge Sourcing and Firm Innovation
Essays on the Micro-Foundations of Firms' Search for Innovation

2014

1. Solon Moreira
Four Essays on Technology Licensing and Firm Innovation

2. Karin Strzeletz Ivertsen
Partnership Drift in Innovation Processes
A study of the Think City electric car development

3. Kathrine Hoffmann Pii
Responsibility Flows in Patient-centred Prevention

4. Jane Bjørn Vedel
Managing Strategic Research
An empirical analysis of science-industry collaboration in a pharmaceutical company

5. Martin Gylling
Processuel strategi i organisationer
Monografi om dobbeltheden i tænkning af strategi, dels som vidensfelt i organisationsteori, dels som kunstnerisk tilgang til at skabe i erhvervsmæssig innovation

6. Linne Marie Lauesen
Corporate Social Responsibility in the Water Sector: How Material Practices and their Symbolic and Physical Meanings Form a Colonising Logic

7. Maggie Qiuzhu Mei
LEARNING TO INNOVATE: The role of ambidexterity, standard, and decision process

8. Inger Høedt-Rasmussen
Developing Identity for Lawyers Towards Sustainable Lawyering

9. Sebastian Fux
Essays on Return Predictability and Term Structure Modelling

10. Thorbjørn N. M. Lund-Poulsen
Essays on Value Based Management

11. Oana Brindusa Albu
Transparency in Organizing: A Performative Approach

12. Lena Olaison
Entrepreneurship at the limits

13. Hanne Sørum
DRESSED FOR WEB SUCCESS? An Empirical Study of Website Quality in the Public Sector

14. Lasse Folke Henriksen
Knowing networks How experts shape transnational governance

15. Maria Halbinger
Entrepreneurial Individuals Empirical Investigations into Entrepreneurial Activities of Hackers and Makers

16. Robert Spliid
Kapitalfondenes metoder og kompetencer

17. Christiane Stelling
Public-private partnerships & the need, development and management of trusting A processual and embedded exploration

18. Marta Gasparin
Management of design as a translation process

19. Kåre Moberg
Assessing the Impact of Entrepreneurship Education From ABC to PhD

20. Alexander Cole
Distant neighbors Collective learning beyond the cluster

21. Martin Møller Boje Rasmussen
Is Competitiveness a Question of Being Alike? How the United Kingdom, Germany and Denmark Came to Compete through their Knowledge Regimes from 1993 to 2007

22. Anders Ravn Sørensen
Studies in central bank legitimacy, currency and national identity Four cases from Danish monetary history

23. Nina Bellak
Can Language be Managed in International Business? Insights into Language Choice from a Case Study of Danish and Austrian Multinational Corporations (MNCs)

24. Rikke Kristine Nielsen
Global Mindset as Managerial Meta-competence and Organizational Capability: Boundary-crossing Leadership Cooperation in the MNC The Case of 'Group Mindset' in Solar A/S.

25. Rasmus Koss Hartmann
User Innovation inside government Towards a critically performative foundation for inquiry

26. Kristian Gylling Olesen
Flertydig og emergerende ledelse i folkeskolen
Et aktør-netværksteoretisk ledelses-studie af politiske evalueringsreformers betydning for ledelse i den danske folkeskole

27. Troels Riis Larsen
Kampen om Danmarks omdømme 1945-2010
Omdømmearbejde og omdømmepolitik

28. Klaus Majgaard
Jagten på autenticitet i offentlig styring

29. Ming Hua Li
Institutional Transition and Organizational Diversity: Differentiated internationalization strategies of emerging market state-owned enterprises

30. Sofie Blinkenberg Federspiel
IT, organisation og digitalisering: Institutionelt arbejde i den kommunale digitaliseringsproces

31. Elvi Weinreich
Hvilke offentlige ledere er der brug for når velfærdstænkningen flytter sig – er Diplomuddannelsens lederprofil svaret?

32. Ellen Mølgaard Korsager
Self-conception and image of context in the growth of the firm – A Penrosian History of Fiberline Composites

33. Else Skjold
The Daily Selection

34. Marie Louise Conradsen
The Cancer Centre That Never Was
The Organisation of Danish Cancer Research 1949-1992

35. Virgilio Failla
Three Essays on the Dynamics of Entrepreneurs in the Labor Market

36. Nicky Nedergaard
Brand-Based Innovation
Relational Perspectives on Brand Logics and Design Innovation Strategies and Implementation

37. Mads Gjedsted Nielsen
Essays in Real Estate Finance

38. Kristin Martina Brandl
Process Perspectives on Service Offshoring

39. Mia Rosa Koss Hartmann
In the gray zone
With police in making space for creativity

40. Karen Ingerslev
Healthcare Innovation under The Microscope
Framing Boundaries of Wicked Problems

41. Tim Neerup Themsen
Risk Management in large Danish public capital investment programmes

2015

1. Jakob Ion Wille
Film som design
Design af levende billeder i film og tv-serier

2. Christiane Mossin
Interzones of Law and Metaphysics
Hierarchies, Logics and Foundations of Social Order seen through the Prism of EU Social Rights

3. Thomas Tøth
TRUSTWORTHINESS: ENABLING GLOBAL COLLABORATION
An Ethnographic Study of Trust, Distance, Control, Culture and Boundary Spanning within Offshore Outsourcing of IT Services

4. Steven Højlund
Evaluation Use in Evaluation Systems – The Case of the European Commission

5. Julia Kirch Kirkegaard
AMBIGUOUS WINDS OF CHANGE – OR FIGHTING AGAINST WINDMILLS IN CHINESE WIND POWER
A CONSTRUCTIVIST INQUIRY INTO CHINA'S PRAGMATICS OF GREEN MARKETISATION MAPPING CONTROVERSIES OVER A POTENTIAL TURN TO QUALITY IN CHINESE WIND POWER

6. Michelle Carol Antero
A Multi-case Analysis of the Development of Enterprise Resource Planning Systems (ERP) Business Practices

Morten Friis-Olivarius
The Associative Nature of Creativity

7. Mathew Abraham
New Cooperativism:
A study of emerging producer organisations in India

8. Stine Hedegaard
Sustainability-Focused Identity: Identity work performed to manage, negotiate and resolve barriers and tensions that arise in the process of constructing or ganizational identity in a sustainability context

9. Cecilie Glerup
Organizing Science in Society – the conduct and justification of resposible research

10. Allan Salling Pedersen
Implementering af ITIL® IT-governance - når best practice konflikter med kulturen Løsning af implementerings-problemer gennem anvendelse af kendte CSF i et aktionsforskningsforløb.

11. Nihat Misir
A Real Options Approach to Determining Power Prices

12. Mamdouh Medhat
MEASURING AND PRICING THE RISK OF CORPORATE FAILURES

13. Rina Hansen
Toward a Digital Strategy for Omnichannel Retailing

14. Eva Pallesen
In the rhythm of welfare creation
A relational processual investigation moving beyond the conceptual horizon of welfare management

15. Gouya Harirchi
In Search of Opportunities: Three Essays on Global Linkages for Innovation

16. Lotte Holck
Embedded Diversity: A critical ethnographic study of the structural tensions of organizing diversity

17. Jose Daniel Balarezo
Learning through Scenario Planning

18. Louise Pram Nielsen
Knowledge dissemination based on terminological ontologies. Using eye tracking to further user interface design.

19. Sofie Dam
PUBLIC-PRIVATE PARTNERSHIPS FOR INNOVATION AND SUSTAINABILITY TRANSFORMATION
An embedded, comparative case study of municipal waste management in England and Denmark

20. Ulrik Hartmyer Christiansen
Follwoing the Content of Reported Risk Across the Organization

21. Guro Refsum Sanden
Language strategies in multinational corporations. A cross-sector study of financial service companies and manufacturing companies.

22. Linn Gevoll
Designing performance management for operational level
- A closer look on the role of design choices in framing coordination and motivation

23. Frederik Larsen
Objects and Social Actions
– on Second-hand Valuation Practices

24. Thorhildur Hansdottir Jetzek
The Sustainable Value of Open Government Data
Uncovering the Generative Mechanisms of Open Data through a Mixed Methods Approach

25. Gustav Toppenberg
Innovation-based M&A
– Technological-Integration Challenges – The Case of Digital-Technology Companies

26. Mie Plotnikof
Challenges of Collaborative Governance
An Organizational Discourse Study of Public Managers' Struggles with Collaboration across the Daycare Area

27. Christian Garmann Johnsen
Who Are the Post-Bureaucrats?
A Philosophical Examination of the Creative Manager, the Authentic Leader and the Entrepreneur

28. Jacob Brogaard-Kay
Constituting Performance Management
A field study of a pharmaceutical company

29. Rasmus Ploug Jenle
Engineering Markets for Control: Integrating Wind Power into the Danish Electricity System

30. Morten Lindholst
Complex Business Negotiation: Understanding Preparation and Planning

31. Morten Grynings
TRUST AND TRANSPARENCY FROM AN ALIGNMENT PERSPECTIVE

32. Peter Andreas Norn
Byregimer og styringsevne: Politisk lederskab af store byudviklingsprojekter

33. Milan Miric
Essays on Competition, Innovation and Firm Strategy in Digital Markets

34. Sanne K. Hjordrup
The Value of Talent Management
Rethinking practice, problems and possibilities

35. Johanna Sax
Strategic Risk Management
– Analyzing Antecedents and Contingencies for Value Creation

36. Pernille Rydén
Strategic Cognition of Social Media

37. Mimmi Sjöklint
The Measurable Me
- The Influence of Self-tracking on the User Experience

38. Juan Ignacio Staricco
Towards a Fair Global Economic Regime? A critical assessment of Fair Trade through the examination of the Argentinean wine industry

39. Marie Henriette Madsen
Emerging and temporary connections in Quality work

40. Yangfeng CAO
Toward a Process Framework of Business Model Innovation in the Global Context
Entrepreneurship-Enabled Dynamic Capability of Medium-Sized Multinational Enterprises

41. Carsten Scheibye
Enactment of the Organizational Cost Structure in Value Chain Configuration
A Contribution to Strategic Cost Management

2016

1. Signe Sofie Dyrby
Enterprise Social Media at Work

2. Dorte Boesby Dahl
The making of the public parking attendant
Dirt, aesthetics and inclusion in public service work

3. Verena Girschik
Realizing Corporate Responsibility Positioning and Framing in Nascent Institutional Change

4. Anders Ørding Olsen
IN SEARCH OF SOLUTIONS
Inertia, Knowledge Sources and Diversity in Collaborative Problem-solving

5. Pernille Steen Pedersen
Udkast til et nyt copingbegreb
En kvalifikation af ledelsesmuligheder for at forebygge sygefravær ved psykiske problemer.

6. Kerli Kant Hvass
Weaving a Path from Waste to Value: Exploring fashion industry business models and the circular economy

7. Kasper Lindskow
Exploring Digital News Publishing Business Models – a production network approach

8. Mikkel Mouritz Marfelt
The chameleon workforce:
Assembling and negotiating the content of a workforce

9. Marianne Bertelsen
Aesthetic encounters
Rethinking autonomy, space & time in today's world of art

10. Louise Hauberg Wilhelmsen
EU PERSPECTIVES ON INTERNATIONAL COMMERCIAL ARBITRATION

11. Abid Hussain
On the Design, Development and Use of the Social Data Analytics Tool (SODATO): Design Propositions, Patterns, and Principles for Big Social Data Analytics

12. Mark Bruun
Essays on Earnings Predictability

13. Tor Bøe-Lillegraven
BUSINESS PARADOXES, BLACK BOXES, AND BIG DATA: BEYOND ORGANIZATIONAL AMBIDEXTERITY

14. Hadis Khonsary-Atighi
ECONOMIC DETERMINANTS OF DOMESTIC INVESTMENT IN AN OIL-BASED ECONOMY: THE CASE OF IRAN (1965-2010)

15. Maj Lervad Grasten
Rule of Law or Rule by Lawyers?
On the Politics of Translation in Global Governance

16. Lene Granzau Juel-Jacobsen
SUPERMARKEDETS MODUS OPERANDI – en hverdagssociologisk undersøgelse af forholdet mellem rum og handlen og understøtte relationsopbygning?

17. Christine Thalsgård Henriques
In search of entrepreneurial learning – Towards a relational perspective on incubating practices?

18. Patrick Bennett
Essays in Education, Crime, and Job Displacement

19. Søren Korsgaard
Payments and Central Bank Policy

20. Marie Kruse Skibsted
Empirical Essays in Economics of Education and Labor

21. Elizabeth Benedict Christensen
The Constantly Contingent Sense of Belonging of the 1.5 Generation Undocumented Youth
An Everyday Perspective

22. Lasse J. Jessen
Essays on Discounting Behavior and Gambling Behavior

23. Kalle Johannes Rose
Når stifterviljen dør…
Et retsøkonomisk bidrag til 200 års juridisk konflikt om ejendomsretten

24. Andreas Søeborg Kirkedal
Danish Stød and Automatic Speech Recognition

25. Ida Lunde Jørgensen
Institutions and Legitimations in Finance for the Arts

26. Olga Rykov Ibsen
An empirical cross-linguistic study of directives: A semiotic approach to the sentence forms chosen by British, Danish and Russian speakers in native and ELF contexts

27. Desi Volker
Understanding Interest Rate Volatility

28. Angeli Elizabeth Weller
Practice at the Boundaries of Business Ethics & Corporate Social Responsibility

29. Ida Danneskiold-Samsøe
Levende læring i kunstneriske organisationer
En undersøgelse af læringsprocesser mellem projekt og organisation på Aarhus Teater

30. Leif Christensen
Quality of information – The role of internal controls and materiality

31. Olga Zarzecka
Tie Content in Professional Networks

32. Henrik Mahncke
De store gaver
- Filantropiens gensidighedsrelationer i teori og praksis

33. Carsten Lund Pedersen
Using the Collective Wisdom of Frontline Employees in Strategic Issue Management

34. Yun Liu
Essays on Market Design

35. Denitsa Hazarbassanova Blagoeva
The Internationalisation of Service Firms

36. Manya Jaura Lind
Capability development in an off-shoring context: How, why and by whom

37. Luis R. Boscán F.
Essays on the Design of Contracts and Markets for Power System Flexibility

38. Andreas Philipp Distel
Capabilities for Strategic Adaptation: Micro-Foundations, Organizational Conditions, and Performance Implications

39. Lavinia Bleoca
The Usefulness of Innovation and Intellectual Capital in Business Performance: The Financial Effects of Knowledge Management vs. Disclosure

40. Henrik Jensen
Economic Organization and Imperfect Managerial Knowledge: A Study of the Role of Managerial Meta-Knowledge in the Management of Distributed Knowledge

41. Stine Mosekjær
The Understanding of English Emotion Words by Chinese and Japanese Speakers of English as a Lingua Franca
An Empirical Study

42. Hallur Tor Sigurdarson
The Ministry of Desire - Anxiety and entrepreneurship in a bureaucracy

43. Kätlin Pulk
Making Time While Being in Time
A study of the temporality of organizational processes

44. Valeria Giacomin
Contextualizing the cluster Palm oil in Southeast Asia in global perspective (1880s–1970s)

45. Jeanette Willert
Managers' use of multiple Management Control Systems: The role and interplay of management control systems and company performance

46. Mads Vestergaard Jensen
Financial Frictions: Implications for Early Option Exercise and Realized Volatility

47. Mikael Reimer Jensen
Interbank Markets and Frictions

48. Benjamin Faigen
Essays on Employee Ownership

49. Adela Michea
Enacting Business Models
An Ethnographic Study of an Emerging Business Model Innovation within the Frame of a Manufacturing Company.

50. Iben Sandal Stjerne
Transcending organization in temporary systems
Aesthetics' organizing work and employment in Creative Industries

51. Simon Krogh
Anticipating Organizational Change

52. Sarah Netter
Exploring the Sharing Economy

53. Lene Tolstrup Christensen
State-owned enterprises as institutional market actors in the marketization of public service provision:
A comparative case study of Danish and Swedish passenger rail 1990–2015

54. Kyoung(Kay) Sun Park
Three Essays on Financial Economics

2017

1. Mari Bjerck
Apparel at work. Work uniforms and women in male-dominated manual occupations.

2. Christoph H. Flöthmann
Who Manages Our Supply Chains? Backgrounds, Competencies and Contributions of Human Resources in Supply Chain Management

3. Aleksandra Anna Rzeźnik
Essays in Empirical Asset Pricing

4. Claes Bäckman
Essays on Housing Markets

5. Kirsti Reitan Andersen
Stabilizing Sustainability
in the Textile and Fashion Industry

6. Kira Hoffmann
Cost Behavior: An Empirical Analysis of Determinants and Consequences of Asymmetries

7. Tobin Hanspal
Essays in Household Finance

8. Nina Lange
Correlation in Energy Markets

9. Anjum Fayyaz
Donor Interventions and SME Networking in Industrial Clusters in Punjab Province, Pakistan

10. Magnus Paulsen Hansen
Trying the unemployed. Justification and critique, emancipation and coercion towards the 'active society'. A study of contemporary reforms in France and Denmark

11. Sameer Azizi
Corporate Social Responsibility in Afghanistan
– a critical case study of the mobile telecommunications industry

12. Malene Myhre
The internationalization of small and medium-sized enterprises: A qualitative study

13. Thomas Presskorn-Thygesen
The Significance of Normativity – Studies in Post-Kantian Philosophy and Social Theory

14. Federico Clementi
Essays on multinational production and international trade

15. Lara Anne Hale
Experimental Standards in Sustainability Transitions: Insights from the Building Sector

16. Richard Pucci
Accounting for Financial Instruments in an Uncertain World Controversies in IFRS in the Aftermath of the 2008 Financial Crisis

17. Sarah Maria Denta
Kommunale offentlige private partnerskaber Regulering I skyggen af Farumsagen

18. Christian Östlund
Design for e-training

19. Amalie Martinus Hauge
Organizing Valuations – a pragmatic inquiry

20. Tim Holst Celik
Tension-filled Governance? Exploring the Emergence, Consolidation and Reconfiguration of Legitimatory and Fiscal State-crafting

21. Christian Bason
Leading Public Design: How managers engage with design to transform public governance

22. Davide Tomio
Essays on Arbitrage and Market Liquidity

23. Simone Stæhr
Financial Analysts' Forecasts Behavioral Aspects and the Impact of Personal Characteristics

24. Mikkel Godt Gregersen
Management Control, Intrinsic Motivation and Creativity – How Can They Coexist

25. Kristjan Johannes Suse Jespersen
Advancing the Payments for Ecosystem Service Discourse Through Institutional Theory

26. Kristian Bondo Hansen
Crowds and Speculation: A study of crowd phenomena in the U.S. financial markets 1890 to 1940

27. Lars Balslev
Actors and practices – An institutional study on management accounting change in Air Greenland

28. Sven Klingler
Essays on Asset Pricing with Financial Frictions

29. Klement Ahrensbach Rasmussen
Business Model Innovation The Role of Organizational Design

30. Giulio Zichella
Entrepreneurial Cognition. Three essays on entrepreneurial behavior and cognition under risk and uncertainty

31. Richard Ledborg Hansen
En forkærlighed til det eksisterende – mellemlederens oplevelse af forandringsmodstand i organisatoriske forandringer

32. Vilhelm Stefan Holsting
Militært chefvirke: Kritik og retfærdiggørelse mellem politik og profession

33. Thomas Jensen
Shipping Information Pipeline: An information infrastructure to improve international containerized shipping

34. Dzmitry Bartalevich
Do economic theories inform policy? Analysis of the influence of the Chicago School on European Union competition policy

35. Kristian Roed Nielsen
Crowdfunding for Sustainability: A study on the potential of reward-based crowdfunding in supporting sustainable entrepreneurship

36. Emil Husted
There is always an alternative: A study of control and commitment in political organization

37. Anders Ludvig Sevelsted
Interpreting Bonds and Boundaries of Obligation. A genealogy of the emergence and development of Protestant voluntary social work in Denmark as shown through the cases of the Copenhagen Home Mission and the Blue Cross (1850 – 1950)

38. Niklas Kohl
Essays on Stock Issuance

39. Maya Christiane Flensborg Jensen
BOUNDARIES OF PROFESSIONALIZATION AT WORK An ethnography-inspired study of care workers' dilemmas at the margin

40. Andreas Kamstrup
Crowdsourcing and the Architectural Competition as Organisational Technologies

41. Louise Lyngfeldt Gorm Hansen
Triggering Earthquakes in Science, Politics and Chinese Hydropower - A Controversy Study

2018

1. Vishv Priya Kohli
Combatting Falsifi cation and Counterfeiting of Medicinal Products in the E uropean Union – A Legal Analysis

2. Helle Haurum
Customer Engagement Behavior in the context of Continuous Service Relationships

3. Nis Grünberg
The Party -state order: Essays on China's political organization and political economic institutions

4. Jesper Christensen
A Behavioral Theory of Human Capital Integration

5. Poula Marie Helth
Learning in practice

6. Rasmus Vendler Toft-Kehler
Entrepreneurship as a career? An investigation of the relationship between entrepreneurial experience and entrepreneurial outcome

7. Szymon Furtak
Sensing the Future: Designing sensor-based predictive information systems for forecasting spare part demand for diesel engines

8. Mette Brehm Johansen
Organizing patient involvement. An ethnographic study

9. Iwona Sulinska
Complexities of Social Capital in Boards of Directors

10. Cecilie Fanøe Petersen
Award of public contracts as a means to conferring State aid: A legal analysis of the interface between public procurement law and State aid law

11. Ahmad Ahmad Barirani
Three Experimental Studies on Entrepreneurship

12. Carsten Allerslev Olsen
Financial Reporting Enforcement: Impact and Consequences

13. Irene Christensen
New product fumbles – Organizing for the Ramp-up process

14. Jacob Taarup-Esbensen
Managing communities – Mining MNEs' community risk management practices

15. Lester Allan Lasrado
Set-Theoretic approach to maturity models

16. Mia B. Münster
Intention vs. Perception of Designed Atmospheres in Fashion Stores

17. Anne Sluhan
Non-Financial Dimensions of Family Firm Ownership: How Socioemotional Wealth and Familiness Influence Internationalization

18. Henrik Yde Andersen
Essays on Debt and Pensions

19. Fabian Heinrich Müller
Valuation Reversed – When Valuators are Valuated. An Analysis of the Perception of and Reaction to Reviewers in Fine-Dining

20. Martin Jarmatz
Organizing for Pricing

21. Niels Joachim Christfort Gormsen
Essays on Empirical Asset Pricing

22. Diego Zunino
Socio-Cognitive Perspectives in Business Venturing

23. Benjamin Asmussen
Networks and Faces between Copenhagen and Canton, 1730-1840

24. Dalia Bagdziunaite
Brains at Brand Touchpoints A Consumer Neuroscience Study of Information Processing of Brand Advertisements and the Store Environment in Compulsive Buying

25. Erol Kazan
Towards a Disruptive Digital Platform Model

26. Andreas Bang Nielsen
Essays on Foreign Exchange and Credit Risk

27. Anne Krebs
Accountable, Operable Knowledge Toward Value Representations of Individual Knowledge in Accounting

28. Matilde Fogh Kirkegaard
A firm- and demand-side perspective on behavioral strategy for value creation: Insights from the hearing aid industry

29. Agnieszka Nowinska
SHIPS AND RELATION-SHIPS Tie formation in the sector of shipping intermediaries in shipping

30. Stine Evald Bentsen
The Comprehension of English Texts by Native Speakers of English and Japanese, Chinese and Russian Speakers of English as a Lingua Franca. An Empirical Study.

31. Stine Louise Daetz
Essays on Financial Frictions in Lending Markets

32. *Christian Skov Jensen*
Essays on Asset Pricing

33. Anders Kryger
Aligning future employee action and corporate strategy in a resource-scarce environment

34. Maitane Elorriaga-Rubio
The behavioral foundations of strategic decision-making: A contextual perspective

35. Roddy Walker
Leadership Development as Organisational Rehabilitation: Shaping Middle-Managers as Double Agents

36. Jinsun Bae
Producing Garments for Global Markets Corporate social responsibility (CSR) in Myanmar's export garment industry 2011–2015

37. Queralt Prat-i-Pubill
Axiological knowledge in a knowledge driven world. Considerations for organizations.

38. Pia Mølgaard
Essays on Corporate Loans and Credit Risk

TITLER I ATV PH.D.-SERIEN

1992

1. Niels Kornum
Servicesamkørsel – organisation, økonomi og planlægningsmetode

1995

2. Verner Worm
Nordiske virksomheder i Kina
Kulturspecifikke interaktionsrelationer ved nordiske virksomhedsetableringer i Kina

1999

3. Mogens Bjerre
Key Account Management of Complex Strategic Relationships
An Empirical Study of the Fast Moving Consumer Goods Industry

2000

4. Lotte Darsø
Innovation in the Making
Interaction Research with heterogeneous Groups of Knowledge Workers creating new Knowledge and new Leads

2001

5. Peter Hobolt Jensen
Managing Strategic Design Identities
The case of the Lego Developer Network

2002

6. Peter Lohmann
The Deleuzian Other of Organizational Change – Moving Perspectives of the Human

7. Anne Marie Jess Hansen
To lead from a distance: The dynamic interplay between strategy and strategizing – A case study of the strategic management process

2003

8. Lotte Henriksen
Videndeling
– om organisatoriske og ledelsesmæssige udfordringer ved videndeling i praksis

9. Niels Christian Nickelsen
Arrangements of Knowing: Coordinating Procedures Tools and Bodies in Industrial Production – a case study of the collective making of new products

2005

10. Carsten Ørts Hansen
Konstruktion af ledelsesteknologier og effektivitet

TITLER I DBA PH.D.-SERIEN

2007

1. Peter Kastrup-Misir
Endeavoring to Understand Market Orientation – and the concomitant co-mutation of the researched, the re searcher, the research itself and the truth

2009

1. Torkild Leo Thellefsen
Fundamental Signs and Significance effects
A Semeiotic outline of Fundamental Signs, Significance-effects, Knowledge Profiling and their use in Knowledge Organization and Branding

2. Daniel Ronzani
When Bits Learn to Walk Don't Make Them Trip. Technological Innovation and the Role of Regulation by Law in Information Systems Research: the Case of Radio Frequency Identification (RFID)

2010

1. Alexander Carnera
Magten over livet og livet som magt
Studier i den biopolitiske ambivalens