Essays in Real Estate Finance

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Mads Gjedsted Nielsen

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"The Doctoral School of 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 is the result of my PhD studies at the Department of Finance at Copenhagen Business School. The thesis consists of 4 essays covering different aspects of the intersection of finance and real estate. Each essay is self-contained and can be read independently.

Structure of the Thesis

The first essay examines the commonality between publicly and privately traded commercial real estate and macroeconomic risk. The second essay investigates the impact of corporate taxes and free cash flow agency problems on the capital structure of companies. The third essay (co-authored with Aleksandra Rzeźnik) uses the 2007 municipality reform in Denmark as an exogenous shock to taxes in order to estimate the effect of both income and property taxes on residential house prices. Lastly, the fourth essay examines the short and long effect of a large and sudden increase in local municipal debt on residential house prices.

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The essays in this PhD thesis have benefited tremendously from the feedback of several people, and they are mentioned in the individual essays.

Mads Gjedsted Nielsen
Copenhagen, September 2014

Contents

Summary

This section contains English and Danish summaries of the 4 articles that make up this PhD thesis.

Summary in English

Essay 1: The Commonality between Private and Public Real Estate and Macroeconomic Risk

The first essay examines the relationship between publicly and privately traded commercial real estate and macroeconomic risk. To represent publicly traded real estate, I use exchange listed US Real Estate Investment Trusts (REITs), and to proxy for direct and privately traded real estate, I use a transaction based index (TBI) based on the data in the NCREIF database.

Because the fundamental asset of the two investment types are the same, it seems reasonable to assume that they should be related in the long run. In the short run there are, however, several investment-vehicle specific reasons why this need not be the case. For example, REITs are publicly listed on stock exchanges, and are thus expected to share a lot of commonalities with other publicly traded stocks. This is in fact also found by Goetzmann and Ibbotson [1990], Ross and Zisler [1991], and Myer and Webb [1994]. The fact that REITs are traded on exchanges makes them more liquid than direct real estate investments, and investors might therefore accept a lower risk premium for holding REITs, than for holding direct real estate. However, the lower contemporaneous correlation between direct real estate and the general stock market gives direct real estate a diversification benefit that may make investors accept a lower risk premium for investing in direct real estate.

If returns are driven by a factor model as the Arbitrage Pricing theory (APT) of Ross [1976], then it is intuitively more appealing to let these factors relate to the overall economy, than to simple portfolios of financial assets such as the Fama and French [1993] factors, since this would constitute a more fundamental explanation of what determines returns. Furthermore, the fact that real estate by nature is a "real" asset, also favors relating it to the real economy.

I use a large macroeconomic dataset of 122 time series and extract the underlying factors by the asymptotic principal components method of Stock and Watson [2002b], Stock and Watson [2002a], and Bai and Ng [2002]. I use these factors to explain the time series behaviour of both REIT and direct real estate excess returns. I find that the 122 data series can be described by 4 underlying factors, which I interpret as a recession factor, a housing and credit factor, an inflation factor, and an interest rate factor.

The results show that REITs are driven by stock market factors and the interest rate factor. REITs lead private real estate, and private real estate also reacts with a lag to the interest rate factor and a recession factor. REITs and private real estate are thus related both directly through their lead-lag relationship and indirectly through a common exposure to US interest rates.

Essay 2: Testing the Effect of Taxes and Free Cash Flow Problems on Capital Structure: Evidence from REITs

The second essay examines the effect of the tax advantage of debt and the mitigating effect of debt on free cash flow agency problems on firm capital structure choices. Specifically, I examine how the two effects affect the level of leverage and the tendency of firms to employ dynamic target leverage ratios that they revert to, as predicted by the dynamic Trade-off theory. I do this by comparing publicly listed real estate investment trust (REITs), which are effectively tax exempt and not prone to free cash flow agency problems, because they are required to pay out at least 90% of their taxable income as dividends and can deduct the dividends from their taxable income, to regular listed real estate companies without the REIT status (non-REITs). The only differences between the two groups of companies are the tax exemption and the 90% payout requirement. By examining the level of leverage and testing the target adjustment behaviour of these two groups of firms, I am able to identify the effect of taxes and free cash flow agency problems. I also include regular industrial companies not related to the real estate industry, to pick up any real estate industry effects.

The REITs do not need two of the most prominent benefits of debt, namely, the tax advantage and the reduction in free cash flow agency problems. So, if these indeed are the most important benefits of debt, one should expect REITs to finance their operations by less debt than similar non-REIT real estate companies.

Furthermore, according to the Trade-off theory firms trade off the benefits and costs of debt to maximize firm value, and thus have an optimal capital structure that they revert back to. The primary benefits of debt are again the tax advantage and the reduction in free cash flow agency problems. If REITs have less benefits of debt, one should expect that REITs have lower target leverage ratios - if any targets at all - than similar non-REIT real estate firms.

Contrary to expectation, I find that REITs have similar or even higher leverage ratios than similar non-REIT real estate firms. More so, I document that REITs have higher target leverage ratios than non-REITs, and that the speed at which they revert to the targets are equal for the two groups. This is not line with the largest benefits of debt being the tax advantage and the reduction in free cash flow agency problems, as is often mentioned in the literature, and it could suggest that firms have other benefits of debt.

Essay 3: House Prices and Taxes (co-authored with Aleksandra Rzeźnik, CBS)

The third essay deals with the effect of municipal income and property tax rates on residential house prices. By utilizing the 2007 municipality reform in Denmark as an exogenous shock to municipal income and property tax rates, we are able to estimate the influence of taxes on house prices.

The idea behind the 2007 municipality reform was to better exploit economies of scale at the municipal level by merging smaller municipalities. With the exemption of only four small islands, all municipalities below 20,000 inhabitants had to merge with one or more nearby municipalities in order to create a new municipalities of at least 30,000 inhabitants. After the reform, the merged municipalities had to set a new and common tax rate, and if the merging municipalities did not all have equal tax rates prior to the reform, the common rate would institute a change for at least one of the merging municipalities.

The new municipalities had to set the new tax rates equal to or lower than an average of the previous tax rates plus an adjustment for changes in the public service task handled by the municipalities[1]. The so called maximum allowed rate. Only a few municipalities chose to set the new rates lower than the maximum allowed rate. The addition due to changes in public service tasks handled by the municipalities were effectively not real changes, because any addition was offset by an equal reduction in the state tax rates. Hence, to control for this, we instrument the income and property tax rates with the average of the previous rates in the merging municipalities.

The tax changes were, however, not the only factor affecting house prices that changed as part of the reform. The municipalities were free to adjust the level of public service. We therefore control for public service, and instrument this variable by education expenditure, since the quality of public service is hard to measure.

We find that a 1%-point increase in the income tax rate lead to a drop in house prices of 7.9% and a 1‰-point increase in the property tax rate lead to a 1.1% drop in house prices. The simple present value of a 1%-point perpetual income tax increase and of a 1‰-point property tax increase, relative to the median house price correspond to 7% and 3.3%, repectively. Our findings are thus in line with predicted values. This indicates that the housing market efficiently incorporates taxes into house prices.

Essay 4: House Prices and Local Public Debt

The fourth essay examines the efficiency of the residential housing market by utilizing the 2002 case of fraud in the Danish municipality of Farum as an exogenous shock to municipal debt. In February 2002 journalists discovered that illegal accounting practices had led to an artificially high liquidity buffer. An unreported loan of 250 million DKK was uncovered, and the Danish Ministry of the Interior granted Farum a long term loan of 750 million DKK, to recover from the financial distress. Effectively, the debt in Farum rose by 1 billion DKK or about 125 million USD in the month of February 2002. The increase in debt was approximately 6600 USD per capita. The municipality in question, Farum,

[1]In connection with the reform some public service task previously defined as state tasks were taken over by the municipalities.

had no long term debt prior to the increase, but the average long term debt for the surrounding municipalities in 2002 was about 1000 USD per capita. The municipal debt increase was thus substantial.

The repayment of the debt increase has to be financed either by tax increases and/or public service reductions. If, for example, the debt is repaid by increased income and or property taxes, this would affect home owners, since you pay municipal income and property tax in the municipality where you reside. Similarly, public service reductions could affect school quality or other variables relevant to home owners. Therefore, one should expect house prices to drop as an effect of the debt increase. Because the value of the total debt increase is easily observed, I will know whether the aggregate house price reaction is exaggerated or understated. A rational drop in house prices should equal the expected part of future tax increases attributable to home ownerships. It is, of course, hard to define exactly how big a part of future tax increases is attributable to home ownerships, since aside from property taxes, Danish municipalities also finance public service by e.g. income taxes, which affect all residents in the municipality and not just home owners[2]. Nonetheless, the aggregate price reaction should not exceed the increase in debt. The public debt increase thus functions as a cap on a rational aggregate price effect.

If the residential housing market is completely efficient, house prices should adjust instantaneously and correctly to new information relevant for the pricing of residential real estate. However, the nature of the residential housing market, with each transaction being slow, and where most market participants are regular people without much financial prowess, suggests that the market will be slow in reacting to news, and that the reaction might be over- or understated.

I find that the average house price dropped between 13.6% and 16.0% due to the debt increase in the 3 months after the debt revelation. The aggregate effect corresponds to between 100% and 118% of the total debt increase. Furthermore, I document that the initial 1-month aggregate price drop equals about 175% of the total debt increase, and that the reaction is dampened in the following months to between 37% to 75% of the total debt increase. This shows that the housing market initially overreacts to the debt increase but quickly adjusts

[2]It should be noted, however, that renters easier can move to another municipality than home owners, and hence avoid the tax increase. And so, one could argue that home owners will carry a larger part of the future tax burden.

to more rational levels. The speed at which the housing market reacts to the increased public debt indicates a very efficient housing market, and the initial overreaction can be fully rational, if the housing market initially fears further debt revelations.

Dansk Resumé

Essay 1: Sammenhægen mellem Offentlig og Privat Fast Ejendom og Makroøkonomisk risiko

Essay 1 undersøger sammenhængen imellem børsnoteret og unoteret kommerciel fast ejendom og makroøkonomisk risiko. Til at repræsentere børsnoteret fast ejendom benytter jeg børsnoterede amerikanske Real Estate Investment Trusts (REITs), og som proxy for direkte ejet og unoteret fast ejendom, bruger jeg et handelsbaseret indeks (TBI), baseret på data fra NCREIF databasen.

Da det fundamentale aktiv er det samme for begge investeringstyper, må det antages rimeligt, at de to investeringer vil samvariere på lang sigt. På kort sigt behøver dette imidlertid ikke være tilfældet på grund af konstruktionen af de to investeringsformer. For eksempel er REITs børsnoterede og vil derfor have en del fællestræk med andre børsnoterede aktier. Dette er netop dokumenteret af Goetzmann and Ibbotson [1990], Ross and Zisler [1991] og Myer and Webb [1994]. Det faktum, at REITs are børsnoterede, gør dem mere likvide end direkte investeringer i fast ejendom, og det kan derfor tænkes at investorer vil kræve en lavere forrentning for at investere i REITs. Den lavere korrelation mellem direkte investeringer i fast ejendom og det børsnoterede aktiemarked giver imidlertid direkte investeringer i fast ejendom en diversifikationsfordel, som modsat kan resultere i et lavere forrentningskrav til direkte investeringer i fast ejendom.

Hvis finansielle afkast er genereret af en faktormodel, som eksempelvis "Arbitrage Pricing"-teorien (APT) fra Ross [1976], så er det intuitivt tiltalende, at disse faktorer afhænger af den generelle økonomi, da det er naturligt at antage at afkast på finansielle aktiver fundamentalt er drevet af makroøkonomien. Det faktum, at fast ejendom af natur er et reelt aktiv, gør det endnu mere oplagt at relatere ejendomsafkast til realøkonomien.

Jeg benytter et stort makroøkonomisk datasæt bestående af 122 tidsrækker og estimerer de underliggende faktorer ved hjælp af “Asymptotic Principal Components”-metoden udledt i Stock and Watson [2002b], Stock and Watson [2002a] og Bai and Ng [2002]. Jeg benytter disse faktorer til at forklare tidsserie variationen i merafkastene for både REITs og direkte investeringer i fast ejendom. Jeg finder, at de 122 tidsrækker kan repræsenteres ved hjælp af 4 underliggende faktorer, som jeg fortolker som hhv. en recessionsfaktor, en ejendoms- og kreditfaktor, en inflationsfaktor og en rentefaktor.

Resultaterne viser, at REITs er drevet af aktiemarkedsfaktorer og af rentefaktoren. REITs leder det unoterede ejendomsmarked, og det unoterede ejendomsmarked reagerer også med en forsinkelse på rentefaktoren og recessionsfaktoren. De børsnoterede ejendomsinvesteringer og det unoterede ejendomsmarked er derfor både relaterede direkte igennem en “leder/følger”-sammenhæng, og indirekte igennem en fælles eksponering mod amerikanske renter.

Essay 2: Test af Skatter og Problemer ved Frie Pengestrømmes Effekt på Virksomhedens Kapitalstruktur: Dokumentation fra REITs

Essay 2 omhandler effekten af skattefordelen ved gæld og den mitigerende effekt af gæld på agenturproblemer vedrørende de frie pengestrømme på virksomheders valg af kapitalstruktur. Jeg undersøger mere specifikt hvordan de to effekter påvirker niveauet af gæld og tendensen til at virksomheder har et optimalt dynamisk gearingsniveau, som de vender tilbage til, som forudsagt af den dynamiske Trade-off teori.

Det gør jeg ved at sammenligne børsnoterede Real Estate Investment Trusts (REITs), som effektivt er skatteundtagede og ikke i samme grad påvirket af agenturproblemer ved frie pengestrømme (da de skal udbetale mindst 90% af deres skattepligtige indkomst som udbytter, og kan fratrække udbytter fra deres skattepligtige indkomst) med almindelige børsnoterede virksomheder der investerer i fast ejendom uden REIT status (non-REITs). Den eneste forskel på disse to virksomhedstyper er skatteundtagelsen og kravet om mindst 90% udbyttebetaling. Ved at sammenligne de to typers gældsniveau og undersøge tendensen til at justere kapitalstrukturen imod et optimalt gearingsforhold, kan jeg identificere effekten af skatter og agenturproblemer ved frie pengestrømme. Jeg inkluderer også almindelige børsnoterede virksomheder, som ikke er relaterede til fast ejendom, for at kontrollere for mulige ejendomsspecifikke effekter.

REITs har ikke brug for to af de mest prominente fordele ved gæld, nemlig, skattefordelen og reduktionen af agenturproblemer ved frie pengestrømme. Så, hvis disse er de største fordele ved gæld, bør man forvente, at REITs vil finansiere deres aktiver med mindre gæld end sammenlignelige non-REIT ejendomsvirksomheder. Jævnfør Trade-off teorien vil virksomheder afveje fordele og omkostninger ved gæld, for at maksimere den enkelte virksomheds værdi, og derved opnå en optimal kapitalstruktur eller et gearingsmål, som de vender tilbage til. De primære fordele ved gæld er igen skattefordelen og reduktionen i agenturproblemer vedrørende frie pengestrømme. Da REITs har færre fordele ved gæld, bør man forvente, at REITs vil have lavere gearingsmål - hvis de da ophovedet har en optimal gearing - end sammenlignelige ejendomsvirksomheder uden REIT status.

Imod forventning finder jeg, at REITs har sammenlignelige eller endda højere gældsniveau end sammenlignelige non-REIT ejendomsvirksomheder. Ydermere dokumenterer jeg, at REITs har højere gearingsmål end non-REITs og hastigheden hvormed de regresserer imod målene er ens for de to virksomhedstyper. Dette står i kontrast til, at de største fordele ved gæld skulle være skattefordelen og reduktionen af agenturproblemer ved frie pengestrømme, som ofte nævnes i litteraturen, og det kunne tyde på, at virksomheder har andre fordele ved gæld.

Essay 3: Huspriser og Skatter (medforfatter Aleksandra Rzeźnik, CBS)

Essay 3 omhandler effekterne af kommunale indkomst- og ejendomsskatter på huspriserne. Ved at udnytte kommunalreformen fra 2007 i Danmark som et eksogent stød til de kommunale indkomst- og ejendomsskattesatser, kan vi estimere skatternes indflydelse på huspriserne.

Baggrunden for kommunalreformen i 2007 var bedre at udnytte stordriftsfordele i kommunerne ved at sammenlægge små kommuner. Med undtagelse af 4 små øer, blev alle kommuner med under 20,000 indbyggere sammenlagt til nye kommuner med mindst 30,000 indbyggere. Efter reformen blev de sammenlagte kommuner nødt til at sætte nye og fælles skattesatser, og hvis ikke de havde ens skattesatser før reformen, medførte reformen nødvendigvis skatteændringer for mindst én af de sammenlagte kommuner.

De nye kommuner var nødsagede til at sætte de nye skattesatser lig med eller mindre end gennemsnittet af de sammenlagte kommuners tidligere skattesatser, plus et tillæg for ændringer i de offentlige velfærdsopgaver som varetages af kommunerne[3]; den såkaldte maksimalt tilladte skattesats. Kun enkelte kommuner valgte at sætte satserne lavere end den maksimalt tilladte skattesats. Tillægget som følge af ændringer i offentlige velfærdsopgaver varetaget af kommunerne var ikke en reel skatteændring, da tillægget blev modsvaret af en tilsvarende reduktion i de statslige satser. For at kontrollere for dette, instrumenterer vi skattesatserne med gennemsnittet af de tidligere skattesatser i de sammenlagte kommuner.

Ændringerne i skattesatserne var, imidlertid, ikke den eneste kommunale ændring som påvirkede huspriserne, da kommunerne frit kunne justere velfærdsniveauet. Vi kontrollere derfor for velfærdsniveauet, og instrumenterer denne variabel med uddannelsesudgifter, da det er vanskeligt at måle kvaliteten af offentlig velfærd.

Vi finder, at en 1%-points forøgelse af indkomstskattesatsen medfører et prisfald på huspriserne på 7.9%, og en 1‰-points forøgelse af grundskyldspromillen medfører et prisfald på 1.1%. Den simple tilbagediskonterede værdi af en evigt løbende forøgelse af indkomstskattesatsen på 1%-point og en 1‰-points forøgelse af grundskyldspromillen relativt til median husprisen, svarer til 7% og 3.3%, respektivt. Vores resultater er på linie med de beregnede værdier. Dette indikerer, at boligmarkedet effektivt inkorporerer de kommunale skatter i huspriserne.

Essay 4: Huspriser og Lokal Offentlig Gæld

Essay 4 undersøger effektiviteten af boligmarkedet ved at udnytte bedragerisagen i Farum kommune fra 2002, som et eksogent stød til den kommunale gæld. I februar 2002 opdagede journalister, at ulovlige regnskabsmetoder dækkede over en overtrædelse af den kommunale kassekreditregel. Ydermere blev et urapporteret lån uden om byrådet på 250 millioner DKK opdaget, og Indenrigsministeriet bevilgede Farum et lån på 750 millioner DKK for at kunne overholde kassekreditreglen. Effekten blev at gælden i Farum steg med 1 milliard DKK eller

[3] I forbindelse med reformen blev nogle velfærdsopgaver flyttet fra at være statslige opgaver til at være kommunale opgaver.

omkring 125 millioner USD i februar 2002. Gældsforøgelsen var omkring 6600 USD per indbygger. Farum have ikke tidligere registreret nogen langsigtet gæld, men gennemsnittet for de omkringliggende kommuner var omkring 1000 USD per indbygger. Gældsforøgelsen var således af betydelig størrelse.

Tilbagebetalingen af gældsforøgelsen må nødvendigvis finansieres ved hjælp af skattestigninger og/eller en reduktion af den kommunale velfærd. En forhøjelse af de kommunale indkomst- og ejendomsskatter vil påvirke husejerne, da man betaler kommunal indkomst- og ejendomsskat i bopælskommunen. Eventuelle reduktioner i den kommunale velfærd vil for eksempel påvirke kvaliteten af folkeskolen eller andre forhold og er ligeledes relevante for husejerne. Man må derfor forvente et fald i huspriserne som følge af gældsforøgelsen. Da værdien af den totale gældsforøgelse er observerbar, vil jeg automatisk vide om den aggregerede husprisreaktion er overdrevet eller underdrevet. Et rationelt fald bør svare til husejernes forventede andel af tilbagebetalingen. Det er selvfølgelig svært præcist at definere hvor stor en andel, der skal tilskrives husejerne, da danske kommuner udover ejendomsskatter også kan finansiere offentlig velfærd gennem eksempelvis indkomstskatter, som påvirker alle indbyggere i kommunen og ikke alene husejere[4]. Ikke desto mindre bør det samlede husprisfald ikke overgå den totale gældsforøgelse. Gældsforøgelsen fungerer derfor som en øvre grænse for en rationel prisreaktion.

Hvis boligmarkedet er fuldstænding effektivt, bør huspriserne reagere øjeblikligt på ny relevant information. Boligmarkedet er imidlertid karakteriseret ved langsommelige handler, og aktøerne på markedet har typisk ikke særlig stor finansiel viden. Det kunne indikere at boligmarkedet vil være lang tid om at inkorporere ny information i huspriserne, og at reaktionen muligvis vil være over- eller underdrevet.

Jeg finder, at den gennemsnitlige huspris faldt med mellem 13.6% og 16.0% pga. gældsforøgelsen i de 3 måneder efter gælden blev afdækket. Den aggregerede effekt svarer til mellem 100% og 118% af den totale gældsforøgelse. Ydermere dokumenterer jeg, at det initiale aggregerede prisfald i den første måned svarede til omkring 175% af gældsforøgelsen, og at reaktionen blev dæmpet i de efterfølgende måneder til mellem 37% og 75% af den totale gældsforøgelse. Dette viser,

[4]Det bør dog nævnes, at lejere lettere kan flytte til en anden kommune end husejere, og dermed undgå en eventuel skattestigning. Således kan man argumentere for at husejere vil bære den største del af den fremtidige skattebyrde.

at boligmarkedet initialt overreagerer som følge af gældforøgelsen, men hurtigt justerer reaktionen til et mere rationelt niveau. Hastigheden hvormed markedet reagerer indikerer et meget effektivt boligmarked, og den initiale overreaktion kan være fuldt ud rationel, hvis markedet frygtede flere gældsafsløringer.

Introduction

Real estate is one of the worlds largest asset classes and the single largest investments of most households. Hence, real estate impacts everyone both directly and indirectly through its influence on the overall economy. The 2008 financial crisis was preceded by a large price depreciation in the US housing market (see for example Taylor [2009]), and many times before have housing markets triggered recessions and financial crises (non-exhaustive examples of theoretical and empirical papers examining the relationship between real estate markets and the real economy are Quigley [2001], Quigley [1999], and Allen and Gale [2000]). Thus, both from an academic and a practical point of view, research in real estate is highly relevant.

Empirical research in real estate is in nature hampered by the availability of data, since most real estate is privately traded. And so, many of the questions already answered for other financial markets such as the stock and bond markets, are left unanswered. Furthermore, the difficulty of setting up controlled experiments - a difficulty in most social sciences - requires the real estate researcher to look elsewhere for answers.

The universal relevance of real estate as an asset class, together with the many unanswered empirical questions, and the availability of high quality Danish data, was what made me pursue a PhD within real estate finance.

This thesis deals with many aspects of real estate markets, from trying to understand the commonalities and differences between publicly and privately traded commercial real estate and macroeconomic risk, through utilizing the special institutional nature of Real Estate Investment Trusts (REITs) to estimate the effect of corporate taxes and agency problems on the capital structure of companies, to the effect of local municipal taxes and debt on residential house prices.

Essay 1 examines the relationship between publicly and privately traded commercial real estate and macroeconomic risk. Investors can invest in real estate indirectly by purchasing stocks or bonds in publicly listed REITs. However, investors can also choose to invest directly in real estate by buying and operating real estate properties. The first article examines how these two investment types relate to each other and to the macro economy. Since the fundamental asset of both investments is real estate properties, the two investments should be related in the long run. However, since one asset is publicly traded and the other is privately traded, there could be several investment-vehicle related reasons why this need not be the case in the short run. Furthermore, if one believes that asset returns are driven by a factor model such as the Arbitrage Pricing Theory (APT) of Ross [1976], and since real estate is indeed a very "real" asset, it seems natural to expect that the underlying factors should be related to the real economy. More so, return generating factors related to the macro economy are intuitively appealing and more fundamental than portfolios of assets, such as the Fama and French [1993] factors.

To proxy the macro economy, I use a dataset of 122 data series much like that of Bernanke et al. [2005] and Ludvigson and Ng [2009]. The dataset is not completely similar, since I have monthly observation, and they have quarterly observations. To avoid data mining and multicollinearity issues, I extract the underlying factors of this dataset using the Asymptotic Principal Components method of Stock and Watson [2002b], Stock and Watson [2002a], and Bai and Ng [2002].

I find that the macreconomic dataset can be described by 4 underlying factors through the 3 information criteria in Bai and Ng [2002]. Together, the 4 factors describe 58.3% of the variation in the dataset. I interpret the four factors as a recession factor, a housing and credit factor, an inflation factor, and an interest rate factor.

Contemporaneously, I find no relation between publicly and privately traded real estate. REITs are explained by stock market risk factors, but also have an exposure to the interest rate factor, and this relation is robust to all the different specifications in the paper. The privately traded real estate, proxied by the MIT transaction based index (TBI), is not contemporaneously related to the stock market nor the macroeconomic factors. However, the TBI does react to both REIT returns and the interest rate factor with a lag, suggesting that REITs, being publicly traded, are more informationally efficient than the private real estate market. The public and private real estate markets are hence related both directly through a lead/lag relationship and indirectly through a common exposure to US interest rates.

The second essay examines the effect of corporate taxes and free cash flow agency problems on the capital structure of companies. Since firms can deduct their interest payments from their taxable income, there is a tax advantage of financing companies with debt compared to equity. Furthermore, Jensen [1986] argues that the issuance of debt instead of equity oblige managers to pay out future free cash flows more effectively than promises of future dividends. Financing investments with debt instead of equity thus reduces the agency costs of free cash flows. However, employing high levels of leverage also increases the risk of bankruptcy, which is costly. The Trade-off theory of firm capital structure, thus, predict that firms trade off the benefits and costs of debt to maximize firm value. As a result, each company will have an optimal capital structure which it will revert to. See for example Fischer et al. [1989], Leland [1994], Leland and Toft [1996] for more on the Trade-off theory.

I compare publicly listed real estate investment trust (REITs), which are effectively tax exempt and not prone to free cash flow agency problems, because they are required to pay out at least 90% of their taxable income as dividends and can deduct their dividends from their taxable income, to regular listed real estate companies without the REIT status (non-REITs). The only differences between the two groups of companies are the tax exemption and the 90% payout requirement. By examining the level of leverage and testing the target adjustment behaviour of these two groups of firms, I am able to identify the effect of taxes and free cash flow agency problems. More so, I also include regular publicly listed US industrial companies not related to real estate, to identify any real estate industry effects.

I find that REITs on average employ ***more*** leverage than similar non-REITs, and they ***also*** adjust their capital structure towards a dynamic target leverage ratio at a similar rate as non-REITs. This is surprising, since REITs as mentioned effectively are tax exempt and have to pay out at least 90% of their taxable income, and thus have less benefits of debt than non-REIT real estate companies. It might suggest that firms have other benefits of debt than the tax advantage and mitigation of free cash flow agency problems. The results are robust to all the modifications in Hovakimian and Li [2011] meant to reduce the potential bias in the tests, using both book and market leverage, different estimation methodologies, excluding industrial firms, and over a subsample from 1992 to 2011.

In the third essay (co-authored with Aleksandra Rzeźnik) we use the 2007 municipality reform in Denmark as a natural experiment in which the tax changes are completely exogenous, and thus provide unbiased estimates of the effects of taxes on house prices.

The purpose of the 2007 municipality reform was to better exploit economies of scale at the municipal level by merging smaller municipalities. With the exemption of only four small islands, all municipalities below 20,000 inhabitants had to merge with one or more nearby municipalities in order to create a new municipality of at least 30,000 inhabitants. The merged municipalities had to set common tax rates, and if the merging municipalities did not all have equal tax rates prior to the reform, the common rate would institute a change for at least one of the merging municipalities.

The new municipalities had to set the new tax rates equal to or lower than an average of the tax rates of the municipalities participating in the merger plus an adjustment for changes in the public service task delivered by the municipalities[5]. Only a few municipalities chose to set the new rates lower than the average of the previous rates plus the addition due to change in public service tasks. The addition due to changes in public service tasks handled by the municipalities were effectively not real changes, since any addition was offset by an equal reduction in the state tax rates. Hence, to control for this, we instrument the income and property tax rates with the average of the previous rates in the merging municipalities.

Furthermore, since the municipalities were free to adjust the level of municipal public service, we also control for public service, and instrument this variable by education expenditure, because the quality of public service is hard to measure.

We find that a 1%-point increase in the income tax rate lead to a drop in house prices of 7.9% and a 1‰-point increase in the property tax rate lead to

[5] In connection with the reform some public service task previously defined as state tasks were taken over by the municipalities.

a 1.1% drop in house prices. The simple present value of a 1%-point perpetual income tax increase and of a 1‰-point property tax increase, relative to the median house price correspond to 7% and 3.3%, repectively. Our findings are thus in line with predicted values. This indicates that the housing market efficiently incorporates taxes into house prices, similar to the findings of Palmon and Smith [1998].

The fourth essay uses the 2002 case of fraud in the Danish municipality of Farum as an exogenous shock to municipal public debt, and examines whether the housing market efficiently incorporate the new information. In February 2002 journalists discovered that illegal accounting practices had led to an artificially high liquidity buffer. An unreported loan of 250 million DKK was uncovered, and the interior ministry granted Farum a long term loan of 750 million DKK, to recover from the financial distress. Effectively, the debt in Farum rose by 1 billion DKK or about 125 million USD in the month of February 2002. The increase in debt was approximately 6600 USD per capita. The municipality in question, Farum, had no long term debt prior to the increase, but the average long term debt for the surrounding municipalities was about 1000 USD per capita. Thus, the municipal debt increase was substantial.

Since debt is a signal of future taxes, and because the value is easily observed, I will automatically know whether the house price reaction is exaggerated or understated. A rational drop in house prices should equal the expected part of future tax increases attributable to home ownerships. It is, of course, hard to define exactly how big a part of future tax increases is attributable to home ownerships, since aside from property taxes, Danish municipalities also finance public service by for example income taxes, which affect all residents in the municipality and not just home owners[6]. Nonetheless, the aggregate price reaction should not exceed the increase in debt. The public debt increase thus functions as a cap on a rational aggregate price effect.

I find that the average home ownership lost between 13.6% and 16.0% in the 3 months after the debt increase. The aggregate effect corresponds to between 100% and 118% of the total debt increase. I further document that the initial 1-month aggregate price drop equals about 175% of the total debt increase, and

[6]It should be noted, however, that renters easier can move to another municipality than home owners, and hence avoid the tax increase. And so, one could argue that home owners will carry a larger part of the future tax burden.

that the reaction is dampened in the following months to between 37% to 75% of the total debt increase. This shows that the housing market initially overreacts to debt increases but quickly adjusts to long-run levels. The speed at which the housing market reacts to the increased public debt indicates a very efficient housing market, and the initial overreaction can be fully rational if the housing market initially fears further debt revelations.

Summing up: The overall theme of this thesis is real estate finance. The first essay examines the commonality between publicly and privately traded commercial real estate and macroeconomic risk. The second essay estimates the effect of corporate taxes and free cash flow agency problems on firm capital structure. The third essay determines the effect of municipal income and property tax rates on residential house prices. The fourth essay examines the efficiency of the residential housing market, by estimating the short and longer term effect of a large and sudden increase in municipal debt on residential house prices.

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Essay 1

The Commonality between Private and Public Real Estate and Macroeconomic Risk[1]

[1] I wish to thank my supervisor Jesper Rangvid and seminar participants at Copenhagen Business School and PenSam Liv A/S for helpful comments. I gratefully acknowledge the financial support of PenSam Liv A/S. All remaining errors are my own.

Abstract

In this paper I examine how both indirect investments in real estate through publicly traded real estate investment trusts (REITs) and privately traded direct real estate investments are related to macroeconomic risk, by extracting a few underlying factors from a large macroeconomic dataset of a 122 time series. I find that REITs are driven by stock market factors and an interest rate factor. REITs lead private real estate, and private real estate also reacts with a lag to the interest rate factor and a recession factor. REITs and private real estate are thus related both directly through their lead-lag relationship and indirectly through a common exposure to US interest rates.

1.1 Introduction

It is a well established fact that indirect investments in real estate through publicly traded real estate investment trusts (REITs) lead direct and privately traded real estate investments[2]. However, I am the first to relate REITs and unsecuritized real estate to macroeconomic risk, by extracting the underlying factors of a large macroeconomic dataset. I show that REITs and private real estate are also indirectly related through a common exposure to US interest rates. REITs react contemporaneously to an interest rate factor whereas private real estate reacts with a lag. Furthermore, I find that private real estate reacts with a lag to a recession factor, and to some extent contemporaneously to a housing and credit factor.

Ever since Giliberto [1990] documented a significant correlation between REITs and direct real estate when controlling for stock and bond factors, many articles have examined the commonality between direct and indirect real estate investments. The approaches have split into two paths; a short-run and a long-run comparison. The previous literature on the "long-run" approach all find that direct and indirect real estate investments are co-integrated, ie. they share a common stochastic trend, so that in the long run, the two investments exhibit similar behaviour. The "short-run" literature examines the correlation between direct and indirect real estate and the findings are weaker. Generally, REITs are mainly driven by stock market risk, and indirect real estate is not.

This study adds to the existing literature by examining how both REITs and direct real estate investments relate to macroeconomic risk. I am the first to use a large macroeconomic dataset of 122 time series and extract the underlying factors by the asymptotic principal components method of Stock and Watson [2002b], Stock and Watson [2002a], and Bai and Ng [2002]. I use these factors to explain the time series behaviour of both REIT and direct real estate excess returns. Furthermore, I am the first to use quarterly REIT returns de-levered by *actual* interest expenses instead of using a corporate bond index as proxy.

If direct and indirect real estate are unrelated, then from a diversification argument, it could be optimal to hold both assets in a well diversified portfolio. If, on the other hand, they *are* related, they might serve as substitutes for each

[2]See for instance Goetzmann and Ibbotson [1990], Ross and Zisler [1991], and Myer and Webb [1994].

other, and difference in investor preferences might explain the need for both. Hence, for investors it is important to determine the relationship between REITs and private real estate since it will affect their asset allocation.

The findings of the current study suggests that REITs and private real estate are neither perfect substitutes nor completely unrelated. Using REITs as a liquid substitute for direct real estate will give the investor an considerable exposure to stock market risks. On the other hand, including both REITs and private real estate in a investment portfolio will duplicate some of the risk exposures with REITs reacting faster to news than private real estate investments. This makes sense since the assets of REITs and direct real estate are fundamentally the same, but the trading of the two investment vehicles differ. Given the fact that commercial real estate often involves long term leases, it is not surprising that the returns both REITs and direct real estate are driven by interest rate risk.

The rest of the paper is organized as follows. Section 1.2 provides a brief summary of the related literature, section 1.3 describes the US commercial real estate market, section 1.4 explains the methodology, section 3.4 describes the data, the summary statistics, and the extracted macroeconomic factors, section 3.6 presents the results, and section 3.7 concludes.

1.2 Literature Review

Several other papers have examined the relationship between direct and indirect real estate investments in both the short and long run. The previous literature on the long run comparison of direct and indirect real estate all agree that in the long run direct and indirect real estate are related. Ang et al. [2012] find evidence of a long run real estate factor common to both direct and indirect real estate returns. Similarly, Oikarinen et al. [2011] and Hoesli and Oikarinen [2012] find that the total return indexes of direct and indirect real estate are co-integrated, ie. they share a common stochastic trend. Hence, direct and indirect real estate co-move in the long run.

In the short run the relationship is not as strong. However, most of the previous literature still find a correlation between REITs and direct real estate investments. Giliberto [1990] finds that the residuals from regressions of both direct and indirect real estate returns on stock and bond market factors are significantly correlated, indicating that direct and indirect real estate share a common factor. Mueller and Mueller [2003] and Brounen and Eichholtz [2005] find, however, that the contemporaneous correlation between direct and indirect real estate is relatively low. Mei and Lee [1994] find some evidence that REITs and direct real estate are driven by a common factor. Clayton and MacKinnon [2001] find that REITs are related to value and small-cap stock market factors, and to a lesser extent a private real estate factor.

From a theoretical point of view it seems reasonable to expect that direct and indirect real estate are related, since they both involve investing in actual properties. However, there might be several investment vehicle specific reasons why this need not be the case in the short run. First of all, REITs are publicly listed on stock exchanges, and are thus expected to share a lot of commonalities with other publicly traded stocks. This is in fact also found by Goetzmann and Ibbotson [1990], Ross and Zisler [1991], and Myer and Webb [1994]. The fact that REITs are traded on exchanges makes REITs more liquid than direct real estate investments, and investors might therefore accept a lower risk premium for holding REITs than for holding direct real estate. However, the lower contemporaneous correlation between direct real estate and the general stock market gives direct real estate a diversification benefit that may make investors accept a lower risk premium for direct real estate. Nonetheless, Pagliari et al. [2005] find that the mean returns of direct and indirect real estate are not significantly different.

Another possible source of distortion is the differing informational efficiency of direct and indirect real estate. REITs are generally thought of as more informationally efficient than direct real estate, because REITs are traded on public exchanges and thus will react faster to new information than privately traded direct real estate. The difference in informational efficiency of REITs and direct real estate, implies that REIT returns should lead direct real estate returns. Gyourko and Keim [1992], Barkham and Geltner [1995] and Oikarinen et al. [2011] find such a lead-lag relationship between indirect and direct real estate. These short-run deviations should, however, cancel out in the long run, since the fundamental assets are the same.

This paper adds to the existing literature by examining how REITs and direct real estate is related to macroeconomic risk.

1.3 The Commercial Real Estate Market

The overall size of the US commercial real estate market was as of December 2010 estimated to be approximately $6.5 trillion, making it the third largest investable asset class in the US.[3] This includes both debt and equity investing. The focus in this paper is on equity investing.

To represent the return on publicly listed real estate I use total returns data from the CRSP Ziman REIT database. The total capitalization of publicly traded equity REITs as of December 2011 was more than $390 billion. Real Estate Investment Trust is a US tax label granting tax treatment much like that of mutual funds. The REITs can deduct dividends from their taxable income given that they pay out 90% of their taxable income as dividends. Furthermore, they are restricted to primarily invest in either real estate equity (equity REITs), real estate debt (mortgage REITs) or a mixture of the two (hybrid REITs). Originating from the 1960s, the REITs where primarily meant as an investment vehicle for small and medium size investors, that otherwise could not get exposure to commercial real estate. Thus, the REITs are restricted to have a broad based ownership structure. Since the early 1990s the ownership changed because new legislation made it possible for institutional investors such as pension funds to count all their investors/pensioners as owners of the REITs. As a result, the REIT industry has expanded significantly from a total capitalization of approximately $12 billion in 1992 to more than $390 billion as of December 2011.

Investing in private/non-listed real estate can be done through funds that are either open-end or close-end, through private partnerships, or through directly owning and managing the real estate properties. I focus on the investment in direct non-listed US real estate. I use data from the National Council of Real Estate Investment Fiduciaries (NCREIF). The NCREIF database is made up of property level appraisal, transactions and income returns reported by participating companies with US real estate under management. The returns are reported on a non-leveraged basis. Note, that since the REITs are free to use debt financ-

[3]Source: Prudential Real Estate Investors. See Investors [2011]

ing, the REIT returns will generally be levered. As of July 2011 the NCREIF database consisted of 6267 income-producing properties worth over $250 billion. The primary and most widely used index for benchmarking direct real estate investments is the NCREIF Property Index (NPI) and is based on income and appraisals of individual properties. It is well establish in the literature (see as an example Geltner [1993] and Geltner [2000]) that using appraisals instead of transaction prices makes the NPI suffer from "stale appraisals" and "appraisal smoothing“.

The "stale appraisals" effect stems from the fact that most properties are only appraised once a year, but the appraisals are reported on a quarterly basis. Thus, properties that have not been appraised in a given quarter will contribute to the index as if the properties have been re-appraised at the same value. This induces artificial volatility dampening in the index. For more on this see Geltner [2000].

The "appraisal smoothing“ effect comes from the way appraisers work. Appraisers need to trade off their updated estimate of the property value and the uncertainty that the estimate could be wrong. Thus, Quan and Quigley [1989] and Quan and Quigley [1991] show that it is in fact optimal for the appraisers to make their appraisal a weighted average of their current price estimate and the previous appraisals. "Appraisal smoothing" thus causes the NPI to suffer from artificial autocorrelation.

Because of these effects, and I prefer using an index that is based on pure trading prices for *some* properties, to an index based on appraisals for *all* properties, I choose to use the MIT Transaction Based Index (TBI) to represent direct real estate investments. It is computed using only actual sales prices from the NCREIF database, and thus avoids the problems applicable to appraisal data. The transaction prices are used to estimate a transaction price model at all times through hedonic regression, to account for the difference in quality of the properties sold. The model is then used on all the properties in the database that have not transacted at a given time. The TBI, thus, consists of either actual or estimated transaction prices for *all* properties in the NCREIF properties.[4]

If direct and indirect real estate are unrelated, then from a diversification perspective, it could be optimal to hold both assets in a well diversified portfolio.

[4]See Fisher et al. [2007] or http://web.mit.edu/cre/research/credl/tbi.html for more on the methodology.

If, on the other hand, they *are* related, they might serve as substitutes for each other, and difference in investor preferences might explain the need for both. As an example, small private investors may not have the funds to obtain a well diversified real estate portfolio by direct real estate investments and thus prefer REITs. Other investors might choose REITs because they value liquidity highly. Finally, large institutional investors, such as pension funds, might not have the same liquidity constraints and thus prefer direct real estate, since they can reap the illiquidity premium. However, if REITs only resemble direct real estate in the long run, then the liquidity argument for substituting direct real estate with REITs does not hold. It is therefore relevant to clarify the short-run relation between REITs and direct real estate.

1.4 Methodology

I will estimate a linear factor model along the lines of the Arbitrage Pricing Theory of Ross [1976] and the Intertemporal Capital Asset Pricing Model of Merton [1973], to try to explain the excess returns of both an equal weighted index of equity REITs and the equal weighted TBI. Specifically, I will run the following time series regression of each of the two indices

$$r_{i,t} = \alpha_i + \sum_{k=1}^{K} \beta_{i,k} F_{k,t} + \varepsilon_{i,t}, \tag{1.1}$$

where $r_{i,t}$ is the excess-return at time t for the ith index, $F_{k,t}$ denotes the time t value of k economic variables, and $\varepsilon_{i,t}$ is the idiosyncratic or residual risk, specific to each of the two indices.

I will use both traditional financial variables such as the Fama and French [1993] factors, and macroeconomic variables as explanatory variables. I will extract a few underlying macroeconomic factors through an approximate factor model of the type in Stock and Watson [2002b], Stock and Watson [2002a], or Bai and Ng [2002] and use the factors as explanatory variables in equation (1.1).

I assume that the macroeconomic variables contained in X_t, which is a $p \times 1$ vector of observed variables at time $t = 1, \ldots, T$, can be efficiently described by the following approximate factor model with time-invariant loadings

$$X_t = \Lambda F_t + \epsilon_t, \tag{1.2}$$

where F_t is a $q \times 1$ vector of underlying factors with $E(F_t) = 0$ and $E(F_t F_t^\intercal) = I_q$, where $q << p$. Λ is $p \times q$ matrix of factor loadings, and ϵ_t is a $p \times 1$ vector of unobserved errors, which is assumed independent of the factors, and having $E(\epsilon_t) = 0$ and variance-covariance matrix Ψ.

The variance-covariance matrix of X is given as

$$\Sigma = E[(\Lambda F_t + \epsilon_t)(\Lambda F_t + \epsilon_t)'] = E[\Lambda F_t F_t' \Lambda' + \epsilon_t \epsilon_t'] = \Lambda\Lambda' + \Psi,$$

since $E(F_t F_t') = I_q$, and F_t and ϵ_t are independent of each other. Note, that the factor model is not uniquely identified. Consider, as an example, a $q \times q$ orthogonal matrix Q, and let $\Lambda^* = \Lambda Q$ and $F_t^* = Q' F_t$, then equation (1.2) can be written as

$$X_t = \Lambda Q Q' F_t + \epsilon_t = \Lambda^* F^* + \epsilon_t, \tag{1.3}$$

and (1.3) will meet all the requirements of the factor model in (1.2), namely that $E(F_t^* F_t^{*\intercal}) = Q' E(F_t F_t^\intercal) Q = I_q$, and that

$$\Sigma = E[(\Lambda^* F_t^* + \epsilon_t)(\Lambda_t^* F_t^* + \epsilon_t)'] = \Lambda\Lambda' + \Psi.$$

Thus, by simply observing X it is not possible to distinguish between Λ and the rotated loadings, $\Lambda^* = \Lambda Q$.

The model is typically either estimated by maximum likelihood methods, as in Anderson [2003], by Bayesian methods as in Otrok and Whiteman [1998] or by the asymptotic principal components method as in Stock and Watson [2002b]. To use maximum likelihood and Bayesian methods one needs to assume that the errors are cross-sectionally uncorrelated. Using the asymptotic principal components method, however, allows for a small degree of cross-sectional correlation.[5]

In this paper I choose to estimate the factor model by the asymptotic principal components method mainly because of its tractability. The different estimation methods should not alter the results significantly. For a thorough

[5]More specifically, the ratio of the covariance of the errors to the total covariance of X has to be bounded by a constant. See Stock and Watson [2006] and Ludvigson and Ng [2009] for more on this.

explanation of the asymptotic principal components method see appendix 1.9.

1.5 Data and Summary Statistics

To illustrate that the NPI suffers from both "stale appraisals" and "appraisal smoothing", and that the TBI is thus a more reasonable proxy for direct real estate, I have included the NPI in the summary statistics. The TBI is an equal weighted index and the NPI is value-weighted. Both of the series are quarterly indexes. The NPI goes back to 1978, and the TBI goes back to 1984. The CRSP Ziman REIT database has REIT data back to 1980. I compose a equal weighted equity REIT index. I use quarterly data since this is the highest frequency of both the NPI and the TBI. The data covers the 2nd quarter of 1984 through to the 1st quarter of 2011.

Since the REITs are free to use debt financing, REITs will generally be leveraged. The NCREIF collects unleveraged returns, so to properly compare the two indices, I need to account for the leverage in the REITs. I follow the methodology used in Pagliari et al. [2005]. It is based on the Modigliani and Miller [1958] transformation of levered equity returns:

$$r_{unl} = r_l(1 - LR) + r_d(LR), \tag{1.4}$$

where r_{unl} is the unlevered equity return, r_l is the levered equity return, LR is the ratio of debt-to-assets, and r_d is the cost of indebtedness. As the REITs are tax-exempt, there is no debt interest rate tax shield to consider. In order to use equation (1.4), I need to estimate both the cost of indebtedness and the ratio of debt-to-assets for each company. The cost of indebtedness is calculated at each quarter, t, for each firm as

$$r_{d,t} = \frac{IE_t + PD_t}{\frac{TD_t + TD_{t-1}}{2} + \frac{PS_t + PS_{t-1}}{2}}, \tag{1.5}$$

where IE_t is the interest expense for each company in quarter t, PD_t is the preferred dividends payed in that quarter, PS_t is the value of preferred stock at the end of quarter t, and TD_t is the total value of debt for each firm at the end of that quarter. It is calculated as

$$TD_t = LTD_t + DCL_t + max(0, CL_t - DCL_t - CA_t).$$

LTD_t is the long term debt, DCL_t is the value of debt in current liabilities, CL_t is current liabilities, and CA_t is current assets. All values are at the end of quarter t. The ratio of debt-to-assets of each company is calculated as

$$LR_t = \frac{\frac{TD_t+PS_t}{TD_t+PS_t+Cap_t} + \frac{TD_{t-1}+PS_{t-1}}{TD_{t-1}+PS_{t-1}+Cap_{t-1}}}{2}, \tag{1.6}$$

where Cap_t is the market capitalization of each REIT at the end of each quarter. The only exceptions to equation (1.5) and (1.6) are when the balance sheet values in both equations for each firm become available for the first time. In this case the denominator of equation (1.5) is not an average of time t and $t-1$ values, but simply the time t values, and likewise equation (1.6) is simply time t values.

The balance sheet items are from the Compustat Database. Since I use quarterly observations, and not yearly observations like Pagliari et al. [2005], not all balance sheet values are available for all the REITs for the entire period. Instead of excluding all the REITs without balance sheet items, I calculate an equal weighted cost of indebtedness and ratio of debt-to-assets at all points in time. These are then applied to the time series returns of the equal weighted equity REIT index. This not too different from Hoesli and Oikarinen [2012], who also calculate average debt-to-assets ratios through time, but use corporate bond yields to proxy cost of indebtedness, and use it to lever the direct real estate returns instead of de-levering REIT returns. My approach has the advantage of using actual REIT interest expenses, and not the proxy bond yields. Figure 1.1 shows the time series plot of both the equal weighted cost of indebtedness estimated from actual interest expenses and the Moody's Baa rated corporate bond yields. The two time series deviate with as much as approximately 1 percentage point in the beginning of the period. Thus, using the Moody's Baa rated corporate debt yields, might not give the same results as using actual interest expenses.

To illustrate the artificial nature of the appraisal based NPI, I have included the NPI in the summary statistics in table 1.1. As seen from the table, the REIT index has the highest mean return of 2.59%, but it is not too different from the mean return of the TBI and NPI, and differences of the means are not significantly different from 0. As expected, the NPI is the least volatile of the three with a quarterly standard deviation of 2.3%. The TBI, which does not suffer from stale appraisals or appraisal smoothing, has a standard deviation of 4.55%. The lower volatility is due to the appraisal nature of the NPI. The equity REIT index returns has been de-levered and has a standard deviation of 4.73%, which is quite comparable to that of the TBI. The levered REIT mean return and standard deviation are not listed in the table, but are respectively 3.10% and 10.6%, and so correctly accounting for leverage is very important when comparing REITs to direct real estate investments. The Sharpe ratio is a little higher for the equity REIT index than for both the NPI and the TBI, but given the fact that the differences in means are not statistically significant from 0, it seems that neither REITs nor direct real estate outperform the other in terms of mean return and standard deviation. This is in line with Pagliari et al. [2005], who find that, when accounting for leverage and the appraisal effects of the NPI[6], the mean and standard deviation of indirect and direct real estate returns are similar.

According to the NCREIF organization, the number of properties sold in times of crisis drops significantly, suggesting that in crisis times investors with liquidity needs probably firstly tries to sell more liquid assets like bonds and stocks, and only investors unable to meet their liquidity needs by selling these assets will liquidate their direct real estate investments. Since REITs are stocks and trade on exchanges, this could mean that during times of crisis REITs experience a bigger price drop than the direct real estate market, simply because the direct real estate market freezes. Figure 1.2 shows that during the financial crisis the drop in the TBI return was indeed not as big as the drop in the equity REIT return, but the subsequent recovery was not as big either.

The summary statistics in table 1.1 show that the three time series are not very correlated. The TBI and NPI has the highest correlation of 53%, while the correlation between the equity REIT index and the TBI and NPI is 24% and 15%, respectively. As expected the trade based index is closer to the REIT index than the appraisal based, which suffers from the above mentioned "appraisal smoothing" and "stale appraisals".

[6]Note that Pagliari et al. [2005] uses the NPI and not the TBI, but tries to remove the appraisal effects through statistical techniques.

From the autocorrelations in table 1.1, it is clear to see how the appraisals induce autocorrelation in the NPI. At the first lag the autocorrelation is as high as 79%, and even at the fourth lag the autocorrelation is 36.8%. While the autocorrelations of the TBI are not above 19% at any lags.

1.5.1 Fundamental Macroeconomic Factors

To explain the commercial real estate returns of the equity REIT index and the TBI, I will extract the underlying factors of 122 macroeconomic variables through the asymptotic principal components methodology of Stock and Watson [2002b], Stock and Watson [2002a] and Bai and Ng [2002]. Together, these 122 variables contain most of the US macroeconomic information. These variables are very similar to the variables used in both Bernanke et al. [2005] and Ludvigson and Ng [2009]. The variables are not completely the same, since Bernanke et al. [2005] and Ludvigson and Ng [2009] have monthly observations and data from the IHS Global Insights database, whereas I have quarterly observations and use data from the Federal Reserve Bank St. Louis FRED database. The variables that are not stationary are transformed to induce stationarity. A complete list of the variables and the transformations used is available in appendix 1.10.

Extracting the factors underlying the macroeconomy has the advantage of extracting most the macroeconomic information in only a few variables. However, it of course comes at a few costs. For example, it adds estimation error, since the factors are unobserved. Furthermore, a clear interpretation of the factors can be difficult, because the factors generally will load on many of the 122 macroeconomic variables.

I find that the 122 macro variables can be described by 4 underlying factors by the information criteria of Bai and Ng [2002]. All three information criteria agree on 4 underlying factors. The 4 factors together describe 58.3% of the variation in the 122 variables. I scale the 4 factors to unit variance to ease comparability.

To attach economic interpretation to the 4 factors I regress each of the 122 variables on each of the factors one at a time and report the R^2. The results are shown in figure 1.3, 1.4, 1.5, and 1.6. The first factor loads heavily on employment and industrial production variables, and hence measures the overall economic activity. Furthermore, the time series plot of the 1st factor in figure 1.7, shows that the factor peaks in recessions. I thus dub it the recession factor.

Figure 1.4 shows that the second factor loads heavily on housing and credit variables. The time series plot in figure 1.8 shows that the housing and credit factor is highly related to the number of new privately owned housing units started. I name it the housing and credit factor.

The 3rd factor loads heavily on prices variables as seen from figure 1.5. The price variables are all transformed to changes in natural logarithms, hence, the 3rd factor is really an inflation factor. The time series graph in figure 1.9 shows that the factor in fact closely the inversion of the change in the log of the consumer price index, all items (CPI). Thus, an increase in the 3rd/inflation factor corresponds to a drop in inflation.

The 4th and last factor is related to changes in US Treasury yields and US Treasury spread levels as seen from figure 1.6. I thus dub the 4th factor, the interest rate factor. In fact, the time series dynamics of this factor closely resembles the movements of the changes in the 3 month US Treasury constant maturity rate as seen from figure 1.10.

1.6 Results

Table 1.2 shows the results from regressions of the excess return of the REIT index and the excess return of the TBI against each other and different stock market factors. The reported standard errors are Newey and West [1987] standard errors. The second column shows (not conditioned on other factors) that REITs and direct real estate are contemporaneously correlated. The estimated TBI beta coefficient is 0.291 and the regression has an adjusted R^2 of 6.7%. This is in line with the time series graph in figure 1.2 showing a connection between the REIT index and the TBI.

As seen from the third column the effect of the market portfolio[7] is much stronger than the TBI effect in line with a classic CAPM model. The fourth column, shows that the TBI excess return remains significant when including the market portfolio. However, including the TBI excess return only raise the

[7]The market portfolio along with the SMB and HML portfolios are from Kenneth R. French's webpage. The market portfolio is a value-weighted index of all the CRSP firms incorporated in the US and listed on either the NYSE, AMEX, or NASDAQ.

adjusted R^2 from 32.2% to 34.7%. This indicate at most a weak relation between REITs and direct real estate.

Including the Fama and French [1993] SMB and HML portfolios in the 5th and 6th column of table 1.2 eliminates the effect of the TBI. If one were to argue that the SMB and the HML portfolios do not represent fundamental risk factors, but simply profitable portfolios, it might be too harsh a demand to require the TBI to remain significant in such a specification. Especially, considering the limited number of observations due to the quarterly frequency of the TBI. Nevertheless, including the Fama and French [1993] SMB and HML portfolios does raise the adjusted R^2 to 71.2%, and hence shows that REITs are primarily related to the stock market.

Column 7 and 8 in table 1.2 shows that the TBI is not at all driven by stock market risk factors, since both the market portfolio, the SMB, and the HML portfolios are statistically insignificant. Given that REITs and direct real estate are respectively publicly and privately traded, it is natural to include lags of the REIT index and the stock market factors, to test for a lagged relation between the two investments. Column 9 and 10 in table 1.2 shows that the 1 quarter lagged REIT excess return is statistically significant, and including both the contemporaneous and lagged REIT excess return raise the adjusted R^2 to 11.4%. Including the 1 quarter lagged Fama and French [1993] factors results in an adjusted R^2 of only 2.7%. Indicating the TBI is reacting to the real estate specific information in the REIT index, and not stock market information. This is in line with the findings of Gyourko and Keim [1992], Barkham and Geltner [1995] and Oikarinen et al. [2011]. In unreported results I find, in line with Barkham and Geltner [1995], that the Granger causality runs from publicly listed REITs and to direct and privately traded but not the other way.

Given that real estate is a “real” asset, and that the assets held by REITs are in fact real estate, an obvious hypothesis is that both REITs and direct real estate are driven by macroeconomic risk. To examine this, I include the 4 macroeconomic factors extracted by asymptotic principal components as explanatory variables in regressions explaining the REIT and TBI excess returns. The results are shown in table 1.3.

From table 1.3 it is seen that the REITs are exposed to the interest rate factor. The factor is even robust to the inclusion of the Fama and French [1993] factors. Comparing the 2nd column of table 1.3 to the same specification, just without the macro factors, in table 1.2 shows that including the macroeconomic factors increases the adjusted R^2 from 32.2% to 38.2%. This is a nontrivial increase, and shows that the interest rate factor is also economically significant. Since the macroeconomic factors are scaled to have unit variances, a 1 standard deviation increase in the interest rate factor leads to a 1.3%-point increase in the quarterly REIT excess return. REITs thus perform better in times of raising interest rates. From a theoretical perspective there are at least two ways in which interest rates affect returns. Firstly, when interest rates go up, the present valuation of the future cash flows goes down, and higher interest rates should thus imply that returns go down. Secondly, however, interest increase are often associated with good economic times, which would lead to higher returns. One interpretation of the of the estimated positive loading on the interest rate factor, is that the latter effect dominates the valuation effect.

However, it is worth noting that the REITs are not exposed to the recession factor. This could be because the recession factor is more related to the real economy and the interest rate factor is closer related to the financial markets.

The TBI excess return is on the other hand not related to the interest rate factor in any of the specifications. It is related to the recession factor in the first specification. A 1 standard deviation increase in the recession factor reduces the TBI excess return by 1.1%-points. Thus, bad real economic times, are related to lower TBI excess returns. In the last column the HML portfolio is statistically significant, but the economic significance is limited. The adjusted R^2 increases only marginally from 7.7% to 8.4%. Direct real estate is at most weakly related to the contemporaneous macroeconomic risk factors.

However, the lead-lag relationship between REITs and direct real estate documented in Gyourko and Keim [1992], Barkham and Geltner [1995] and Oikarinen et al. [2011] and the significant lagged REIT excess return in column 9 and 10 in table 1.2 suggest adding lagged time series of the macroeconomic factors in explaining the TBI excess returns. The results from regressions including lagged terms of the macroeconomic factors and the REIT excess return are shown in table 1.4. In column 2-5 up to 4 quarters lags of the 4 factors are included one at a time along with the 1 quarter lag of the REIT excess return. The 1 year lags of the recession factor and the interest rate factor are significant both statistically and economically. The adjusted R^2 increases from 6.0% in column 9 of table 1.2 to 12.9% and 14.2% for the recession factor and the interest rate factor respectively. And, a 1 standard deviation increase in the two factors will lead to a 1.5%-point drop and a 1.7%-point increase in the quarterly excess return, respectively. The lagged REIT excess return is significant in all these specifications.

Including the 1 year lags of both the recession factor and the interest rate factor in column 5 results in only the interest rate factor being significant. This suggests that the significance of the 4th lag of the recession factor in column 2 was due multicollinearity with one or more of the other lags. In fact, the last column in table 1.4 shows the best specification including the recession and the interest rate factor. It includes the 1st lag of the recession factor and the 4th lag of the interest rate factor. The adjusted R^2 is 18.4%. Caution is probably warranted in putting too much emphasis on the specific lag structure, but the results in table 1.4 do show that controlling for lagged REIT excess returns, direct real estate reacts to both the recession and the interest rate factor with a lag.

As a robustness check, I try forming simple macroeconomic factors as equal weighted averages of the variables that each factor loads heavily on. Thus, the simple mean or average recession factor is the equal weighted average of all the output and income and employment and earnings variables. The mean housing and credit factor is the equal weighted average of all the housing variables and the money and credit variables. The mean inflation factor is the equal weighted average of all the price variables. And finally, the mean interest rate factor is the average of all the US Treasury rates and spreads against the US federal funds rate.

The simple mean factors are substituted for the extracted macroeconomic factors in the regression specification used in table 1.3. The results are shown in table 1.5. The mean interest rate factor is again the only factor affecting REIT excess returns. This further strengthens the result that REITs are related to an interest rate factor.

The most notable difference from using the extracted macroeconomic factors, is that the housing and credit factor becomes significant for the TBI. The factor is significant in all the specifications, and a 1 standard deviation increase in the factor leads to 1.1-1.2%-point increase in the TBI excess return. Furthermore, using the simple mean factors increases the adjusted R^2 from 7.8% (in column 6 of table 1.3 using extracted factors) to 16.1% in the corresponding column in table 1.5. This suggests that the TBI excess return is contemporaneously related to a housing and credit factor.

However, table 1.6 presenting the results from regressing lags of the simple average macroeconomic factors instead of extracted factors shows that only the contemporaneous simple inflation factor is significant, and the adjusted R^2 is only 6.0%. This suggests that the factors extracted by asymptotic principal components entail important information not contained in the simple mean factors.

Overall, I find that REIT excess returns are related to stock market factors and to the interest rate factor describing the change in the short term US interest rates. Furthermore, REITs lead the direct real estate market, measured by the TBI, by about 1 quarter. The TBI is is driven by lags of the recession and the interest rate factors even when controlling for the lagged REIT excess returns. Hence, REITs and direct real estate are related through a lag both directly and via a common exposure to the interest rate factor.

1.7 Conclusion

I have examined the commonality between publicly traded real estate investments via REITs, privately traded direct real estate investments, measured by the TBI, and the macro economy by extracting the factors underlying a large dataset of a 122 macroeconomic variables by the asymptotic principal components method of Stock and Watson [2002b], Stock and Watson [2002a], and Bai and Ng [2002].

I de-lever the REIT returns using *actual* interest expenses, contrary to earlier studies using the yield on Baa rated debt as a proxy, to make REIT returns comparable to the TBI which is reported on an unlevered basis.

I find not only that REITs lead private real estate, but also that they are related through a common exposure to an interest rate factor. REITs react contemporaneously to the interest rate factor and private real estate reacts with a lag, consistent with REITs being more informationally efficient than the private real estate market.

Furthermore, I find that REITs are mainly driven by stock market risk, and that private real estate is driven by a lagged recession factor and, to some extent, a housing and credit factor.

1.8 Figures and Tables

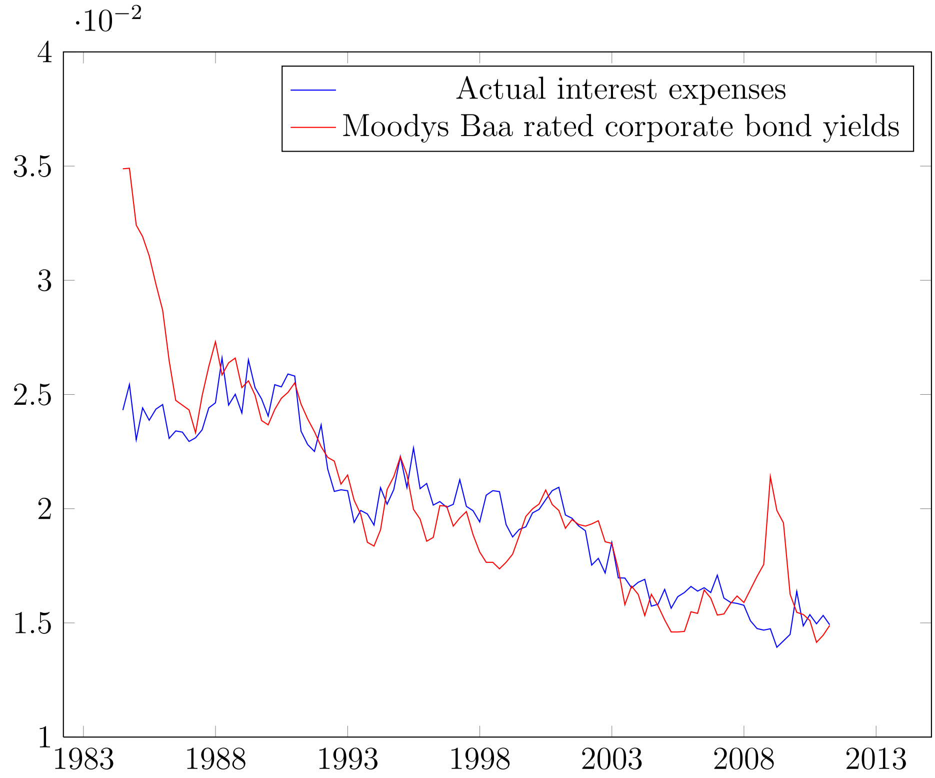

Figure 1.1: Comparison of the cost of indebtedness proxied by Moody's Baa rated corporate debt yields, and calculated as an equal weighted average interest cost from actual REIT interest expenses.

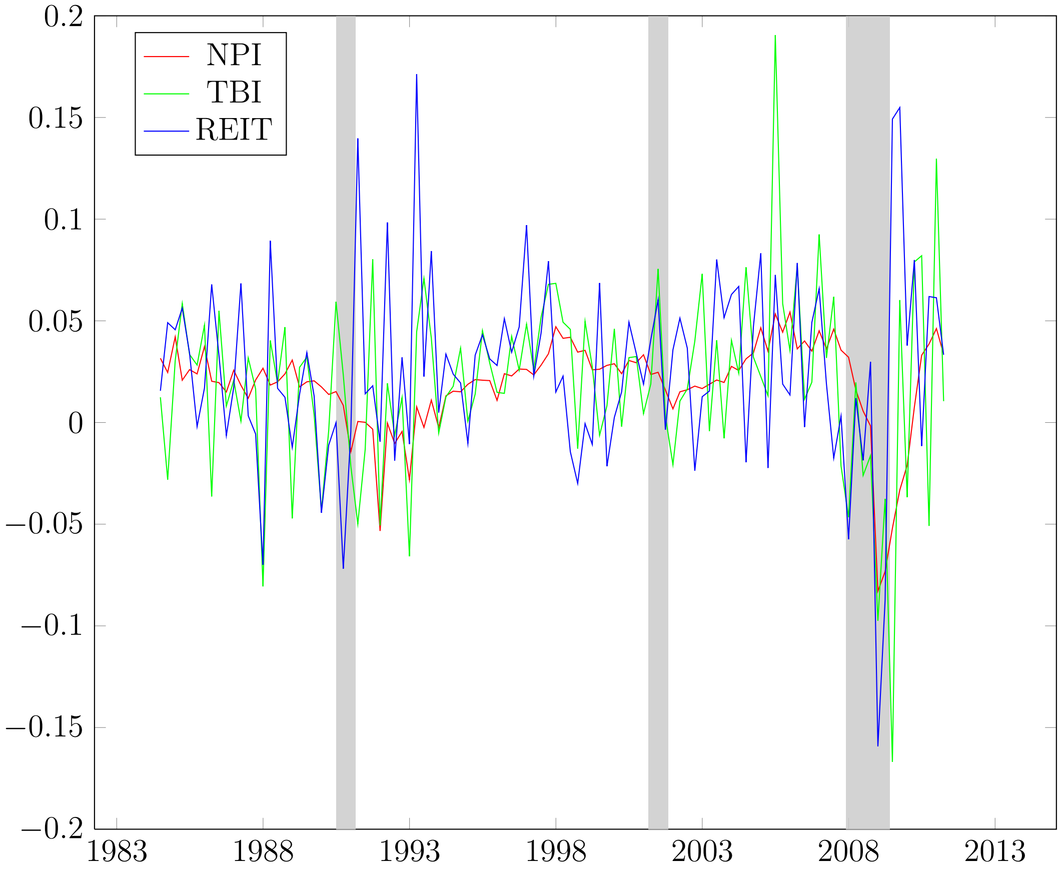

Figure 1.2: Time-series plot of the returns of the NPI, the TBI, and the all equity REIT index. Shaded areas indicate NBER recessions.

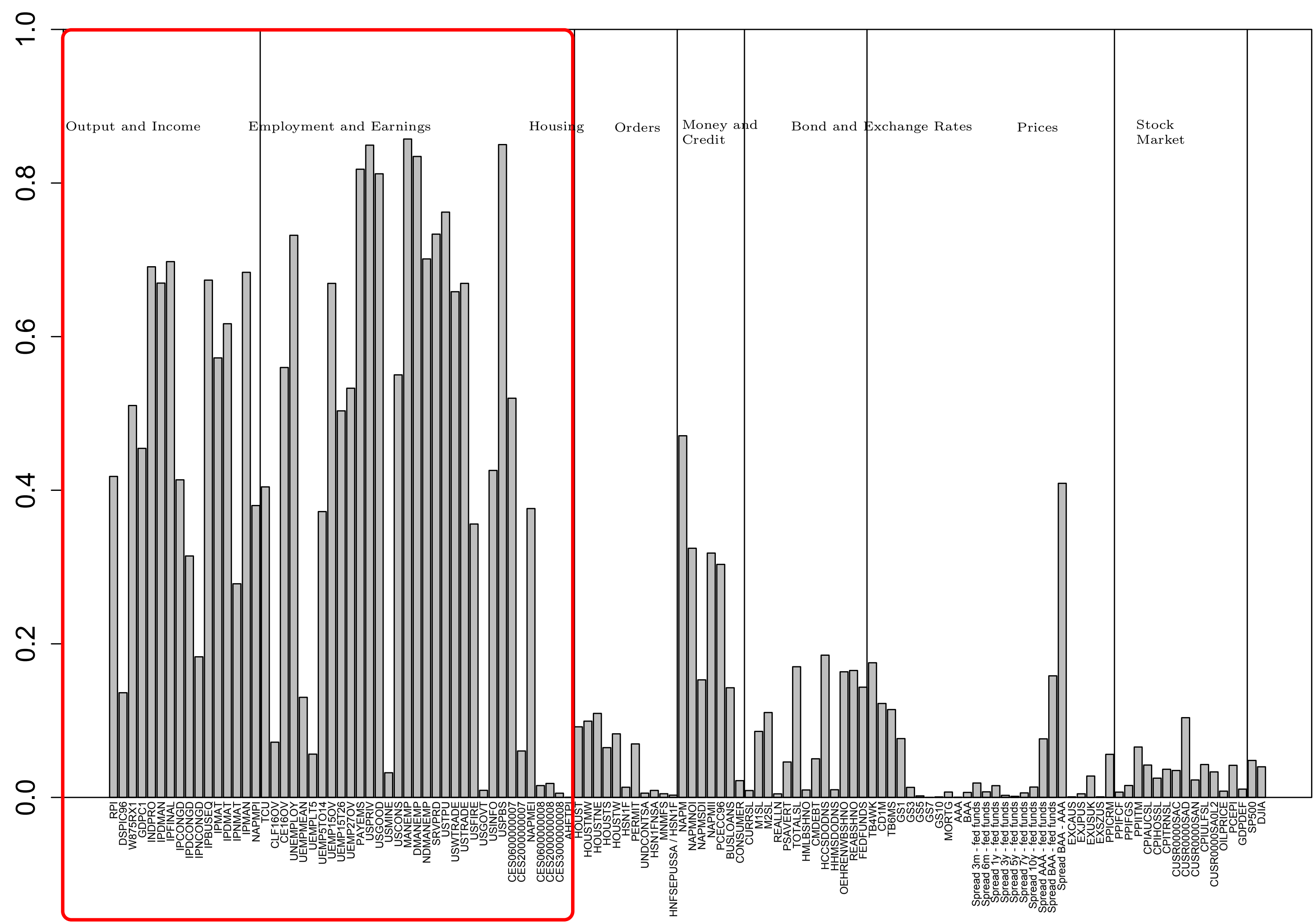

Figure 1.3: The 1st factor or the recession factor. The graph depicts the R^2 from regressions of each of the 122 macroeconomic variables on the 1st factor.

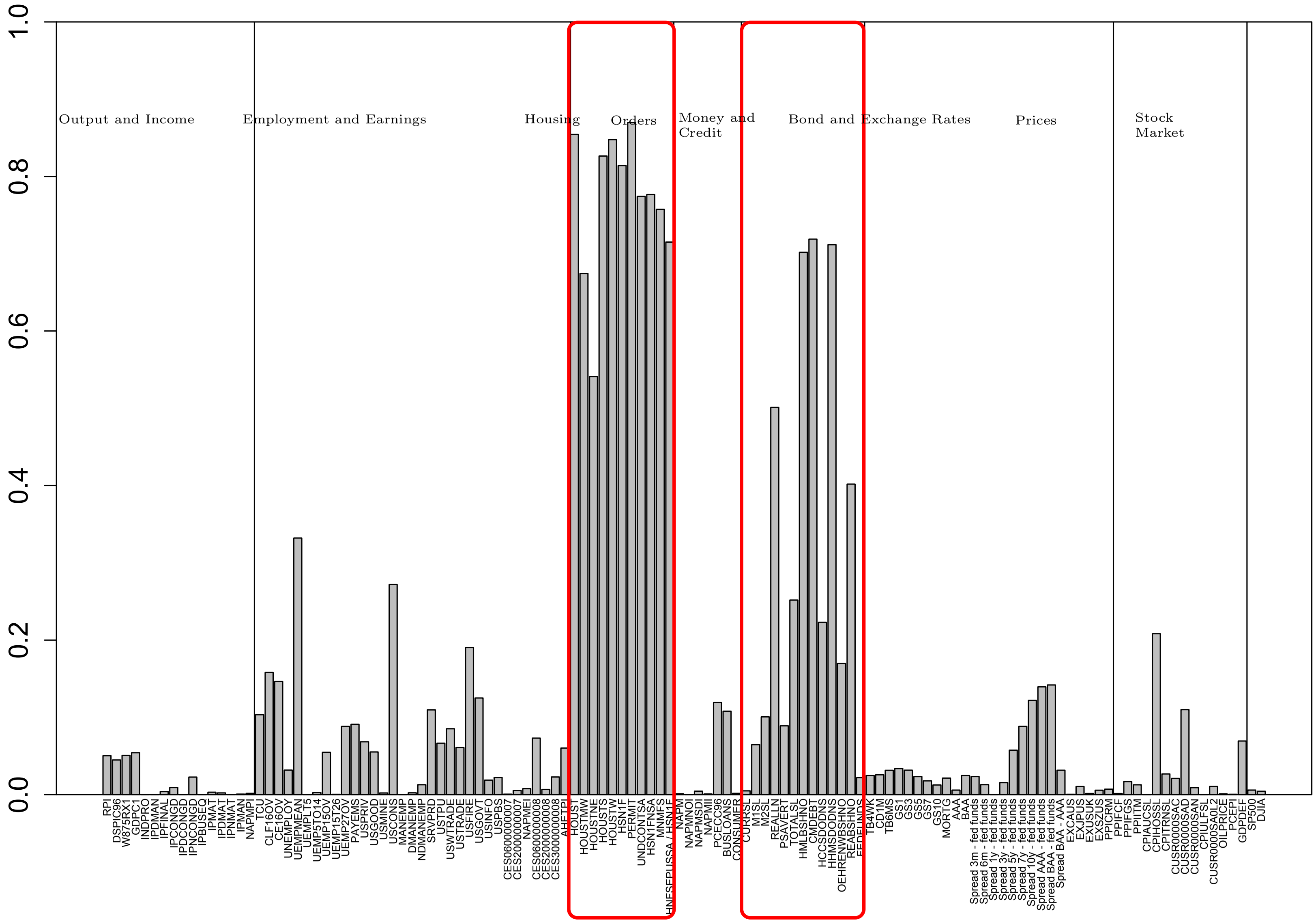

Figure 1.4: The 2nd factor or the housing and credit factor. The graph depicts the R^2 from regressions of each of the 122 macroeconomic variables on the 2nd factor.

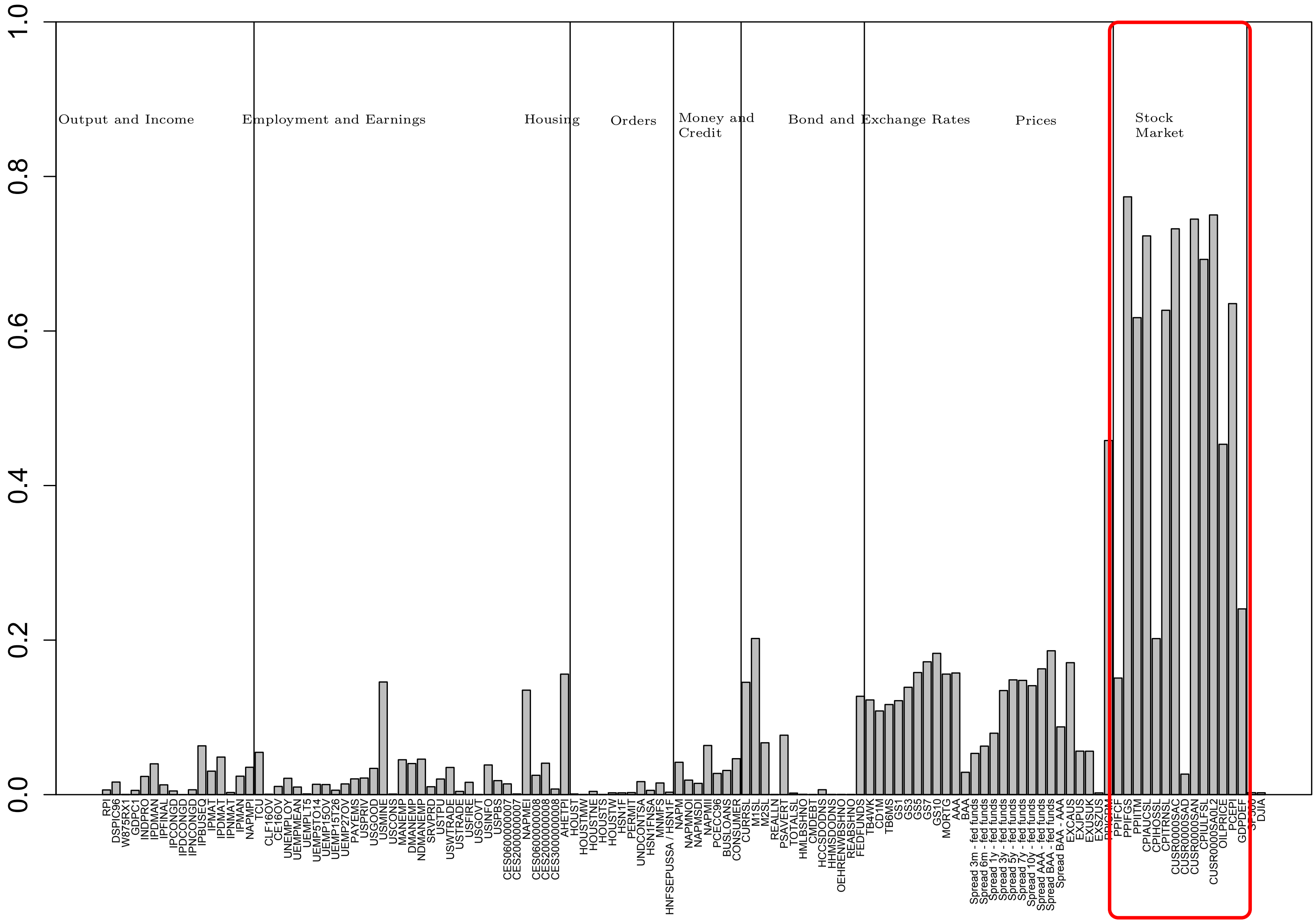

Figure 1.5: The 3rd factor or the inflation factor. The graph depicts the R^2 from regressions of each of the 122 macroeconomic variables on the 3rd factor.

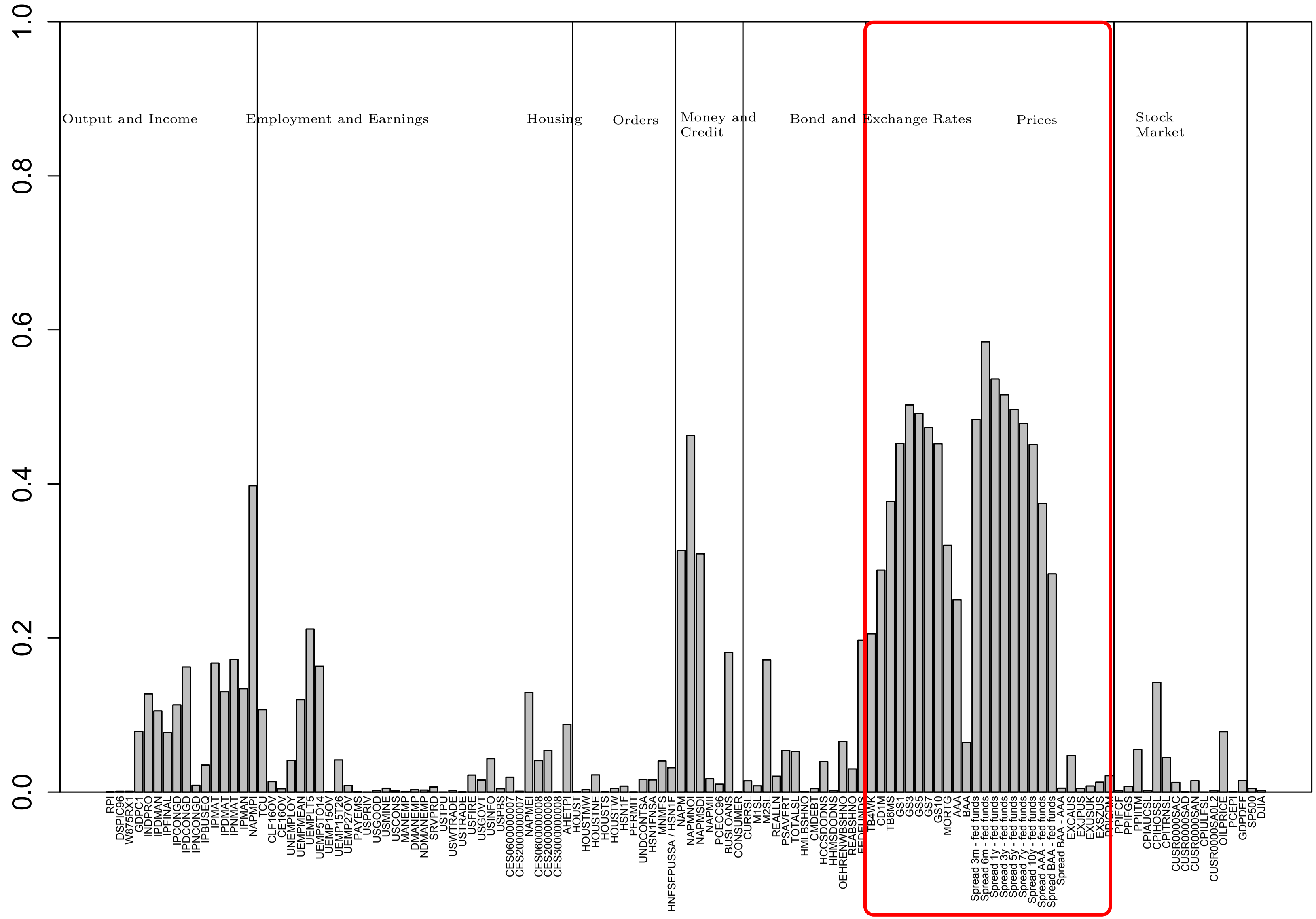

Figure 1.6: The 4th factor or the interest rate factor. The graph depicts the R^2 from regressions of each of the 122 macroeconomic variables on the 4th factor.

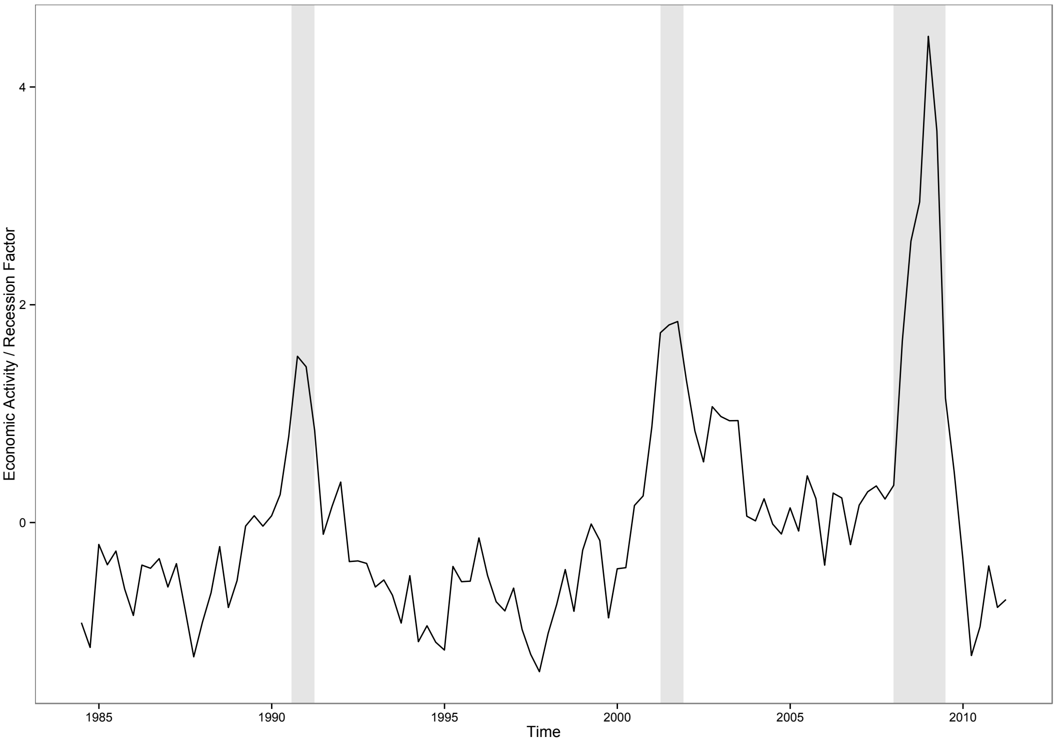

Figure 1.7: Time-series plot of the recession factor (1st factor). Shaded areas indicate NBER recessions.

Figure 1.8: Time-series plot of the housing and credit factor (2nd factor), and the log of the of new privately owned business units started. Both series are scaled to have unit variance to increase comparability. The scale on y-axis thus have no economic meaning. Shaded areas indicate NBER recessions.

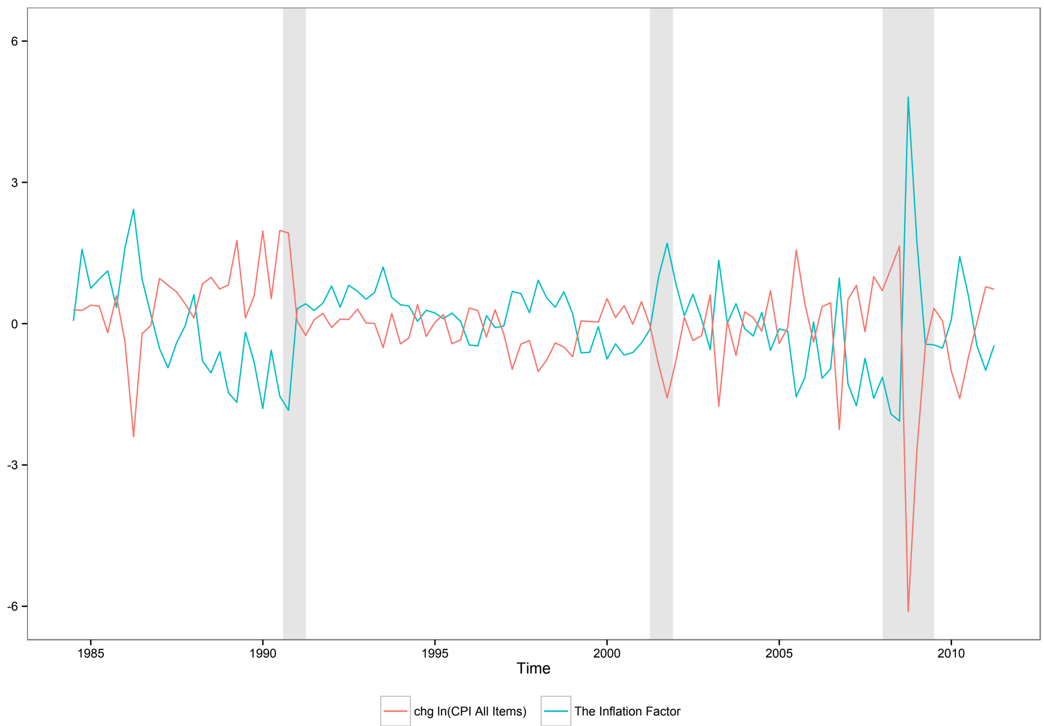

Figure 1.9: Time-series plot of the inflation factor (3rd factor), and the difference in the log of the CPI:All Items. Both series are scaled to have unit variance to increase comparability. The scale on y-axis thus have no economic meaning. Shaded areas indicate NBER recessions.

Figure 1.10: Time-series plot of the interest rate factor (4th factor), and the change in the US Treasury 3 month constant maturity rate. Both series are scaled to have unit variance to increase comparability. The scale on y-axis thus have no economic meaning. Shaded areas indicate NBER recessions.

Table 1.1: Summary statistics for the total return time-series: Equity REITs, the NPI, and the TBI.

		REITs	TBI	NPI
	Mean (%)	2.59	1.96	1.84
	Std. dev. (%)	4.73	4.55	2.30
	Sharpe Ratios	0.298	0.171	0.288
Correlations	Equity REITs	1.00	0.24	0.15
	TBI	0.24	1.00	0.53
	NPI	0.15	0.53	1.00
Autocorrelations	1st lag (%)	6.6	3.0	79.0
	2nd lag (%)	-3.7	19.0	67.4
	3rd lag (%)	-7.2	8.6	47.8
	4th lag (%)	14.1	12.9	36.8

Table 1.2: Regressions of REIT and TBI excess returns on each other and stock market factors. Newey and West [1987] standard errors are shown in parentheses. *** denotes significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

	Dependent variable									
	Unlevered REIT excess return					**TBI excess return**				
Intercept	0.012**	0.008.	0.007	0.003	0.003	0.006	0.005	0.005	0.002	0.006
	(0.004)	(0.005)	(0.004)	(0.003)	(0.002)	(0.006)	(0.006)	(0.006)	(0.004)	(0.006)
$TBI_t - Rf_t$	0.291***		0.189*		0.087					
	(0.074)		(0.087)		(0.077)					
$R_t^{mkt} - Rf_t$		0.319***	0.301***	0.332***	0.323***	0.094*	0.107			
		(0.080)	(0.082)	(0.042)	(0.047)	(0.043)	(0.055)			
SMB_t				0.373***	0.368***		0.056			
				(0.051)	(0.050)		(0.083)			
HML_t				0.435***	0.425***		0.117*			
				(0.053)	(0.053)		(0.049)			
$R_t^{REIT} - Rf_t$									0.236	
									(0.129)	
$R_{t-1}^{REIT} - Rf_{t-1}$								0.246**	0.220**	
								(0.083)	(0.078)	
$R_{t-1}^{mkt} - Rf_{t-1}$										0.079
										(0.102)
SMB_{t-1}										0.001
										(0.115)
HML_{t-1}										0.172*
										(0.066)
N	108	108	108	108	108	108	108	107	107	107
Adj. R^2	6.7%	32.2%	34.7%	71.2%	71.6%	2.3%	2.9%	6.0%	11.4%	2.7%

Table 1.3: OLS regressions of the REIT and TBI excess return on stock market factors and the 4 extracted macroeconomic factors, the recession factor (Recession), the housing and credit factor (Housing), the inflation factor (Inflation), and the interest rate factor (Interest rate). Newey and West [1987] standard errors are shown in parentheses. *** denotes significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

	Dependent variable						
	Unlevered REIT excess return				TBI excess return		
Intercept	0.009*	0.008*	0.004	0.003	0.008	0.007	0.006
	(0.004)	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)
$TBI - Rf$		0.193*		0.090			
		(0.074)		(0.078)			
$R_{mkt} - Rf$	0.279***	0.270***	0.314***	0.309***		0.049	0.051
	(0.060)	(0.067)	(0.036)	(0.041)		(0.058)	(0.076)
SMB			0.314***	0.305***			0.100
			(0.047)	(0.047)			(0.106)
HML			0.433***	0.424***			0.099*
			(0.045)	(0.046)			(0.038)
Recession	-0.003	-0.001	-0.002	-0.002	-0.011*	-0.009	-0.01
	(0.005)	(0.004)	(0.002)	(0.002)	(0.004)	(0.005)	(0.006)
Housing	-0.002	-0.004	-0.003	-0.004**	0.008	0.009	0.008
	(0.004)	(0.003)	(0.002)	(0.001)	(0.006)	(0.007)	(0.006)
Inflation	0.005	0.006*	0.001	0.002	-0.005	-0.005	-0.006
	(0.003)	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.004)
Interest rate	0.013***	0.012***	0.008***	0.008***	0.005	0.004	0.003
	(0.003)	(0.003)	(0.001)	(0.002)	(0.004)	(0.004)	(0.004)
N	108	108	108	108	108	108	108
Adj. R^2	38.2%	40.7%	73.2%	73.6%	7.8%	7.7%	8.4%

Table 1.4: OLS regressions of the TBI excess return on the lagged REIT excess return and lags of the 4 extracted macroeconomic factors, the recession factor (Recession), the housing and credit factor (Housing), the inflation factor (Inflation), and the interest rate factor (IR). Newey and West [1987] standard errors are shown in parentheses. *** denotes significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

	Dependent variable TBI excess return					
Intercept	0.006	0.006	0.005	0.005	0.006	0.007
	(0.005)	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)
$R_{t-1}^{REIT} - Rf_{t-1}$	0.201*	0.248**	0.208**	0.232*	0.215*	0.164
	(0.076)	(0.075)	(0.073)	(0.106)	(0.094)	(0.086)
$Recession_t$	0.011					
	(0.008)					
$Recession_{t-1}$	-0.019					-0.01*
	(0.016)					(0.004)
$Recession_{t-2}$	-0.003					
	(0.014)					
$Recession_{t-3}$	-0.014					
	(0.011)					
$Recession_{t-4}$	0.015*				-0.005	
	(0.006)				(0.004)	
$Housing_t$		0.024				
		(0.014)				
$Housing_{t-1}$		-0.001				
		(0.018)				
$Housing_{t-2}$		-0.001				
		(0.016)				
$Housing_{t-3}$		-0.032				
		(0.016)				
$Housing_{t-4}$		0.018				
		(0.014)				
$Inflation_t$			-0.006			
			(0.006)			
$Inflation_{t-1}$			0.000			
			(0.009)			
$Inflation_{t-2}$			0.000			
			(0.006)			
$Inflation_{t-3}$			0.000			
			(0.011)			
$Inflation_{t-4}$			0.008			
			(0.008)			
IR_t				0.005		
				(0.006)		
IR_{t-1}				-0.011		
				(0.008)		
IR_{t-2}				0.012		
				(0.007)		
IR_{t-3}				-0.007		
				(0.007)		
IR_{t-4}				0.017*	0.015***	0.012**
				(0.007)	(0.004)	(0.004)
N	104	104	104	104	104	104
Adj. R^2	12.9%	10.6%	5.5%	14.2%	15.5%	18.4%

Table 1.5: OLS regressions of the REIT and TBI excess return on stock market factors and 4 simple macroeconomic factors. The macroeconomic factors are simply the equal weighted means of the variables with the highest loadings in figure 1.3, 1.4, 1.5, and 1.6 denoted the average recession factor (Avg. Recession), the average housing and credit factor (Avg. Housing), the average inflation factor (Avg. Inflation), and the average interest rate factor (Avg. IR). Newey and West [1987] standard errors are shown in parentheses. *** denotes significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

	Dependent variable						
	Unlevered REIT excess return				**TBI excess return**		
Intercept	0.009*	0.008*	0.004	0.003	0.008*	0.007	0.006
	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.004)	(0.004)
$TBI - Rf$		0.155		0.079			
		(0.084)		(0.079)			
$R_{mkt} - Rf$	0.291***	0.285***	0.319***	0.316***		0.042	0.039
	(0.073)	(0.072)	(0.040)	(0.046)		(0.056)	(0.069)
SMB			0.354***	0.348***			0.081
			(0.052)	(0.048)			(0.091)
HML			0.426***	0.421***			0.061
			(0.059)	(0.059)			(0.054)
Avg. Recession	-0.007	-0.005	-0.002	-0.002	-0.013*	-0.011	-0.011
	(0.003)	(0.004)	(0.002)	(0.002)	(0.005)	(0.006)	(0.006)
Avg. Housing	0.004	0.002	0.000	-0.001	0.012*	0.012*	0.011*
	(0.004)	(0.003)	(0.003)	(0.002)	(0.005)	(0.006)	(0.005)
Avg. Inflation	-0.002	-0.002	0.002	0.002	0.003	0.003	0.003
	(0.003)	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)
Avg. IR	0.011***	0.011***	0.004*	0.004**	0.001	0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.003)	(0.003)	(0.003)
N	108	108	108	108	108	108	108
Adj. R^2	40.0%	38.2%	71.1%	71.3%	16.1%	15.8%	15.3%

Table 1.6: OLS regressions of the TBI excess return on the lagged REIT excess return and lags of the 4 simple macroeconomic factors. The macroeconomic factors are simply the equal weighted means of the variables with the highest loadings in figure 1.3, 1.4, 1.5, and 1.6 denoted the average recession factor (Avg. Recession), the average housing and credit factor (Avg. Housing), the average inflation factor (Avg. Inflation), and the average interest rate factor (Avg. IR). Newey and West [1987] standard errors are shown in parentheses. *** denotes significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

	Dependent variable TBI excess return			
Intercept	0.007	0.005	0.005	0.005
	(0.004)	(0.003)	(0.005)	(0.005)
$R^{mkt}_{t-1} - Rf_{t-1}$	0.135	0.213*	0.260***	0.235*
	(0.079)	(0.099)	(0.064)	(0.118)
Avg. $Recession_t$	-0.005			
	(0.006)			
Avg. $Recession_{t-1}$	-0.01			
	(0.008)			
Avg. $Recession_{t-2}$	-0.009			
	(0.006)			
Avg. $Recession_{t-3}$	0.006			
	(0.007)			
Avg. $Recession_{t-4}$	-0.003			
	(0.004)			
Avg. $Housing_t$		-0.005		
		(0.020)		
Avg. $Housing_{t-1}$		0.004		
		(0.023)		
Avg. $Housing_{t-2}$		0.018		
		(0.025)		
Avg. $Housing_{t-3}$		0.031		
		(0.023)		
Avg. $Housing_{t-4}$		-0.034		
		(0.019)		
Avg. $Inflation_t$			0.009*	
			(0.004)	
Avg. $Inflation_{t-1}$			0.001	
			(0.005)	
Avg. $Inflation_{t-2}$			0.005	
			(0.005)	
Avg. $Inflation_{t-3}$			0.001	
			(0.008)	
Avg. $Inflation_{t-4}$			0.004	
			(0.005)	
Avg. IR_t				-0.005
				(0.005)
Avg. IR_{t-1}				0.000
				(0.007)
Avg. IR_{t-2}				-0.003
				(0.007)
Avg. IR_{t-3}				0.005
				(0.007)
Avg. IR_{t-4}				0.007
				(0.005)
N	104	104	104	104
Adj. R^2	17.7%	13.6%	6.0%	6.0%

1.9 Asymptotic Principal Components

The method of asymptotic principal components is a quasi-MLE method, meaning that the estimators are proven under strict assumptions, but consistency is proved under weaker nonparametric assumptions. Here I just derive the factors and factor loadings. For more on the consistency of the estimated factors see Stock and Watson [2002a] and Bai and Ng [2006].

Under the assumptions that ϵ_t in

$$X_t = \Lambda F_t + \epsilon_t,$$

is iid. as $N(0, \sigma_\epsilon^2)$ (both independent in the time series and the cross-sectional dimension), where X_t is the $p \times 1$ vector of variables at time t, Λ is the $p \times q$ matrix of factor loadings, and the stacked factors, F, is a $T \times q$ dimensional unknown nonrandom parameter to be estimated, the maximum likelihood estimator of (Λ, F_t) for a given number of factors, k, solves the following nonlinear least squares problem

$$\min_{F^k, \Lambda^k} V(F^k, \Lambda^k) = \frac{\sum_{i=1}^{p} \sum_{t=1}^{T} \left(X_{i,t} - \Lambda_i^k F_t^k\right)^2}{pT}. \tag{1.7}$$

Here the superscript, k, represents the number of factors in the estimation, such that $\hat{F}^k$ is a $T \times k$ matrix of estimated factors. The first order conditions leads to the following expression for the minimizers of equation (1.7), $(\hat{F}^k, \hat{\Lambda}^k)$,

$$\hat{\Lambda}_i^{k\intercal} = \left(\sum_{t=1}^{T} \hat{F}_t^k X_{i,t}\right) \left(\sum_{t=1}^{T} \hat{F}_t^k \hat{F}_t^{k\intercal}\right)^{-1} \tag{1.8}$$

$$\hat{F}_t^k = \left(\sum_{t=1}^{T} \hat{\Lambda}^{k\intercal} X_{i,t}\right) \left(\sum_{t=1}^{T} \hat{\Lambda}^{k\intercal} \hat{\Lambda}^k\right)^{-1}. \tag{1.9}$$

One solution is obtained by imposing the restriction $\Lambda^{k\intercal}\Lambda^k/p = I_k$ and substituting equation (1.9) into equation (1.7), and then minimizing with respect to Λ^k. The objective function is minimized at $\hat{\Lambda}^k$ equal to $\sqrt{p}$ times the eigenvectors corresponding to the k largest eigenvalues of the $p \times p$ matrix $X'X$. The normalization implies that $\hat{F}^k = X\hat{\Lambda}^k/p$.

Another solution is obtained by instead assuming that $F^{k\intercal}F^k/T = I_k$, and then substituting equation (1.8) into (1.7), and then minimizing with respect to F^k. This illustrates the rotational indeterminacy of factor models.

Bai and Ng [2002] propose three information criteria for determining the number of underlying factors, and show that the number of underlying factors can be consistently estimated by all three criteria. The three criteria are

$$
\begin{aligned}
IC1(k) &= \ln(V(k, \hat{F}^k)) + k\left(\frac{p+T}{pT}\right)\ln\left(\frac{pT}{p+T}\right) \\
IC2(k) &= \ln(V(k, \hat{F}^k)) + k\left(\frac{p+T}{pT}\right)\ln C_{pT}^2 \\
IC3(k) &= \ln(V(k, \hat{F}^k)) + k\left(\frac{\ln C_{pT}^2}{C_{pT}^2}\right),
\end{aligned}
$$

where $C_{pT}^2 = \min\{p, T\}$ and

$$
V(k, \hat{F}^k) = \frac{\sum_{i=1}^p \sigma_i^2}{p} = \frac{\sum_{i=1}^p \hat{e}_i'\hat{e}_i/T}{p},
$$

where $\hat{e}_i$ are the i'th estimated residuals.

The information criteria are calculated for $k = 1, \ldots, kmax$ underlying factors. The number of factors yielding the lowest information criteria corresponds to the estimate of the number of underlying factors.

1.10 Macroeconomic Variables

The 122 variables used in this paper are listed below. Data was collected from the St. Louis Federal Reserve Bank FRED database. In the tables below "SA" means that the time series is seasonally adjusted, "ln" means that the natural logarithm was taken to induce stationarity, ei. $ln(X_{i,t})$, "lvl" means that no transformation was performed, "Δlvl" means "difference in levels", ei. $X_{i,t} - X_{i,t-1}$, and "Δln" means "difference in logs", ei. $ln(X_{i,t}) - ln(X_{i,t-1})$.

Output and Income	
Δln	Personal Income, SA
Δln	Disposable Personal Income, SA
Δln	Personal Income Excluding Current Transfer Receipts, SA
Δln	Gross Domestic Product, SA
Δln	Industrial Production Index - Total Index, SA
Δln	Industrial Production Index - Durable Manufacturing, SA
Δln	Industrial Production Index - Final Products, SA
Δln	Industrial Production Index - Consumer Goods, SA
Δln	Industrial Production Index - Durable Consumer Goods, SA
Δln	Industrial Production Index - Nondurable Consumer Goods, SA
Δln	Industrial Production Index - Business Equipment, SA
Δln	Industrial Production Index - Materials, SA
Δln	Industrial Production Index - Durable Goods Materials, SA
Δln	Industrial Production Index - Nondurable Goods Materials, SA
Δln	Industrial Production Index - Manufacturing, SA
lvl	NAPM Production Index, SA
lvl	Capacity Utilization, SA

Employment, Hours, and Earnings	
Δln	Civilian Labor Force, SA
Δln	Civilian Employment, SA
Δlvl	Unemployed, SA
Δlvl	Average Duration of Unemployment, SA
Δln	Civilians Unemployed - Less than 5 weeks, SA
Δln	Civilians Unemployed - 5-14 weeks, SA
Δln	Civilians Unemployed - 15 weeks and over, SA
Δln	Civilians Unemployed - 15-26 weeks, SA
Δln	Civilians Unemployed - 27 weeks and over, SA
Δln	All Employees: Total Nonfarm, SA
Δln	All Employees: Total Private Industries, SA
Δln	All Employees: Goods-Producing Industries, SA
Δln	All Employees: Mining and Logging, SA
Δln	All Employees: Construction, SA
Δln	All Employees: Manufacturing, SA
Δln	All Employees: Durable Goods, SA
Δln	All Employees: Nondurable Goods, SA
Δln	All Employees: Service-Providing Industries, SA
Δln	All Employees: Trade, Transportation and Utilities, SA
Δln	All Employees: Wholesale Trade, SA
Δln	All Employees: Retail Trade, SA
Δln	All Employees: Financial Activities, SA
Δln	All Employees: Government, SA
Δln	All Employees: Information Services, SA
Δln	All Employees: Professional and Business Services, SA
lvl	Average Weekly Hours of Production and Nonsupervisory Employees: Goods
Δlvl	Average Weekly Hours of Production and Nonsupervisory Employees: Construction
lvl	NAPM Employment Index, SA
Δln	Average Hourly Earnings of Production and Nonsupervisory Employees: Goods
Δln	Average Hourly Earnings of Production and Nonsupervisory Employees: Construction
Δln	Average Hourly Earnings of Production and Nonsupervisory Employees: Manufacturing
Δln	Average Hourly Earnings of Production and Nonsupervisory Employees: Total Private

Housing	
ln	Housing Starts Total: New Privately Owned Housing Units Started, SA
ln	Housing Starts in Midwest Census Region, SA
ln	Housing Starts in Northeast Census Region, SA
ln	Housing Starts in South Census Region, SA
ln	Housing Starts in West Census Region, SA
ln	New One Family Houses Sold: United States, SA
ln	New Private Housing Units Authorized by Building Permits, SA
ln	New Privately-Owned Housing Units Under Construction, SA
ln	New Homes Sold in the United States
lvl	Median Number of Months on Sales Market
lvl	Ratio of Houses for Sale to Houses Sold, SA

Consumption, Orders, and Inventories	
lvl	Purchasing Managers' Index, SA
lvl	New Orders Index, SA
lvl	Supplier Deliveries Index, SA
lvl	Inventories Index, SA
Δln	Personal Consumption Expenditures, SA

Money and Credit	
Δln	Commercial and Industrial Loans at All Commercial Banks, SA
Δln	Consumer (Individual) Loans at All Commercial Banks, SA
Δln	Currency Component of M1, SA
Δln	M1 Money Stock, SA
Δln	M2 Money Stock, SA
Δln	Real Estate Loans at All Commercial Banks, SA
lvl	Personal Savings Rate, SA
Δln	Total Consumer Credit Outstanding, SA
Δln	Home Mortgages - Liabilities - Balance Sheet of Households and Nonprofit Organisations
Δln	Household Sector: Liabilities: Household Credit Market Debt Outstanding, SA
Δln	Debt Outstanding Domestic Nonfinancial Sectors - Household, Consumer Credit Sector, SA
Δln	Debt Outstanding Domestic Nonfinancial Sectors - Household, Home Mortgage Sector, SA
Δln	Owners' Equity in Household Real Estate - Net Worth - Balance Sheet of Households and Nonprofit Organizations
Δln	Real Estate - Assets - Balance Sheet of Households and Nonprofit Organizations

Bond and Exchange Rates	
Δlvl	Interest Rate: Federal Funds Rate
Δlvl	Interest Rate: US Treasury Bills, Sec. Mkt., 1m
Δlvl	Interest Rate: US Treasury Bills, Sec. Mkt., 3m
Δlvl	Interest Rate: US Treasury Bills, Sec. Mkt., 6m
Δlvl	Interest Rate: US Treasury Const. Mat., 1y
Δlvl	Interest Rate: US Treasury Const. Mat., 3y
Δlvl	Interest Rate: US Treasury Const. Mat., 5y
Δlvl	Interest Rate: US Treasury Const. Mat., 7y
Δlvl	Interest Rate: US Treasury Const. Mat., 10y
Δlvl	Interest Rate: 30y Conventional Mortgage Rate
Δlvl	Bond Yield: Moody's AAA Corporate
Δlvl	Bond Yield: Moody's BBB Corporate
lvl	Spread: 3m - Federal Funds Rate
lvl	Spread: 6m - Federal Funds Rate
lvl	Spread: 1y - Federal Funds Rate
lvl	Spread: 3y - Federal Funds Rate
lvl	Spread: 5y - Federal Funds Rate
lvl	Spread: 7y - Federal Funds Rate
lvl	Spread: 10y - Federal Funds Rate
lvl	Spread: AAA - Federal Funds Rate
lvl	Spread: BAA - Federal Funds Rate
lvl	Spread: BAA - AAA
Δln	Foreign Exchange Rate: Canadian Dollars to One US Dollar
Δln	Foreign Exchange Rate: Japanese Yen to One US Dollar
Δln	Foreign Exchange Rate: US Dollars to One British Pound
Δln	Foreign Exchange Rate: Swiss Francs to One US Dollar

Prices	
Δln	Producer Price Index: Crude Materials for Further Processing, SA
Δln	Producer Price Index: Finished Consumer Foods, SA
Δln	Producer Price Index: Finished Goods, SA
Δln	Producer Price Index: Intermediate Materials: Supplies and Components, SA
Δln	CPI-U: All Items, SA
Δln	CPI-U: Housing, SA
Δln	CPI-U: Transportation, SA
Δln	CPI-U: Commodities, SA
Δln	CPI-U: Durables, SA
Δln	CPI-U: Nondurables, SA
Δln	CPI-U: All Items Less Food, SA
Δln	CPI-U: All Items Less Shelter, SA
Δln	Spot Oil Price: West Texas Intermediate, SA
Δln	Personal Consumption Expenditures: Chain-type Price Index, SA
Δln	Gross Domestic Product: Implicit Price Deflator, SA

Stock Market	
Δln	S&P Composite Index Level
Δln	Dow Jones Industrial Average

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Essay 2

Testing the Effect of Taxes and Free Cash Flow Problems on Capital Structure: Evidence from REITs[1]

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Abstract

Utilizing the fact that Real Estate Investment Trusts (REITs) are effectively tax exempt and have to pay out at least 90% of their taxable income as dividends, I show that even in the absence of tax advantages of debt and free cash flow agency problems, firms ***still*** adjust their capital structure towards a dynamic target leverage ratio as predicted by the Trade-off theory. Furthermore, REITs on average tend to have higher leverage ratios than similar real estate firms without the REIT status. This suggests that firms have other benefits of debt than the tax advantage and mitigation of free cash flow agency problems.

2.1 Introduction

In this article I examine the effect of the tax advantage of debt and the mitigating effect of debt on free cash flow agency problems on firm capital structure choices. Specifically, I examine how the two effects affect the level of leverage and the tendency of firms to have dynamic target leverage ratios that they revert to as predicted by the dynamic Trade-off theory. I do this by comparing publicly listed real estate investment trust (REITs) to regular listed real estate companies without the REIT status (non-REITs). REITs are effectively tax exempt and not prone to free cash flow agency problems, because they are required to pay out at least 90% of the taxable income as dividends and can deduct their dividends from their taxable income. The only differences between the two groups of companies are the tax exemption and the 90% payout requirement. By examining the level of leverage and testing the target adjustment behaviour of these two groups of firms, I am able to identify the effect of taxes and free cash flow agency problems.

I find that REITs on average have higher leverage ratios than similar non-REITs, and they ***still*** adjust their capital structure towards a dynamic target leverage ratio. This suggests that firms have other benefits of debt than the tax advantage and mitigation of free cash flow agency problems. The results are robust to all the modifications in Hovakimian and Li [2011] (meant to reduce the potential bias in partial adjustment tests), to using both book and market leverage, to using different estimation methodologies, to excluding industrial firms[2], and to using a subsample from 1992 to 2011.

Real Estate Investment Trusts (REITs) can deduct their dividends from their taxable income, and since most REITs payout 100% of their taxable income as dividends, they are effectively exempt from paying corporate income tax. Furthermore, REITs are required to pay out at least 90% of their taxable income as dividends, and are therefore less prone to free cash flow agency problems than other firms.

Thus, two of the most noted arguments for issuing debt in the Trade-off theory, the tax advantage of interest payments and the reduction of free cash flow agency problems, are basically not relevant for REITs. REITs do, however,

[2] The group of industrial firms are defined as firms in the CRSP/Compustat Merged database not being utility companies (SIC codes 4900-4999), financial firms (SIC codes 6000-6999), REITs, limited partnerships, nor companies with real estate SIC or NAICS codes. For more on the data definitions see section 3.4.

issue debt, and thus propose an interesting setup for testing the predictions of the Trade-off theory. Basically, the idea of this article is; if taxes and free cash flow problems are the main benefits in the Trade-off theory, REITs should act less in line with the Trade-off theory than other real estate firms without the REIT status. Or at least they should have a lower target leverage level than other real estate firms without the REIT status.

I employ a target adjustment model of the type in Fama and French [2002] and Flannery and Rangan [2006] to test the central prediction of the Trade-off model that firms have target leverage levels that they revert to. I incorporate the firm type of REIT or non-REIT to estimate the effect of taxes and free cash flow agency problems on capital structure choices. I also include industrial firms to examine whether a real estate industry effect affects the results.

The rest of the paper is organized as follows. Section 3.2 reviews related literature, section 2.3 shortly presents the main predictions the Trade-off theory, and states the empirical framework which is used to test the predictions. Section 3.4 presents the data and summary statistics. Section 3.6 presents the results and section 3.7 concludes.

2.2 Related Literature

Since the seminal work of Modigliani and Miller [1958] much research have dealt with the capital structure of companies both from a theoretical and empirical perspective. One of the most prominent theories of capital structure is the Trade-off theory (see e.g. Fischer et al. [1989], Leland [1994], Leland and Toft [1996]). This paper is not the first to test the predictions of the Trade-off theory. Some of the most notable studies testing the implications of the Trade-off theory are Fischer et al. [1989], Shyam-Sunder and Myers [1999], Fama and French [2002], Welch [2004], Leary and Roberts [2005], and Flannery and Rangan [2006]. The results vary substantially. In the one end Welch [2004] finds that companies do not dynamically re-balance their capital structure to offset changes in the market value of equity even over long periods. Similarly, Shyam-Sunder and Myers [1999] finds little evidence of target adjustment behaviour of firms and shows that the target adjustment tests often applied in testing implications of the Trade-off theory, suffer from low statistical power. Fama and French [2002] find some evidence in favor of the Trade-off theory, and Leary and Roberts [2005] find that firms do dynamically re-balance their capital structure towards a target range. At the other end, Flannery and Rangan [2006] find not only that firms have a target capital structure, but also that the rate at which they revert to the target, is as much as one third per year.

Graham and Harvey [2001] survey 392 CFOs about capital structure and capital budgeting, and they find some support for the Trade-off theory. By simulating company specific marginal tax rates Graham [1996] find that firms with high marginal tax rates employ more debt than firms with low marginal tax rates. However, Graham [2000] estimate that firms could double the tax benefit from debt by issuing more debt, indicating that the tax advantage of debt is not the primary reason for using debt.

A few other papers have utilized REITs and other corporate tax exempt entities in estimating the effect of the tax advantage of debt on the capital structure. However, no other papers have examined the validity of the Trade-off theory in the absence of tax advantages of corporate debt. Barclay et al. [2012] utilizes the corporate tax exempt status of REITs to estimate the degree of leverage due to the tax advantages of debt by comparing the leverage to that of similar industrial companies. They find at most a tax effect on leverage of 5%. Nevertheless, they pool REITs and limited partnerships which are also tax exempt but have no pay-out restriction. They, hence, confound the tax benefit and the reduction of free cash flow agency problems. Gentry [1994] find that corporate tax exempt Public Traded Partnerships (PTPs) in the real estate and oil and gas industries have 30% lower leverage ratio than regular corporations. However, Gentry [1994] fail to control for industry effects that might affect the capital structure.

The current study differs from the these studies by testing the effect of the tax advantages of debt and free cash flow agency problems on the amount of leverage *and* the prediction of the Trade-off theory that firms have target leverage ratios that they revert to.

2.3 Empirical Strategy

The overall empirical strategy is to use REITs as the treatment group, with the treatment being tax exemption and the 90% dividend payout requirement. The non-REIT real estate firms will be the control group, being tax liable and having no payout requirement. By comparing these two groups I will estimate the effect of corporate taxes and free cash agency problems on firm capital structure. As an extra control, and to pick up any real estate industry effects, I add regular industrial firms not related to real estate.

2.3.1 The Partial Adjustment Test

Since firms can deduct their interest payments from their taxable income, there is a tax advantage of financing companies with debt compared to equity. Furthermore, Jensen [1986] argues that managers of companies with large free cash flows, might initiate projects yielding private benefits to the manager, but that are not in the best interest of the owners. Jensen [1986] suggests that the issuance of debt instead of equity oblige managers to pay out future free cash flows more effectively than promises of future dividends. Financing investments with debt instead of equity thus reduces the agency costs of free cash flows. However, employing high levels of leverage also increases the risk of bankruptcy, which is costly. The bankruptcy costs include both direct costs, such as salaries to lawyers etc., and indirect costs such as customers and subcontractors refusing to do business with firms close to bankruptcy, since they risk not receiving goods or payments in the case of bankruptcy.

To illustrate the tax advantage of debt for the end-investor, consider the following small example. Let earnings before interest and taxes at time t be defined as ξ_t. Then, for the tax liable (non-REIT) firm, the cash flow available for the equity and debt investor (assuming no retained earnings) equals

$$\begin{aligned} E: &\quad (1-\tau_d)\left[(1-\tau_c)\left[\xi_t - c_t\right]\right] \\ E: &\quad (1-\tau_e)\xi_t - (1-\tau_e)c_t \\ D: &\quad (1-\tau_i)c_t. \end{aligned}$$

In total this becomes

$$(1-\tau_e)\xi_t + (\tau_e - \tau_i)c_t$$

where c_t is the interest payment to debt at time t, τ_d is the taxation of dividend, τ_c is the corporate tax rate, τ_i is the tax rate applicable for interest income, and $(1-\tau_e) = (1-\tau_d)(1-\tau_c)$. Thus, as long as τ_e is bigger than τ_i, there is a tax advantage of debt financing of $(\tau_e - \tau_i)c_t$. If dividends are taxed at the same rate as interest income, this will always be the case.

For the corporate tax-exempt company (REIT) $\tau_c = 0$, and the above collapses to

$$(1-\tau_d)\xi_t + (\tau_d - \tau_i)c_t.$$

Thus, as long as dividends and interest income are taxed alike, there is no tax advantage of debt. If dividends are taxed at a higher rate, there will still be a tax advantage of debt, and if dividends are taxes at a lower rate than interest income there will even be a tax *disadvantage* of debt. Whether REITs have a tax advantage or not, hence, depends on tax regime of the end-investor.

Under the current US tax law, (most) dividends qualify to be taxed as long term capital gains as long as the investor has held the stock for more than 60 days during the 121-day period that begins 60 days before the ex-dividend date[3]. Interest income from corporate bonds are, however, taxed as ordinary income. Since the long term capital gains tax rate is lower than ordinary income tax rate, there is actually a tax disadvantage of debt for REITs for the US end-investor.

In the Trade-off theory, firms trade off the previously mentioned advantages and disadvantages of debt, and thus have a possibly time-varying optimal leverage ratio. This notion is often tested through variation of the following target adjustment model (see for example Fama and French [2002] or Flannery and Rangan [2006]):

$$LR_t - LR_{t-1} = \alpha_0 + \alpha_1 (TL_t - LR_{t-1}) + \varepsilon_t, \tag{2.1}$$

where LR_t is the current observed leverage ratio, TL_t is the current target leverage ratio, and ε_t is the residual. Firm subscripts have been suppressed. α_1 determines the speed of adjustment towards the target leverage ratio, TL_t.

[3] See the United States Internal Revenue Code for the specific requirements for qualified dividends.

In the extreme case of full adjustment in each period, α_0 is 0 and α_1 equals 1. The leverage ratios are either defined in terms of book or market values, and I will examine the target adjustment behaviour of both book and market leverage ratios. That is, I will define LR_t as both $\frac{L_t}{A_t}$ and $\frac{L_t}{V_t}$, where L_t is the total value of debt at the end of the fiscal year t, A_t is the total book value of assets, and V_t is the total market value of assets. The precise variable definitions are in appendix 2.8. The target leverage ratio is, however, unobserved, and thus have to be estimated. TL_t in equation (2.1) is often defined as the fitted values from the following regression:

$$TL_t = \beta X_{t-1} \tag{2.2}$$

where X_{t-1} contains lagged variables relevant for explaining the observed leverage level, such as firm size, asset tangibility, market-to-book, and research and development (R&D) expenses. The target leverage ratio is thus allowed to be time-varying. Substituting βX_{t-1} from equation (2.2) for TL_t in equation (2.1) yields

$$LR_t = \alpha_0 + \alpha_1 \beta X_{t-1} + (1 - \alpha_1) LR_{t-1} + \varepsilon_t. \tag{2.3}$$

Equation (2.3) can be estimated in one step. To isolate the effect of the tax advantage of debt and free cash flow agency problems on the target adjustment behaviour of firm leverage ratios, I interact the lagged leverage ratio, LR_{t-1}, in equation (2.3) with a dummy variable equalling 1 if the firm type is REIT and 0 otherwise. To control for industry effects, I also interact the lagged leverage ratio, LR_{t-1}, with a dummy variable equalling 1 if the firm group is industrial and 0 otherwise (neither REIT nor non-REIT real estate firm). The base group is thus the non-REIT real estate companies. The equation becomes

$$\begin{aligned} LR_t = \alpha_0 + \alpha_1 \beta X_{t-1} + \alpha_{base} LR_{t-1} + \alpha_{REIT} LR_{t-1} \cdot 1_{REIT} \\ + \alpha_{Industrial} LR_{t-1} \cdot 1_{Industrial} + \varepsilon_t, \end{aligned} \tag{2.4}$$

so that the estimate of the the speed of target adjustment for non-REITs, REITs, and industrial firms thus becomes:

$$Adj_{non-REIT} = 1 - \alpha_{base} \tag{2.5}$$

$$Adj_{REIT} = 1 - (\alpha_{base} + \alpha_{REIT}) \tag{2.6}$$

$$Adj_{Industrial} = 1 - (\alpha_{base} + \alpha_{Industrial}). \tag{2.7}$$

If observed leverage ratios exhibit mean reversion not related to target adjustment, then the estimate of α_1 in both equation (2.1), (2.3), and 2.4 might be positive even when companies do not have target leverage ratios. Chang and Dasgupta [2009] argue that since leverage ratios are limited between 0 and 1, leverage ratios close to either 0 or 1 will exhibit mechanical mean reversion. Furthermore, Shyam-Sunder and Myers [1999] argue that leverage ratios may be mean reverting due to positively serially correlated capital investments and cyclical cash flows. Hovakimian and Li [2011] suggest allowing for different coefficients for the target leverage ratio and the lagged observed leverage ratio in equation (2.1) to deal with the mean reversion bias:

$$LR_t - LR_{t-1} = \alpha_0 + \alpha_1 TL_t + \alpha_2 LR_{t-1} + \varepsilon_t \tag{2.8}$$

This specification, however, excludes the possibility for a one-step estimation, since a_1 and a_2 differ. Instead the target leverage ratio will be estimated as the fitted values from the following regression

$$TL_t = \beta X_{t-1} + \epsilon_t \tag{2.9}$$

Similar to the 1-step methodology, I interact the target leverage ratio in equation (2.8) with a dummy variable that equals 1 if the firm is a REIT real estate company and 0 otherwise, to identify the effect of tax advantages of debt and free cash flow agency costs on the adjustment towards a target leverage ratio. I also add a term where I interact the target leverage ratio with a dummy variable that equals 1 if the firm is an industrial firm (neither REIT nor a non-REIT real estate company) to pick up any potential real estate industry effect. The non-REIT real estate firms hence serve as the base group in the regression. Equation

(2.8) thus becomes

$$LR_t - LR_{t-1} = \alpha_0 + \alpha_1 TL_t + \alpha_2 TL_t \cdot 1_{REIT} + \alpha_3 TL_t \cdot 1_{Industrial} + \alpha_4 LR_{t-1} + \varepsilon_t. \quad (2.10)$$

I will use both the one-step specification in equation (2.4) and the two-step approach allowing for different coefficients in front of the target leverage and the lagged observed leverage in equation (2.10). I follow the previous literature (see e.g. Fama and French [2002] or Flannery and Rangan [2006]) in defining X_t. Substituting for X_{t-1} in equation 2.9 yields

$$LR_{ijt} = \beta_i + \beta_1 LR_{jt-1}^{IndustryMedian} + \beta_2 \frac{V_{it-1}}{A_{it-1}} + \beta_3 \frac{PPE_{it-1}}{A_{it-1}} + \beta_4 \frac{ET_{it-1}}{A_{it-1}} + \beta_5 \frac{Dp_{it-1}}{A_{it-1}} + \beta_6 \frac{RD_{it-1}}{A_{it-1}} + \beta_7 RDD_{it-1} + \beta_8 log(A_{it-1}) + \epsilon_{it}, \quad (2.11)$$

where i denotes the firms, t denotes time, and j indexes the industries. The variables have been shown to determine leverage ratios in previous studies (e.g. Fama and French [2002], Flannery and Rangan [2006], and Hovakimian and Li [2011]), and proxies for investment opportunities and profitability. $LR_{t-1}^{IndustryMedian}$ is the lagged median industry leverage ratio included to capture possible industry effects. The industry is classified according to the 49 industries in Fama and French [1997]. $\frac{PPE_{it-1}}{A_{it-1}}$ is property, plant and equipment to the book value of assets, and measures the tangibility of the firm's assets. $\frac{V_{t-1}}{A_{t-1}}$ is the market value of the firm's assets to the book value of assets. It is assumed to be a driver for expected investment opportunities, and profitability. $\frac{ET_{t-1}}{A_{t-1}}$ is the earnings before interest and taxes to the book value of assets, and is assumed to measure profitability. Dp_{t-1} is depreciation. $\frac{RD_{t-1}}{A_{t-1}}$ is the R&D expenditures to the book value of assets, and is a proxy for expected investment opportunities, since research and development investments generate future investments. Since many companies do not have research and development expenses, I include a dummy variable, RDD_{t-1}, indicating whether the firm had any R&D expenditures in the previous year. $log(A_{t-1})$ is the natural logarithm of the book value of assets, and is a measure of size.

Shyam-Sunder and Myers [1999] and Chang and Dasgupta [2009] show that the partial adjustment model of equation (2.8) can lead to significantly positive speed of adjustment parameters, even when the data is constructed not to exhibit target adjustment behaviour. And even though the specification in equation (2.10) deals with the mean reversion bias by allowing for different coefficients for the target leverage and the lagged leverage, estimating the target leverage (equation (2.11)) on the entire dataset will create look-ahead bias.

Some previous studies (e.g. Fama and French [2002]) have used the entire dataset to estimate the target leverage. Hovakimian and Li [2011] show that this can lead to an artificially high degree of target adjustment. They propose to only estimate the target adjustment data on past data. I follow their suggestion and estimate the target leverage from running a firm fixed effects estimation of equation (2.11) on past values.

Hovakimian and Li [2011] also suggest removing observed leverage ratios above 0.8 to reduce the effect of mechanical mean reversion without reducing the size of the dataset too much. Hovakimian and Li [2011] report that excluding leverage ratios above 0.8 only reduces their sample by 0.8%. As a robustness check, I also exclude leverage ratios above 80%. Hovakimian and Li [2011] show that these modifications can increase the statistical power of the partial adjustment test.

2.4 Data

I identify three groups of firms; publicly listed Real Estate Investment Trusts (REITs), publicly listed non-REIT real estate firms, and traditional publicly listed firms, which I dub industrial firms. The term 'REIT' is a real estate company label under U.S. Federal income tax law much similar to that of US mutual funds. The main advantage of the REIT status is to avoid double taxation. REITs are exempt from paying corporate tax if they pay out 100% of their taxable income as dividends. The main requirements to qualify as a REIT are that at least 75% of the company's assets are in real estate, that at least 75% of the income derive from real estate (e.g. real estate rents, interest on real estate mortgages, or from sales of real estate properties), and finally that the company pay out at least 90% of their taxable income as dividends. The REITs are identified in the CRSP Ziman REIT database and cash flow and balance sheet information are from the CRSP/Compustat Merged database.

The non-REIT real estate firms are used to examine the effect of corporate income taxes on capital structure, and the industrial firms are included to make the results comparable to previous studies.

The non-REITs are from the CRSP/Compustat Merged database, and identified as the companies with real estate SIC codes 6512-6519, or 7011 or NAICS codes 531120, 531110, 531190, or 721110, and not being REITs or limited partnerships, since these are also exempt from corporate taxation.[4] Data on industrial companies are from the CRSP/Compustat Merged database, and excludes utilities (SIC codes 4900-4999), financials (SIC codes 6000-6999), REITs, limited partnerships, and companies with real estate SIC or NAICS codes.

The sample covers 1980 to 2011. I define annual observations on the basis of fiscal years since firms use a variety of fiscal year-ends. I require firms to report fiscal year end stock price, end of fiscal year shares outstanding, total book value of asset, total long-term liabilities, depreciation and amortization, total income taxes, and dividends to common equity. The REIT group consist of 5305 firm year observations. The non-tax-exempt real estate group consists of 1194 firm year observations, and the industrial firm group consists of 132648 firm year observations. The data is unbalanced since companies are not required to exist over the entire sample period.

Table 4.2 presents the summary statistics for both REITs, non-REIT (tax-liable) real estate companies, and industrial firms. Comparing REITs and non-REITs, REITs on average tend to be a marginally bigger than their non-REIT counterparts with a mean market value of assets of 1,873 million USD as opposed to 1,777 million USD. However, the difference is not statistically significant. The REITs do have more debt than the non-REITs and this difference *is* statistically significant. The REITs also have a higher book leverage and market leverage than the non-REITs, and the differences are also statistically significant. This contradicts the Trade-off theory, since REITs - having no tax advantage of debt and being less prone to free cash flow agency problems - should have lower levels of leverage than similar non-REIT real estate firms. Industrial firms have on average a much lower leverage ratio than both REITs and non-REIT real estate companies. This applies both to market leverage and book leverage.

Payout ratio, defined as the cash dividends to the taxable income, is far

[4]The limited partnerships are excluded from this study, since they do not have the requirement of paying out at least 90% of their taxable income.

from symmetrically distributed. A lot of firms do not pay dividends and some pay very high dividends. The median payout ratio for the REITs are 1.093. This is possible for some real estate firms because of the properties they own exhibit high depreciation making their taxable income smaller than their free cash flow. The non-REITs on the other hand, have a median payout ratio of 0, as do the industrial firms. It is clear that the 90% payout requirement of REITs make them pay out much more dividends than the non-REITs and the industrial firms.

As seen from figure 2.1 both the median book and market leverage have been significantly higher for real estate firms than for industrial firms for the entire period. The median book leverage for the REITs is lower than for the non-REITs until 1992. After 1992 the relationship reverses, and REITs have higher median leverage than non-REITs. In the early 1990s the REIT market experienced a tremendous growth both in the number of REITs and in the total market capitalization. Most of the growth was due to initial public offerings of capital constrained private real estate firms sitting on highly levered properties following the overbuilding in the late 1980s. See Block [2011] or Chan et al. [2002] for more on the history of REITs. The median market leverage ratios for REITs and non-REITs are very similar during the entire period.

2.5 Results

2.5.1 The Partial Adjustment Test

Table 2.2 presents the results from the 1-step estimation of the partial adjustment regression model in equation (2.4) on both book leverage and market leverage. The regressions are estimated by both Fama and MacBeth [1973] type regressions (Fama-MacBeth), classic OLS, and OLS including firm fixed effects.

The determinants of target leverage vary a bit in the existing literature. Frank and Goyal [2009] examine the determinants of corporate leverage and find the median industry leverage to have a positive influence on the level of leverage, that more profitable firms (high ET_{t-1}/A_{t-1}) tend to have lower leverage than less profitable firms, that firms with a higher market-to-book value of assets (high V_{t-1}/A_{t-1}) tend to have a lower leverage than firms with low V_{t-1}/A_{t-1}, that companies with more tangible assets (high PPE_{t-1}/A_{t-1}) tend to have higher leverage than firms with less tangible assets, and that bigger firms on average have a higher degree of leverage than smaller firms.

The results in table 2.2 share their findings for the median industry leverage which is significantly positive in all the specifications. The firm size is also positively related to the level of leverage in the specifications where it is statistically significant. Both the tangibility of assets and the market-to-book value of assets reliably show the opposite signs from the findings of Frank and Goyal [2009], with high market-to-book firms tending to have more leverage, and firms with more tangible assets tending to have lower levels of leverage. Flannery and Rangan [2006] also employ the 1-step estimation method, and find the estimate for market-to-book value of assets to be close to 0 as in table 2.2. Similarly, they find that firms with higher depreciation and amortizations tend to have lower levels of leverage and that more research intensive firms tend to have higher levels of leverage both agreeing with most of the results in table 2.2.

The non-REIT real estate firms have a degree of target adjustment between 10% and 15%[5] a year for the Fama-MacBeth and OLS specifications, but as much 35% for the specification including firm fixed effects. Fama and French [2002] advocate using the Fama-Macbeth methodology to avoid understating standard errors due to cross-firm correlation and year-to-year correlation. The Fama-MacBeth methodology, however, ignores much of the time-series information available in the panel data. Flannery and Rangan [2006] argue that the firm fixed effects specification is more relevant when firms have relatively stable unobserved factors affecting leverage targets. While the choice of estimation methodology have significant impact on the degree of target adjustment for the base group (the non-REIT real estate firms), the interaction term between the lagged leverage ratio and the REIT dummy is not significant in all but one specification. This means that there is no significant difference between the target adjustment speed of REITs and the base group (the non-REIT real estate firms). The only exception is in the firm fixed effects estimation on book leverage. In this specification the REITs still adjust towards their target leverage ratio, with a degree of target adjustment of as much as 26.9% percent a year (1-(0.645+0.086)). The fact that REITs seem to have target leverage ratios that

[5]From equation (2.4) is seen that the degree of target adjustment for non-REITs is recovered from the results as $Adj_{non-REIT} = 1 - \alpha_{base}$, where α_{base} is the coefficient in front of the lagged leverage ratio.

they revert to in the same order of magnitude as similar tax-liable real estate firms more prone to free cash flow agency problems, indicates that neither the tax benefit of debt nor the mitigating effect of debt on free cash flow agency problems are the primary reasons why firms have target leverage ratios.

In some of the specifications industrial firms have a statistically significant higher degree of target adjustment, but economically the difference to the base group (the non-REIT real estate firms) is at most 4.8% percentage points a year. The last three columns, presenting the results where leverage ratios above 80% have been removed, only drops 160 and 581 observations from the book and market leverage regressions respectively, and the results are not different from including them. This is probably because the data is already trimmed at the top and bottom 0.5%.

The 1-step methodology could be affected by mean reversion bias described in section 2.3.1 stemming from mean reversion in the observed leverage ratios not related to firms having target leverage ratios. Employing the 2-step methodology, where the target leverage ratio is estimated in a 1st step as the fitted values from equation (2.11) and used as the target leverage in the 2nd step estimation of equation (2.10), is robust to the mean reversion bias, since the coefficient for the lagged observed leverage is allowed to differ from the coefficient for the target leverage.

In the 2-step methodology the target leverage is estimated as the fitted values from regressing equation (2.11) on past values only and including firm fixed effects. Hence, the dataset on which the target leverage is estimated increases for every year. The results of the last 1st-step regression (using data from 1980 till 2011) are shown in table 2.3.

Contrary to the results from the 1-step approach, the determinants of the target leverage all have the same signs as in Frank and Goyal [2009]. The reason why some of the 1-step results differ from the results in Frank and Goyal [2009] is probably because it included the lagged leverage, which is a strong determinant of current leverage. The specification in Frank and Goyal [2009] does not include the lagged leverage ratio. Again, excluding the leverage ratios above 80% does not change the results.

Figure 2.2 shows the time series of the median estimated target leverage for book and market values of leverage. As expected from the plots of the observed leverage in figure 2.1, both the REITs and the non-REIT real estate firms have similar target leverage ratios, whereas the industrial firms tend to have lower target leverage ratios.

The results from the 2nd step (the actual target adjustment test) in table 2.4 show lower levels of target adjustment for the base group (the non-REIT real estate firms) than the 1-step approach. The degree of target adjustment ranges from 7-22% per year. This indicates, as expected, that some of the target adjustment in the 1-step approach, is due to mean reversion in the observed leverage not related to firms having target leverage ratios.

The REITs still revert to a target leverage ratio, and in fact their degree of target adjustment is not different from the similar non-REIT real estate firms in any of the specifications. Along with the results from the 1-step approach, this again shows that neither the tax advantage of debt, nor the mitigating effect of debt on free cash flow agency problems, are the main reasons why companies have target leverage ratios, as is often mentioned as a motivation for the Trade-off theory.

Opposing the results of the 1-step approach, the industrial firms have a significantly lower degree of target adjustment than the real estate firms. The low levels of target adjustment are in line with the findings of Hovakimian and Li [2011] and Welch [2004]. The lower degree of target adjustment for industrial firms in the 2-step approach is probably more reliable than the results from the 1-step approach, since these are robust to mean reversion bias and, hence, have more statistical power.

Overall, the results show that when properly accounting for the biases in partial adjustment models, industrial firms show low degrees of target adjustment. Furthermore, the target adjustment behaviour is not driven by the tax advantage of debt nor the mitigating effect of debt on free cash flow agency problems, since REITs (not having the tax benefit of debt nor prone to free cash flow agency problems) have the same degree of target adjustment as similar non-REIT real estate firms.

Table 2.5 and 2.6 shows the one-step and the two-step target adjustment test excluding the industrial firms, to make sure that industrial firms are not driving the results. The results of the one-step approach in table 2.5 are similar to the results including the industrial firms in table 2.2. The REITs do not have different speeds of target adjustment than non-REITs in any of the six specifications except for the firm fixed effects specification on book leverage where REITs have 8.4% and 8.1% lower degree of target adjustment than non-REITs. However, in these specifications REITs still have speed of adjustment coefficients of 28.2% and 28.1% per year. This is a large degree of target adjustment considering that REITs lack the benefits of debt usually attributed to why firms have target leverage ratios. Generally, both non-REITs and REITs exhibit target adjustment behaviour in the order of approximately 8% to 35% a year depending on whether the specification includes firm fixed effects.

The results of the two-step approach in table 2.6 shows that the speed of target adjustment of REITs and non-REITs are not different in any of the six specifications for neither book nor market values of leverage. Both REITs and non-REITs exhibit target adjustment behaviour in the magnitude of approximately 5% to 13.5% a year in all the specifications except in the specifications estimated by the Fama and MacBeth [1973] methodology. In these cases the speed of adjustment is positive but statistically insignificant. Doing repeated cross sectional regressions and then averaging over time, as in the Fama and MacBeth [1973] methodology, dismisses much of the time series variation in the estimation. This is probably why the speed of adjustment is not statistically significant, since all other specifications are statistically bigger than 0.

To address the potential concern of using data both before and after the boom in REIT initial public offerings in the beginning of the 1990s, I redo the analysis on data from 1992 and onwards. As seen from the time series plot in figure 2.1, starting in 1992, the book leverage for REITs rises significantly. From 1992 and on REITs have higher median leverage than non-REITs.

The results of the one-step approach estimated on data from 1992 to 2011 are shown in table 2.7. In all the specifications there is no statistically significant difference between the speed of adjustment of REITs and the non-REITs. Both REITs and non-REITs have target adjustment in the order of approximately 11% to 40% per year, depending on the specification and book or market leverage.

The results from the second step in the two-step approach estimated on data from 1992 to 2011 are shown in table 2.8. The results are similar to using the entire dataset. Both REITs and non-REITs show significant degrees of target adjustment, and there is still no statistically significant difference between the speed of adjustment for REITs and non-REITs. Hence, the results are not bias by using data before and after the REIT IPO boom in the early 1990s.

Overall, I find that both REITs and non-REITs alike have optimal leverage ratios which they revert to. The speed at which they revert to their targets are not significantly different. And the results are robust to the modifications suggested in Hovakimian and Li [2011] to improve statistical power, definitions of book or market leverage, different estimation methodologies, to excluding industrial firms, and over a sub sample from 1992 to 2011. Together with the fact that REITs on average have a bit higher leverage than non-REITs - especially from 1992 and on - this indicates that the tax advantage of debt and the reduction of free cash flow agency problems are not the primary benefits of debt, since REITs are effectively tax exempt and are required to payout at least 90% of their taxable income as dividends. Furthermore I document that industrial firms on average employ less leverage and exhibit slower degrees of target adjustment in many of the specifications. This could indicate an asset related explanation of both the level of leverage and the target adjustment behaviour.

2.6 Conclusion

I have examined the effect of the tax advantage of debt and the mitigating effect of debt of free cash flow agency problems on the level of leverage and the tendency to follow a target adjustment behaviour, by comparing REITs to similar non-REIT real estate firms.

Firstly, I show that REITs on average do not have lower leverage levels than non-REIT real estate firms. Furthermore, I show that REITs and non-REIT real estate firms alike have target leverage ratios, and that their degrees of target adjustment are not significantly different. This suggests that firms have other benefits of debt than the tax advantage and mitigation of free cash flow agency problems that they trade off against the costs and thus display target adjustment behaviour.

The results are robust to the modifications suggested in Hovakimian and Li [2011] to improve statistical power, definitions of book or market leverage, different estimation methodologies, to excluding industrial firms, and over a sub sample from 1992 to 2011.

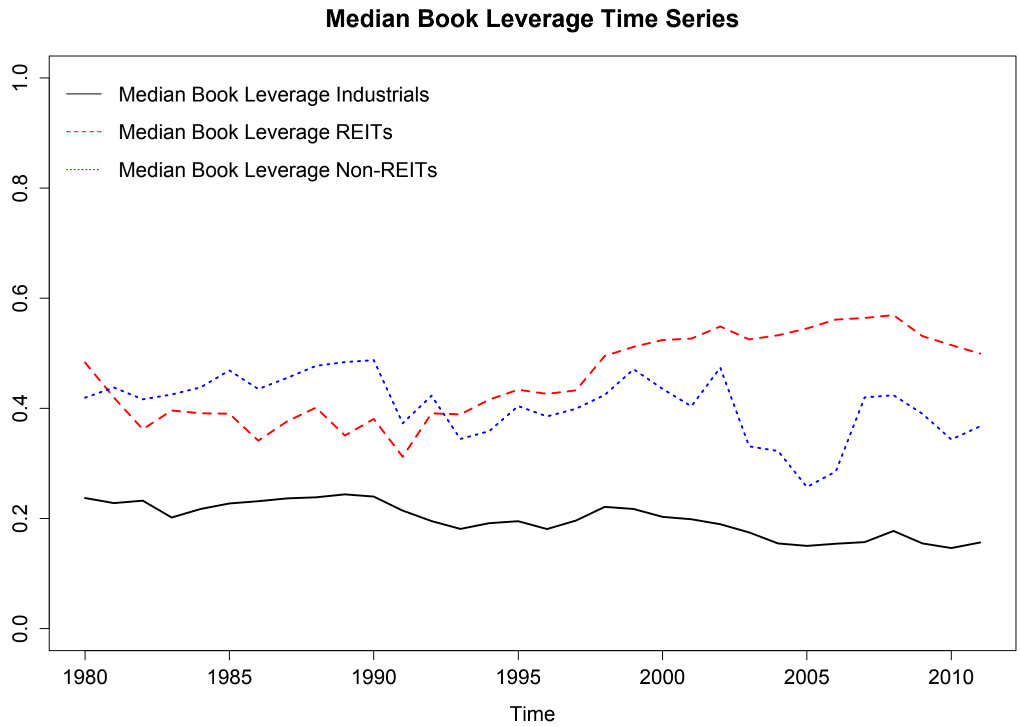
Finally, I document that the real estate industry is more levered than general industrial firms, and that they have a higher degree of target adjustment than industrial firms, which could indicate an industry or asset related benefit of debt.

2.7 Figures and Tables

Table 2.1: Summary Statistics. The sample includes all the REITs, non-REIT real estate firms, and industrial firms used in either the financing deficit test or the partial adjustment test. The dataset covers the years 1980 to 2011. Total debt is total assets minus book equity. Market capitalization is share price times shares outstanding. Book equity is total assets minus total liabilities + deferred taxes and investments tax credit minus the value of preferred stock. Market value is total liabilities minus deferred taxes and investments tax credit plus the value of preferred stock and market cap. Book value is total assets. Size is the natural log of total assets. Market leverage is total debt over market value. Book leverage is the total debt over book value. All values are in million USD.

REITs	Mean	Std. dev.	1st Qu.	Median	3rd Qu.
Total Debt	1010	3064	31	184	836
Book value of assets	1683	4201	89	396	1552
Market value of assets	1873	4579	86	451	1758
Book value of equity	541	1181	38	146	519
Market value of equity	790	1814	39	182	716
Size, $log(A)$	6.3	1.7	5.1	6.4	7.6
BookLeverage, $\frac{L}{A}$	0.462	0.247	0.312	0.480	0.628
MarketLeverage, $\frac{L}{V}$	0.432	0.249	0.264	0.430	0.604
Payout Ratio, DIV/Taxable Income	1.863	6.550	0.775	1.093	1.550
Non-REIT (tax-liable) real estate firms					
Total Debt	694	2685	10	70	387
Book value of assets	1581	5500	33	156	866
Market value of assets	1777	5563	34	152	996
Book value of equity	584	2218	10	38	307
Market value of equity	889	2380	14	57	431
Size, $log(A)$	5.6	2.1	4.0	5.6	7.1
BookLeverage, $\frac{L}{A}$	0.406	0.234	0.230	0.411	0.577
MarketLeverage, $\frac{L}{V}$	0.373	0.232	0.198	0.359	0.546
Payout Ratio, DIV/Taxable Income	0.832	7.654	0.000	0.000	0.168
Industrials					
Total Debt	612	5582	1	15	143
Book value of assets	2137	13404	26	115	610
Market value of assets	3186	18740	40	169	887
Book value of equity	893	5430	11	52	255
Market value of equity	2071	11978	22	104	572
Size, $log(A)$	5.3	2.2	3.7	5.2	6.8
BookLeverage, $\frac{L}{A}$	0.230	0.203	0.046	0.199	0.357
MarketLeverage, $\frac{L}{V}$	0.183	0.184	0.022	0.131	0.289
Payout Ratio, DIV/Taxable Income	0.229	3.563	0.000	0.000	0.164

Figure 2.1: Time series evolution the average book and market leverage for both REITs, Tax liable real estate firms, and industrial companies.



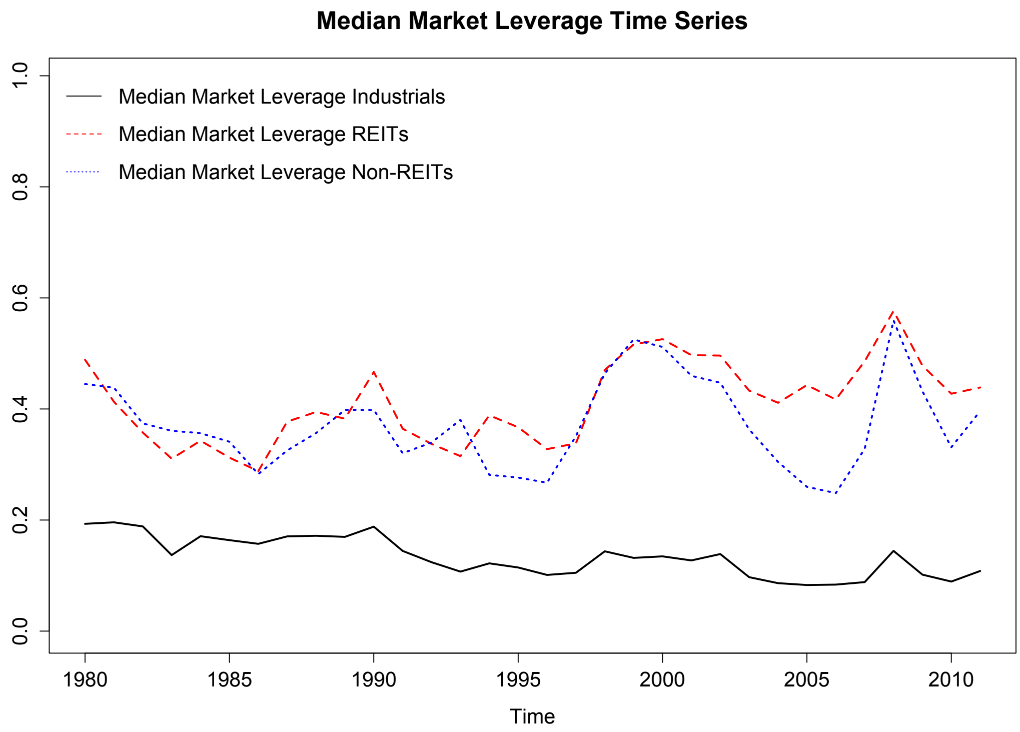


Table 2.2: Results of the one-step the estimation of the partial adjustment model in equation (2.4). The first part uses market leverage, that is the book value of debt divided by the sum of the book value of debt and the market value of assets. The second part uses book values, that is the book value of debt divided by the book values of both debt and assets. In each regression, the current leverage is regressed upon the determinants of leverage, the lagged leverage times a dummy variable equaling 1 if the firm is a REIT real estate firm, and the lagged leverage times a dummy variable equaling 1 if the firm is an industrial firm. The data is trimmed at the top and bottom 0.5%, and in the last three columns leverage ratios above 90% are also removed to avoid mechanical mean reversion. The regression are estimated by Fama and MacBeth [1973] type regressions (Fama-MacBeth), by pooled OLS (OLS), and by fixed effects (FE). Standard errors are shown in parentheses. *** denotes significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

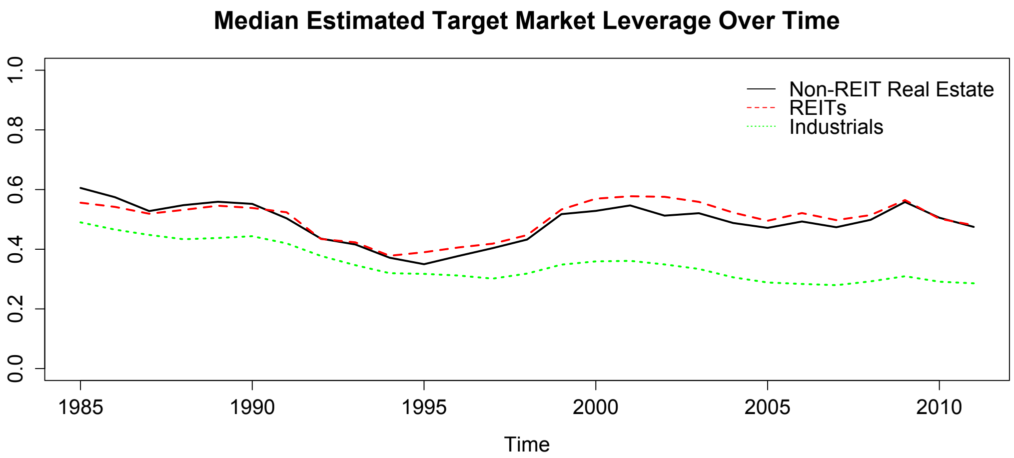
Market Leverage	All values			Leverage ratios above 80% excluded		
	Fama-MacBeth	OLS	FE	Fama-MacBeth	OLS	FE
Intercept	0.031***	0.036***		0.031***	0.037***	
	(0.004)	(0.001)		(0.004)	(0.001)	
$LR_{t-1}^{IndustryMedian}$	0.058***	0.043***	0.074***	0.059***	0.044***	0.074***
	(0.011)	(0.004)	(0.007)	(0.011)	(0.004)	(0.007)
V_{t-1}/A_{t-1}	0.000	0.001***	0.000**	0.000	0.001***	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PPE_{t-1}/A_{t-1}	-0.003	-0.003***	-0.007***	-0.003	-0.003***	-0.007***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
ET_{t-1}/A_{t-1}	-0.009**	-0.003*	-0.008***	-0.009**	-0.003*	-0.008***
	(0.003)	(0.001)	(0.002)	(0.003)	(0.001)	(0.002)
Dp_{t-1}/A_{t-1}	-0.031**	-0.039***	-0.036***	-0.033**	-0.039***	-0.035***
	(0.010)	(0.006)	(0.007)	(0.010)	(0.006)	(0.007)
RD_{t-1}/A_{t-1}	-0.04***	-0.025***	-0.001	-0.04***	-0.025***	-0.001
	(0.010)	(0.003)	(0.004)	(0.010)	(0.003)	(0.004)
RDD_{t-1}	-0.011***	-0.014***	-0.002	-0.011***	-0.014***	-0.002
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
$log(A_{t-1})$	0.001	0.000*	0.017***	0.001	0.000*	0.017***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\mathbf{LR_{t-1}}$	0.894***	0.893***	0.648***	0.891***	0.890***	0.645***
	(0.014)	(0.008)	(0.023)	(0.014)	(0.008)	(0.023)
$\mathbf{LR_{t-1} \cdot 1^{REIT}}$	-0.005	-0.003	0.031	-0.009	-0.007	0.014
	(0.014)	(0.009)	(0.026)	(0.014)	(0.009)	(0.027)
$\mathbf{LR_{t-1} \cdot 1^{Industrial}}$	-0.026*	-0.033***	-0.048*	-0.024*	-0.03***	-0.046*
	(0.010)	(0.008)	(0.023)	(0.011)	(0.008)	(0.023)
N	108923	108923	108923	108763	108763	108763
R^2	76.0%	74.4%	80.7%	75.7%	74.0%	80.4%

Book Leverage	All values			Leverage ratios above 80% excluded		
	Fama-MacBeth	OLS	FE	Fama-MacBeth	OLS	FE
Intercept	0.021*	0.034***		0.022*	0.034***	
	(0.008)	(0.001)		(0.008)	(0.001)	
$LR_{t-1}^{IndustryMedian}$	0.091***	0.086***	0.142***	0.093***	0.085***	0.142***
	(0.008)	(0.004)	(0.009)	(0.008)	(0.004)	(0.009)
V_{t-1}/A_{t-1}	0.011***	0.000	0.000**	0.010***	0.000	0.000**
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
PPE_{t-1}/A_{t-1}	-0.011***	-0.003***	-0.004**	-0.01***	-0.003***	-0.003*
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
ET_{t-1}/A_{t-1}	-0.025***	-0.021***	-0.022***	-0.024***	-0.02***	-0.021***
	(0.005)	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)
Dp_{t-1}/A_{t-1}	0.173**	-0.024**	-0.035***	0.154***	-0.026***	-0.037***
	(0.016)	(0.007)	(0.010)	(0.015)	(0.007)	(0.009)
RD_{t-1}/A_{t-1}	-0.058***	-0.041***	-0.026***	-0.06***	-0.041***	-0.025***
	(0.014)	(0.004)	(0.005)	(0.013)	(0.004)	(0.005)
RDD_{t-1}	-0.002***	-0.008***	-0.001	-0.002	-0.007***	-0.001
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
$log(A_{t-1})$	0.003**	0.000	0.009***	0.003**	0.000	0.009***
	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)
$\mathbf{LR_{t-1}}$	0.872***	0.877***	0.645***	0.857***	0.873***	0.648***
	(0.016)	(0.008)	(0.028)	(0.016)	(0.008)	(0.028)
$\mathbf{LR_{t-1} \cdot 1^{REIT}}$	-0.028	0.000	0.086**	-0.035	-0.004	0.083*
	(0.017)	(0.009)	(0.032)	(0.019)	(0.009)	(0.033)
$\mathbf{LR_{t-1} \cdot 1^{Industrial}}$	0.013	-0.028***	-0.045	0.014	-0.027***	-0.051
	(0.017)	(0.008)	(0.028)	(0.016)	(0.008)	(0.028)
N	108019	108019	108019	107438	107438	107438
R^2	61.3%	72.6%	79.4%	61.1%	72.4%	79.1%

Table 2.3: Results of the first stage of the estimation of the partial adjustment model in equation (2.11) - estimating the target leverage. The current leverage is regressed against the lagged market-to-book value of assets, V_{t-1}/A_{t-1}, the lagged median industry leverage ratio, $LR_{t-1}^{IndustryMedian}$, the lagged ratio of property, plant and equipment to the book value of assets, PPE_{t-1}/A_{t-1}, the lagged ratio of earnings before interest and taxes to book value of assets, ET_{t-1}/A_{t-1}, the lagged depreciation to book value of assets, Dp_{t-1}/A_{t-1}, the lagged R&D expenditures to book value of assets, RD_{t-1}/A_{t-1}, a lagged dummy variable indicating whether the firm had any R&D expenditures last year, and the lagged natural log of book value of assets, $log(A_{t-1})$. Equation (2.11) is estimated on past data only. The target leverage for 1982 is estimation on data from 1980 till 1982, the 1983 target leverage on data from 1980 till 1983 etc. The estimated coefficients change over time. Below the estimation from 1980 till 2011 is presented. The first part uses market leverage, that is the book value of debt divided by the sum of the book value of debt and the market value of assets. The second part uses book values, that is the book value of debt divided by the book values of both debt and assets. The data is trimmed at the top and bottom 0.5%. In the 3rd and 5th column leverage ratios above 90% are also trimmed to avoid mechanical mean reversion. *** denotes significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

	Market Leverage		**Book Leverage**	
	All values	Leverage ratios above 80% excluded	All values	Leverage ratios above 90% excluded
$LR_{t-1}^{IndustryMedian}$	0.472***	0.470***	0.488***	0.487***
	(0.008)	(0.008)	(0.011)	(0.011)
V_{t-1}/A_{t-1}	-0.004***	-0.004***	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
PPE_{t-1}/A_{t-1}	0.010***	0.010***	0.011***	0.011***
	(0.001)	(0.001)	(0.002)	(0.002)
ET_{t-1}/A_{t-1}	-0.064***	-0.064***	-0.069***	-0.068***
	(0.002)	(0.002)	(0.002)	(0.002)
Dp_{t-1}/A_{t-1}	0.005	0.006	0.078***	0.062***
	(0.008)	(0.008)	(0.011)	(0.011)
RD_{t-1}/A_{t-1}	-0.049***	-0.049***	-0.053***	-0.053***
	(0.005)	(0.005)	(0.006)	(0.006)
RDD_{t-1}	-0.007***	-0.007***	-0.005*	-0.005*
	(0.002)	(0.002)	(0.002)	(0.002)
$log(A_{t-1})$	0.041***	0.041***	0.032***	0.031***
	(0.001)	(0.001)	(0.001)	(0.001)
N	108923	108794	108229	107766
R^2	71.2%	70.9%	68.5%	68.3%

Figure 2.2: Time series evolution the estimated target market and book leverage for both REITs, Tax liable real estate firms, and industrial companies. The estimation is done on past values only. The 1983 target leverage is estimated on data from 1980 till 1983 and the 1984 target leverage is estimated on data from 1980 till 1984 etc. Thus, the coefficients determining the target leverage change over time.



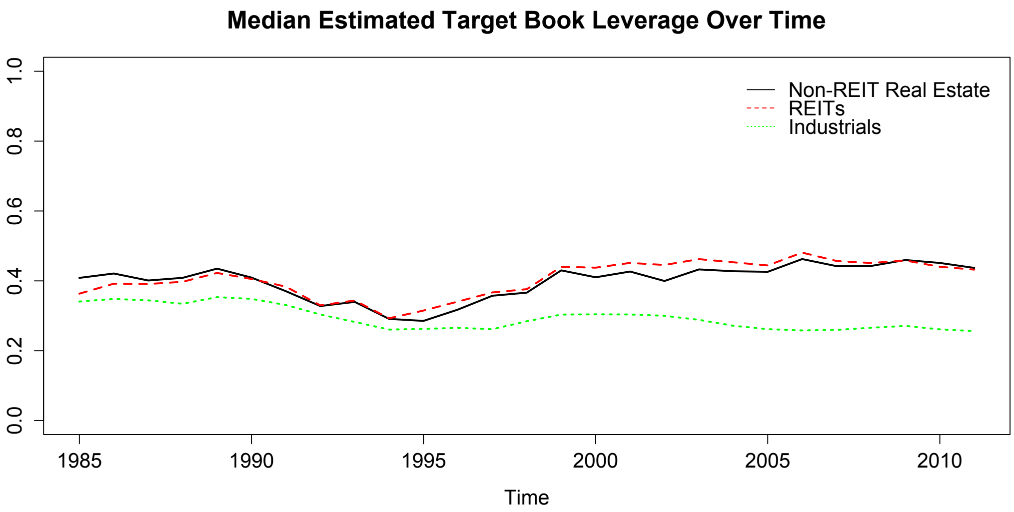


Table 2.4: Results of the second stage of the estimation of the partial adjustment model in equation (2.10). The first part uses market leverage, that is the book value of debt divided by the sum of the book value of debt and the market value of assets. The second part uses book values, that is the book value of debt divided by the book values of both debt and assets. In each regression, the current change in leverage is regressed upon the target leverage (the fitted values from the first stage regression of equation (2.11)), the past leverage, the target leverage times a dummy variable equaling 1 if the firm is a REIT real estate firm, and the target leverage times a dummy variable equaling 1 if the firm is an industrial firm. In the first three columns all values are used, and in the last three columns leverage ratios above 90% are trimmed to avoid mechanical mean reversion. The regression are estimated by Fama and MacBeth [1973] type regressions (Fama-MacBeth), by pooled OLS (OLS), and by fixed effects (FE). Standard errors are shown in parentheses. *** denotes significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

Market Leverage						
		All values		Leverage ratios above 80% excluded		
	Fama-MacBeth	OLS	FE	Fama-MacBeth	OLS	FE
Intercept	0.021***	0.021***		0.021***	0.021***	
	(0.004)	(0.001)		(0.004)	(0.001)	
$\mathbf{TL_t}$	0.072***	0.077***	0.222***	0.073***	0.077***	0.216***
	(0.012)	(0.007)	(0.050)	(0.013)	(0.007)	(0.051)
$\mathbf{LR_{t-1}}$	-0.119***	-0.127***	-0.401***	-0.12***	-0.129***	-0.403***
	(0.012)	(0.002)	(0.003)	(0.012)	(0.002)	(0.003)
$\mathbf{TL_t \cdot 1^{REIT}}$	-0.002	0.001	-0.008	-0.004	-0.002	-0.08
	(0.012)	(0.008)	(0.059)	(0.012)	(0.008)	(0.060)
$\mathbf{TL_t \cdot 1^{Industrials}}$	-0.041***	-0.05***	-0.08	-0.041***	-0.049***	-0.076
	(0.009)	(0.007)	(0.051)	(0.009)	(0.007)	(0.051)
Firm Fixed Effects?	No	No	Yes	No	No	Yes
N	103520	103520	103520	103366	103366	103366
R^2	7.2%	4.9%	29.5%	7.2%	5.0%	29.6%
Book Leverage						
		All values		Leverage ratios above 80% excluded		
	Fama-MacBeth	OLS	FE	Fama-MacBeth	OLS	FE
Intercept	0.024***	0.024***		0.024***	0.024***	
	(0.005)	(0.001)		(0.005)	(0.001)	
$\mathbf{TL_t}$	0.108***	0.109***	0.215**	0.111***	0.111***	0.202**
	(0.018)	(0.010)	(0.076)	(0.017)	(0.010)	(0.076)
$\mathbf{LR_{t-1}}$	-0.14***	-0.138***	-0.402***	-0.143***	-0.141***	-0.403***
	(0.005)	(0.002)	(0.003)	(0.005)	(0.002)	(0.003)
$\mathbf{TL_t \cdot 1^{REIT}}$	-0.012	0.005	-0.005	-0.012	-0.001	-0.03
	(0.017)	(0.011)	(0.088)	(0.015)	(0.011)	(0.089)
$\mathbf{TL_t \cdot 1^{Industrials}}$	-0.061***	-0.061***	-0.044	-0.061***	-0.062***	-0.041
	(0.013)	(0.010)	(0.076)	(0.012)	(0.010)	(0.076)
Firm Fixed Effects?	No	No	Yes	No	No	Yes
N	102635	102635	102635	102064	102064	102064
R^2	6.2%	5.5%	30.2%	6.4%	5.7%	30.2%

Table 2.5: Results of the one-step the estimation of the partial adjustment model but excluding the industrial firms. The first part uses market leverage, that is the book value of debt divided by the sum of the book value of debt and the market value of assets. The second part uses book values, that is the book value of debt divided by the book values of both debt and assets. In each regression, the current leverage is regressed upon the determinants of leverage, the lagged leverage times a dummy variable equaling 1 if the firm is a REIT real estate firm. The data is trimmed at the top and bottom 0.5%, and in the last three columns leverage ratios above 90% are also removed to avoid mechanical mean reversion. The regression are estimated by Fama and MacBeth [1973] type regressions (Fama-MacBeth), by pooled OLS (OLS), and by fixed effects (FE). Standard errors are shown in parentheses. *** denotes significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

Market Leverage						
		All values			Leverage ratios above 80% excluded	
	Fama-MacBeth	OLS	FE	Fama-MacBeth	OLS	FE
Intercept	0.048**	0.024*		0.047**	0.028*	
	(0.012)	(0.012)		(0.012)	(0.012)	
$LR_{t-1}^{IndustryMedian}$	-	-0.043	0.012	-	-0.047	0.006
	-	(0.027)	(0.030)	-	(0.027)	(0.030)
V_{t-1}/A_{t-1}	0.000	0.015***	0.018***	0.001	0.014***	0.017***
	(0.004)	(0.002)	(0.003)	(0.004)	(0.002)	(0.003)
PPE_{t-1}/A_{t-1}	-0.01	-0.007	0.022*	-0.01	-0.007	0.022
	(0.005)	(0.006)	(0.011)	(0.005)	(0.006)	(0.011)
ET_{t-1}/A_{t-1}	-0.066	-0.021	-0.015	-0.06	-0.02	-0.014
	(0.039)	(0.013)	(0.014)	(0.039)	(0.013)	(0.014)
Dp_{t-1}/A_{t-1}	-0.134	-0.131	-0.364*	-0.128	-0.095	-0.302
	(0.148)	(0.111)	(0.171)	(0.143)	(0.112)	(0.174)
RD_{t-1}/A_{t-1}	-0.13	0.156	-1.152**	-0.148	0.152	-1.166**
	(0.746)	(0.265)	(0.437)	(0.740)	(0.265)	(0.435)
RDD_{t-1}	-0.003	-0.005	-0.004	-0.003	-0.005	-0.005
	(0.010)	(0.011)	(0.019)	(0.010)	(0.012)	(0.019)
$log(A_{t-1})$	0.002	0.004***	0.029***	0.002	0.004**	0.028***
	(0.002)	(0.001)	(0.004)	(0.002)	(0.001)	(0.004)
$\mathbf{Leverage_{t-1}}$	0.915***	0.923***	0.641***	0.914***	0.916***	0.640***
	(0.015)	(0.013)	(0.029)	(0.015)	(0.014)	(0.029)
$\mathbf{Leverage_{t-1}} \cdot \mathbf{1^{REIT}}$	-0.018	-0.015	0.037	-0.018	-0.015	0.025
	(0.013)	(0.012)	(0.032)	(0.013)	(0.012)	(0.033)
N	3035	3035	3035	2925	2925	2925
R^2	84.1%	81.8%	86.7%	82.7%	79.7%	85.2%

Book Leverage						
		All values			Leverage ratios above 80% excluded	
	Fama-MacBeth	OLS	FE	Fama-MacBeth	OLS	FE
Intercept	0.040**	0.016		0.043**	0.020	
	(0.010)	(0.015)		(0.010)	(0.015)	
$LR_{t-1}^{IndustryMedian}$	-	-0.002	-0.060	-	-0.005	-0.059
	-	(0.034)	(0.040)	-	(0.034)	(0.040)
V_{t-1}/A_{t-1}	0.003	0.011***	0.011***	0.002	0.010***	0.010***
	(0.005)	(0.003)	(0.003)	(0.005)	(0.003)	(0.003)
PPE_{t-1}/A_{t-1}	-0.006	0.000	0.017	-0.007	-0.002	0.010
	(0.006)	(0.006)	(0.011)	(0.006)	(0.006)	(0.011)
ET_{t-1}/A_{t-1}	-0.076	-0.032*	-0.014	-0.079	-0.033**	-0.016
	(0.036)	(0.012)	(0.014)	(0.036)	(0.012)	(0.014)
Dp_{t-1}/A_{t-1}	0.047	0.025	-0.076	0.022	0.007	-0.047
	(0.134)	(0.105)	(0.165)	(0.129)	(0.106)	(0.167)
RD_{t-1}/A_{t-1}	-0.152	0.054	-0.707	-0.197	0.030	-0.715
	(0.800)	(0.248)	(0.415)	(0.757)	(0.242)	(0.404)
RDD_{t-1}	-0.008	-0.008	-0.013	-0.007	-0.006	-0.013
	(0.008)	(0.011)	(0.018)	(0.008)	(0.011)	(0.018)
$log(A_{t-1})$	0.002	0.004**	0.019***	0.002	0.003**	0.019***
	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)	(0.004)
$\mathbf{Leverage_{t-1}}$	0.909***	0.908***	0.634***	0.912***	0.907***	0.638***
	(0.014)	(0.012)	(0.029)	(0.014)	(0.012)	(0.029)
$\mathbf{Leverage_{t-1}} \cdot \mathbf{1^{REIT}}$	-0.005	0.000	0.084*	-0.008	-0.004	0.081*
	(0.010)	(0.011)	(0.033)	(0.010)	(0.011)	(0.033)
N	3010	3010	3010	2871	2871	2871
R^2	85.8%	83.9%	87.8%	84.9%	82.6%	86.9%

Table 2.6: Results of the second stage of the estimation of the partial adjustment model but excluding industrial firms. The first part uses market leverage, that is the book value of debt divided by the sum of the book value of debt and the market value of assets. The second part uses book values, that is the book value of debt divided by the book values of both debt and assets. In each regression, the current change in leverage is regressed upon the target leverage (the fitted values from the first stage regression of equation (2.11)), the past leverage, the target leverage times a dummy variable equaling 1 if the firm is a REIT real estate firm. In the first three columns all values are used, and in the last three columns leverage ratios above 90% are trimmed to avoid mechanical mean reversion. The regression are estimated by Fama and MacBeth [1973] type regressions (Fama-MacBeth), by pooled OLS (OLS), and by fixed effects (FE). Standard errors are shown in parentheses. *** denotes significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

Market Leverage						
		All values			Leverage ratios above 80% excluded	
	Fama-MacBeth	OLS	FE	Fama-MacBeth	OLS	FE
Intercept	0.039*	0.021*		0.026**	0.026**	
	(0.013)	(0.009)		(0.009)	(0.009)	
$\mathbf{TL_t}$	0.018	0.053**	0.136*	0.049	0.049**	0.136*
	(0.028)	(0.018)	(0.061)	(0.019)	(0.019)	(0.060)
$\mathbf{LR_{t-1}}$	-0.098***	-0.101***	-0.312***	-0.11***	-0.11***	-0.324***
	(0.011)	(0.008)	(0.014)	(0.009)	(0.009)	(0.015)
$\mathbf{TL_t \cdot 1^{REIT}}$	-0.004	0.000	0.024	-0.003	-0.003	-0.033
	(0.010)	(0.009)	(0.071)	(0.009)	(0.009)	(0.071)
Firm Fixed Effects?	No	No	Yes	No	No	Yes
N	3035	3035	3035	2925	2925	2925
R^2	8.2%	4.8%	28.9%	8.3%	5.1%	29.6%

Book Leverage						
		All values			Leverage ratios above 80% excluded	
	Fama-MacBeth	OLS	FE	Fama-MacBeth	OLS	FE
Intercept	0.038**	0.016**		0.040**	0.020**	
	(0.012)	(0.006)		(0.012)	(0.006)	
$\mathbf{TL_t}$	0.058	0.084***	0.118**	0.049	0.079***	0.116**
	(0.045)	(0.017)	(0.041)	(0.042)	(0.017)	(0.041)
$\mathbf{LR_{t-1}}$	-0.093***	-0.094***	-0.285***	-0.095***	-0.098***	-0.282***
	(0.012)	(0.008)	(0.014)	(0.012)	(0.008)	(0.015)
$\mathbf{TL_t \cdot 1^{REIT}}$	-0.01	0.002	-0.004	-0.009	-0.002	-0.019
	(0.015)	(0.011)	(0.049)	(0.014)	(0.011)	(0.050)
Fixed Effects?	No	No	Yes	No	No	Yes
N	3110	3110	3110	2871	2871	2871
R^2	7.4%	5.1%	27.6%	7.3%	5.2%	27.8%

Table 2.7: Results of the one-step the estimation of the partial adjustment model in equation (2.4) on datat from 1992 to 2011. The first part uses market leverage, that is the book value of debt divided by the sum of the book value of debt and the market value of assets. The second part uses book values, that is the book value of debt divided by the book values of both debt and assets. In each regression, the current leverage is regressed upon the determinants of leverage, the lagged leverage times a dummy variable equaling 1 if the firm is a REIT real estate firm, and the lagged leverage times a dummy variable equaling 1 if the firm is an industrial firm. The data is trimmed at the top and bottom 0.5%, and in the last three columns leverage ratios above 90% are also removed to avoid mechanical mean reversion. The regression are estimated by Fama and MacBeth [1973] type regressions (Fama-MacBeth), by pooled OLS (OLS), and by fixed effects (FE). Standard errors are shown in parentheses. *** denotes significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

Market Leverage	All values			Leverage ratios above 80% excluded		
	Fama-MacBeth	OLS	FE	Fama-MacBeth	OLS	FE
Intercept	0.024***	0.031***		0.024***	0.031***	
	(0.005)	(0.001)		(0.005)	(0.001)	
$LR_{t-1}^{IndustryMedian}$	0.074***	0.051***	0.061***	0.075***	0.051***	0.062***
	(0.012)	(0.005)	(0.009)	(0.012)	(0.005)	(0.009)
V_{t-1}/A_{t-1}	0.000	0.001***	0.001**	0.000	0.001***	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PPE_{t-1}/A_{t-1}	-0.004	-0.003***	-0.004**	-0.004	-0.003***	-0.004**
	(0.003)	(0.001)	(0.002)	(0.003)	(0.001)	(0.002)
ET_{t-1}/A_{t-1}	-0.007	-0.004**	-0.01***	-0.007	-0.004**	-0.01***
	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Dp_{t-1}/A_{t-1}	-0.04**	-0.042***	-0.032***	-0.039**	-0.041***	-0.032***
	(0.010)	(0.007)	(0.008)	(0.010)	(0.007)	(0.008)
RD_{t-1}/A_{t-1}	-0.017*	-0.019***	0.001	-0.017*	-0.019***	0.001
	(0.007)	(0.003)	(0.004)	(0.006)	(0.003)	(0.004)
RDD_{t-1}	-0.012***	-0.016***	-0.006*	-0.012***	-0.016***	-0.006*
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)
$log(A_{t-1})$	0.001*	0.001***	0.021***	0.001*	0.001***	0.021***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
$\mathbf{Leverage_{t-1}}$	0.890***	0.893***	0.623***	0.887***	0.889***	0.616***
	(0.020)	(0.010)	(0.031)	(0.020)	(0.010)	(0.031)
$\mathbf{Leverage_{t-1} \cdot 1^{REIT}}$	0.002	-0.004	-0.012	0.001	-0.006	-0.022
	(0.020)	(0.011)	(0.038)	(0.021)	(0.011)	(0.039)
$\mathbf{Leverage_{t-1} \cdot 1^{Industrial}}$	-0.014	-0.029**	-0.074*	-0.011	-0.026**	-0.068*
	(0.011)	(0.010)	(0.031)	(0.012)	(0.010)	(0.032)
N	68367	68367	68367	68275	68275	68275
R^2	77.4%	74.8%	82.3%	77.0%	74.4%	82.0%

Book Leverage	All values			Leverage ratios above 80% excluded		
	Fama-MacBeth	OLS	FE	Fama-MacBeth	OLS	FE
Intercept	0.022***	0.027***		0.022***	0.027***	
	(0.005)	(0.002)		(0.005)	(0.002)	
$LR_{t-1}^{IndustryMedian}$	0.074***	0.083***	0.144***	0.073***	0.083***	0.144***
	(0.007)	(0.005)	(0.012)	(0.007)	(0.005)	(0.012)
V_{t-1}/A_{t-1}	-0.001	0.000	-0.001**	-0.001	0.000	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PPE_{t-1}/A_{t-1}	-0.003	-0.002**	0.000	-0.003	-0.002*	0.000
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)
ET_{t-1}/A_{t-1}	-0.02***	-0.017***	-0.015***	-0.019***	-0.015***	-0.014***
	(0.004)	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)
Dp_{t-1}/A_{t-1}	-0.011	-0.021*	-0.032**	-0.01	-0.019*	-0.027*
	(0.014)	(0.009)	(0.012)	(0.013)	(0.009)	(0.012)
RD_{t-1}/A_{t-1}	-0.024*	-0.029***	-0.016**	-0.025*	-0.028***	-0.014**
	(0.009)	(0.004)	(0.005)	(0.009)	(0.004)	(0.005)
RDD_{t-1}	-0.009***	-0.009***	-0.005	-0.009***	-0.009***	-0.004
	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.003)
$log(A_{t-1})$	0.002***	0.001***	0.011***	0.002***	0.001***	0.011***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
$\mathbf{Leverage_{t-1}}$	0.881***	0.875***	0.607***	0.880***	0.874***	0.614***
	(0.008)	(0.011)	(0.042)	(0.008)	(0.011)	(0.042)
$\mathbf{Leverage_{t-1} \cdot 1^{REIT}}$	0.011	0.008	0.046	0.008	0.007	0.067
	(0.011)	(0.012)	(0.049)	(0.011)	(0.012)	(0.050)
$\mathbf{Leverage_{t-1} \cdot 1^{Industrial}}$	-0.027**	-0.024*	-0.051	-0.031**	-0.026*	-0.06
	(0.009)	(0.011)	(0.042)	(0.008)	(0.011)	(0.042)
N	67786	67786	67786	67422	67422	67422
R^2	75.2%	74.0%	81.5%	74.8%	73.6%	81.2%

Table 2.8: Results of the second stage of the estimation of the partial adjustment model on data from 1992 to 2011. The first part uses market leverage, that is the book value of debt divided by the sum of the book value of debt and the market value of assets. The second part uses book values, that is the book value of debt divided by the book values of both debt and assets. In each regression, the current change in leverage is regressed upon the target leverage (the fitted values from the first stage regression of equation (2.11)), the past leverage, the target leverage times a dummy variable equaling 1 if the firm is a REIT real estate firm, and the target leverage times a dummy variable equaling 1 if the firm is an industrial firm. In the first three columns all values are used, and in the last three columns leverage ratios above 90% are trimmed to avoid mechanical mean reversion. The regression are estimated by Fama and MacBeth [1973] type regressions (Fama-MacBeth), by pooled OLS (OLS), and by fixed effects (FE). Standard errors are shown in parentheses. *** denotes significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

Market Leverage						
		All values		Leverage ratios above 80% excluded		
	Fama-MacBeth	OLS	FE	Fama-MacBeth	OLS	FE
Intercept	0.010*	0.013***		0.009*	0.014***	
	(0.004)	(0.001)		(0.004)	(0.001)	
$\mathbf{TL_t}$	0.092***	0.094***	0.475***	0.090***	0.094***	0.479***
	(0.014)	(0.012)	(0.087)	(0.016)	(0.009)	(0.096)
$\mathbf{Leverage_{t-1}}$	-0.114***	-0.126***	-0.446***	-0.108***	-0.128***	-0.469***
	(0.018)	(0.003)	(0.006)	(0.019)	(0.002)	(0.007)
$\mathbf{TL_t \cdot 1^{REIT}}$	0.003	-0.003	-0.103	0.007	-0.007	-0.231
	(0.016)	(0.014)	(0.131)	(0.017)	(0.010)	(0.148)
$\mathbf{TL_t \cdot 1^{Industrials}}$	-0.04***	-0.049***	-0.237**	-0.035**	-0.048***	-0.185
	(0.010)	(0.012)	(0.088)	(0.011)	(0.008)	(0.096)
Fixed Effects?	No	No	Yes	No	No	Yes
N	72048	72048	72048	71946	71946	71946
R^2	7.5%	4.7%	32.7%	6.9%	4.7%	33.7%
Book Leverage						
		All values		Leverage ratios above 80% excluded		
	Fama-MacBeth	OLS	FE	Fama-MacBeth	OLS	FE
Intercept	0.010*	0.013***		0.010***	0.013***	
	(0.004)	(0.001)		(0.004)	(0.001)	
$\mathbf{TL_t}$	0.135***	0.129***	0.425***	0.139***	0.132***	0.436***
	(0.013)	(0.012)	(0.118)	(0.012)	(0.012)	(0.122)
$\mathbf{Leverage_{t-1}}$	-0.14***	-0.141***	-0.438***	-0.145***	-0.144***	-0.44***
	(0.007)	(0.002)	(0.003)	(0.006)	(0.002)	(0.003)
$\mathbf{TL_t \cdot 1^{REIT}}$	0.018	0.017	-0.098	0.016	0.014	-0.121
	(0.012)	(0.013)	(0.139)	(0.012)	(0.014)	(0.145)
$\mathbf{TL_t \cdot 1^{Industrials}}$	-0.047***	-0.047***	-0.161	-0.047***	-0.048***	-0.179
	(0.009)	(0.011)	(0.119)	(0.008)	(0.011)	(0.123)
Fixed Effects?	No	No	Yes	No	No	Yes
N	71437	71437	71437	71050	71050	71050
R^2	6.3%	5.7%	33.0%	6.5%	5.9%	32.9%

2.8 Variable Definitions

Table 2.9: Variable definitions for the partial adjustment test to examine the empirical validity of the Trade-off theory.

	Description	Xpressfeed name(s) in Compustat
BE_t	Book value of equity at the end of fiscal year t	$AT - LT + TXDITC$
ET_t	Earnings before interest and taxes during fiscal year t	$IB + XINT + TXT$
A_t	Total book value of assets at the end of fiscal year t	AT
Dp_t	Depreciation and amortization in fiscal year t	DPC
L_t	Total debt at the end of fiscal year t	$DLC + DLTT$
RD_t	Research and development expenses in fiscal year t	XRD
ME_t	Market value of equity at the end of fiscal year t	$PRCC\_F * CSHO$
PPE_t	Total (gross) property, plant and equipment in fiscal year t	$PPEGT$
$PrefStock_t$	Preferred stock liquidation value if available, else redemption value if available, else carrying value	$PSTKL$ or $PSTKRV$ or $PSTK$
V_t	Market value of assets at the end of fiscal year t	$LT - TXDITC + PrefStock + ME$
DIV_t	Cash dividends paid in fiscal year t	DV
EBT_t	Taxable income	$IB + TXT$

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Essay 3

House Prices and Taxes[1]

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Abstract

By using the 2007 municipality reform in Denmark as an exogenous shock to municipal tax rates, we find that a 1%-point increase in income tax rates lead to a drop in house prices of 7.9% and a 1‰-point increase in the property tax rates lead to a 1.1% drop in house prices. The simple present values of a 1%-point perpetual income tax increase and a 1‰-point property tax increase, relative to the median house price, are 7% and 3.3%, repectively. Our findings are thus in line with the predicted median tax loss. This indicates that the housing market efficiently incorporates taxes into house prices. The exogeneity of the shock to taxes and the size of the dataset is an improvement over earlier studies.

3.1 Introduction

It is difficult to measure the effect of taxes on house prices. Since the seminal work of Oates [1969] many researchers have tried to estimate the degree of property tax capitalization into house prices. That is, the extent to which higher property taxes, all else equal, lead to lower house prices. Full capitalization is said to occur when the change in house prices exactly corresponds to the present value of a change in taxes. The common approach (as in Palmon and Smith [1998], Oates [1969], Oates [1973], Edel and Sclar [1974], and Rosen and Fullerton [1977]) in the literature has been to use cross-sectional data on house sales in one or a few counties with varying taxes. Besides the small sample size and the small geographical area, the main problem with this type of analysis is controlling for public service, which varies significantly between counties. This is because it is hard to measure the quality of public service.

Another approach (as in Wicks et al. [1968] and Smith [1970]) would be to use tax changes from one year to another, where differences in the quality of public service are arguably much smaller than in the cross section. However, this approach introduces a potential bias if the change in taxes are not completely exogenous to house prices. For example, if the factors driving the tax changes might also influence house prices directly, the estimates will be biased.

In this paper we use the 2007 municipality reform in Denmark as a natural experiment in which the tax changes are completely exogenous, and thus provide unbiased estimates of the effects of taxes on house prices.

Much of the previous literature on taxes and house prices estimates the degree of tax capitalization. Taxes are fully capitalized into house prices if, all else equal, the change in house prices exactly equals the present value of the change in taxes. That is, when accounting for all other factors, the change in house prices completely equals:

$$\sum_{n}^{N} \frac{\Delta \text{Tax}}{(1+i)^n},$$

where i is the relevant discount factor and N the lifetime of the house. For large N, as is reasonable to assume for houses, the present value of the changes in taxes are well approximated by $\frac{\Delta Tax}{i}$. Thus the degree of housing capitalization deliver insights to the rationality and efficiency of the housing market. If the residential housing market is completely rational and efficient, then only future unexpected tax changes can be transferred to future home owners, and we should have full tax capitalization. The current study uses both cross-sectional differences and time changes in the nominal tax rates to estimate the capitalization of taxes. We argue that the tax changes in relation to the 2007 municipality reform in Denmark were completely exogenous of any factors plausibly influencing house prices.

Whereas the earlier literature only focuses on property taxes, we also look at the capitalization of municipal income taxes. Since Danes pay municipal income taxes in the municipality where they reside, everything else equal, one should prefer living in a municipality with lower taxes.

The purpose of the 2007 municipality reform was to better exploit economies of scale at the municipal level by merging smaller municipalities. With the exemption of only four small islands, all municipalities below 20,000 inhabitants had to merge with one or more nearby municipalities in order to create a new municipality of at least 30,000 inhabitants. The new municipalities set the new tax rates equal to an average of the tax rates of the municipalities participating in the merger plus an adjustment for changes in the public service task offered by the municipalities[2]. The new municipalities had the option to set the tax rates lower than this average plus an adjustment, but only 9 of the 98 municipalities chose to set the income tax rates below the maximum allowed rate, and only 11 chose to set the property tax rates below the allowed maximum. We instrument the tax rates after the reform with the average of the merging municipalities previous tax rates, since this average is closely related to the chosen tax rate, and is independent of any factors that might influence house prices, like the economic situation in the municipality.

Of course the municipalities were free to change the level of public service provided, and so we control for the level of public service. Because the quality of public service is hard to measure, we instrument our service variable with the total school expenditure and the total education expenditure in the municipality.

We find that a 1%-point increase in the income tax rate lead to a drop in house prices of 7.9% and a 1‰-point increase in the property tax rate lead to a 1.1% drop in house prices. The simple present value of a 1%-point perpetual income tax increase and of a 1‰-point property tax increase, relative to the

[2] In connection with the reform some public service task previously defined as state tasks were taken over by the municipalities.

median house price correspond to 7% and 3.3%, repectively. Our findings are thus in line with predicted. This indicates that the housing market efficiently incorporates taxes into house prices, similar to the findings of Palmon and Smith [1998].

The rest of the paper is organized as follows. Section 3.2 briefly reviews related literature, section 3.3 explains the municipality reform, section 3.4 discusses the data and summary statistics, section 3.5 lays out the estimation strategy, 3.6 presents the results, and section 3.7 concludes.

3.2 Related Literature

Oates [1969] was the first to formally test the extent of property tax capitalization. Where full capitalization is said to occur, when controlling all other factors such as public service and housing characteristics, the present value of tax differences equal the differences in house prices. Oates [1969] used cross-sectional data on US property taxes. The study was criticized by Pollakowski [1973] for not properly accounting for the difference in public service levels. Since then many papers have attempted to estimate the degree of property tax capitalization, with differing findings and limited controls for the quality of public service.

Chinloy [1978] and Gronberg [1979] find limited capitalization effects, whereas Oates [1969], Edel and Sclar [1974], Gustely [1976], and Yinger et al. [1988] report varying degrees of tax capitalization. Oates [1973], Reinhard [1981], and Gallagher et al. [2013] find close to full or even over capitalization.

Palmon and Smith [1998,b] are the first study to properly control for public service except schooling. They construct a quasi-experiment by subdividing houses into municipal utility districts (MUDs) that have similar service levels (except for school quality), but varying effective property taxes. This is an important improvement compared to earlier identification strategies, but still fails to effectively control for public school quality, which is shown to be priced by home owners in Black [1999].

The current study uses both variation in the cross-section of municipalities and over time to estimate the capitalization of taxes. To our knowledge this is the first study to have completely exogenous variation over time due to the municipality reform. Having both cross-sectional and time-series variation should give us a better estimate of the effect of taxes on house prices.

3.3 The Danish Municipality Reform in 2007

In April 2004 the Danish government laid forth a proposal for a reform of the municipalities and regions ("Amter") in Denmark. The background for the proposal was the report from the Structural Commission in January 2004. The idea was to better exploit economies of scale by reducing the number of municipalities from 271 to 98 and thus increasing the size of the municipalities. Furthermore, the 13 regions ("Amterne") were replaced by 5 bigger regions ("Regionerne"), where the new regions lost the ability to levy taxes, and their main task would be hospital services. The reform took effect from January 1st 2007.

In June 2005 the division of the new municipalities was established. Municipalities smaller than 20,000 inhabitants should merge with other municipalities to create a new municipality of at least 30,000 inhabitants. 32 municipalities did not partake in any merger. The new merged municipalities of course had to set new tax rates.

From 2001 there had been a tax freeze in Denmark. This was still the case during the municipality reform. The tax freeze meant that there could not be municipal tax increases at an aggregate level, so if one municipality decided to raise taxes another had to decrease their taxes by an equal amount. The result was that municipal taxes remained almost completely constant from 2001 to 2007.

Two municipal taxes directly affect households in Denmark; the property tax and the income tax. The municipal income tax is a tax on labor income, and before the reform in 2006, the income tax rates varied from 15.5% to 23.2% as seen from table 3.2. The municipal property tax is a tax on the assessed value of the lot where a residential property is located. Residential real estate is assessed in odd years. Thus, the only change in property taxes between 2006 and 2007 is due to the reform, since the assessed lot values were not changed. The municipal property tax rates in 2006 ranged from 6‰ to 24‰ as seen from the table 3.2.

Municipalities could not freely choose the tax rates. Instead they could choose to set the rate equal to or lower than a maximum allowed rate. The maximum allowed tax rates were calculated as an average of the merging municipalities' previous tax rates plus an addition due to the split of the region's public service responsibilities between the state and the municipalities and due to the municipalities taking over some of the state's public service tasks. To avoid the political battles over the new tax rates, and to prevent dramatic changes in any one municipality's tax rate, almost all municipalities chose to set the tax rates equal to the maximum allowed rate. Only 8 of the 98 new municipalities chose to set the income tax rates below the maximum allowed rate, and only 11 chose to set the property tax below the maximum. The old region ("amt") income tax rates were split as 8%-points to the state income taxes, and the rest to the maximum allowed rate for the new municipal income tax. The old region property tax rates were uniformly 10‰, and they were added to the maximum allowed rate of the new municipal property tax rates.

The changes in tax rates were a function of the previous tax rates in the municipalities that happened to merge. The "choice" to merge was determined by the municipal size. It seems reasonable to assume that the change in size of the municipality is independent of factors affecting house prices, since the change of geographical municipal boundary and the change in municipal size should not affect house prices, when properly accounting for changes in municipal factors such as taxes and service.

The selection of which municipalities to partake in a given merger depended on which municipalities that were adjacent to each other. And since all merging municipalities had to agree upon who to merge with, one could imagine that merging municipalities would be similar in terms of tax rates and service levels. This could potentially lead to very small tax changes. However, table 3.2 shows that both property tax rates and income tax rates changed substantially due to the reform. A few municipalities failed to find candidates to merge with, and in these cases the national parliament decided which municipalities to merge.

Hence, it seems reasonable to assume that the reform instigated a change in tax rates that was exogenous to house prices. Specifically, it seems obvious that the tax changes were independent of the economic situation of the individual municipalities, and thus serves as good experiment to examine how exogenous changes in tax rates affect house prices. Figure 3.1 shows the geographical distribution of the merging and non-merging municipalities. The merging municipalities are located all over Denmark.

3.4 Data

To conduct the study, we have collected a very detailed description of the houses sold including house-specific characteristics and spatial data, the municipal taxes, and the public service levels before and after the municipal reform in Denmark in 2007. In the following sections we describe the data sources and present summary statistics.

3.4.1 House Prices and Spatial Data

All Danish housing sales[3] are recorded by the Danish tax authorities and are available through the Danish public information server through www.OIS.dk. It includes sales prices, size, number of rooms etc. for all Danish addresses back to 1992. We use residential house prices from sales in 2006 and 2007. Our regressand is the natural logarithm of the sales price.

We exclude family transactions. Family sales are easily identified in the dataset, because all family sales are registered and marked as such. We also exclude forced sales, and thus only include regular arms length sales in the dataset.

We focus only on the three biggest housing types in Denmark; regular houses, apartments, and townhouses[4]. This is done to avoid special house types, that might be priced different than regular owner-occupied housing.

To deal with incorrectly registered sales we trim the data for the top and bottom 1%. We have tried trimming the top and buttom 3, 2, and 0.5% instead, and it did not significantly change the results. Some of the houses in the data are listed as having been remodelled after the sale in either 2006 and 2007, and since the database only records the current house characteristics, we exclude all houses renovated after the sales date to avoid backdated values.

All the addresses of the sold houses are geocoded with latitude and longitude coordinates, and the municipal affiliation before and after the reform of each location is determined through the Danish Geodata Agency's (Geodatastyrelsen) mapping services "GeoVA" and "GeoK7".

The house characteristics are supplemented by the distance to the nearest

[3]Except the housing type "Andelsbolig", which is a Danish cooperative housing type, that is governed by very different laws than regular home ownership.

[4]Villaer, ejerlejligheder, and rækkehuse in Danish.

big city in Denmark. This spatial variable is meant to catch the effects of living close to a big city, like bigger job opportunities, better shopping facilities, closer proximity to schools etc.

3.4.2 Taxes and Public Service

In connection with the Danish municipality reform two tax rates affecting private citizens changed, the municipal property tax rate[5] and the municipal income tax rate. Data on these two taxes before and after the reform are from the Danish Ministry for Economic Affairs and the Interior available at www.noegletal.dk.

As part of the reform the previous regions called "Amter" were dismantled and the income taxes previously collected by these regions were split between national taxes and municipal taxes. 8 percentage-points of the regions income tax were converted into an 8% national income tax, and the rest were added to the municipal income tax rate. The added part is not an actual tax increase, since it is exactly offset by the removal of the regional tax. Thus, when comparing pre-reform tax rates to post-reform tax rates, the added part needs to be subtracted the post-reform tax rates to correctly identify real tax changes.

The old regions also had a property tax on the value of each private lot. The tax rate was uniformly 10‰ and this was added to the municipal property tax rate as part of the reform. Again, we subtract 10‰ from the post-reform municipal property tax rate, since this addition was exactly offset by the removal of the regional property taxes.

Table 3.1 shows a fictitious example of how the tax rates changed because of the reform for households living in two merging municipalities, A and B. The municipalities in the example belonged to different counties ("Amter") before the reform. The new merged municipality, AB, sets the income tax rate equal to the average of the previous tax rates in A and B, plus the part of the county tax rate above 8%, which is the part not transferred to the new state health tax. The new municipal property tax rate is equal to the average of the previous municipal property tax rates plus the county property tax rates (The county property tax rates were uniformly 10‰ before the reform). However, the relevant tax changes exclude the redistribution of the county tax rates. Hence, the relevant

[5] The municipal property tax is a tax on the current appraised value of each private property lot.

tax changes are shown in the last rows in table 3.1.

The two municipalities, Værløse and Farum, were excluded from the sample, since even though the two municipalities merged, the municipalities upheld differential tax rates even after the reform. This was due to substantial debt and subsequent tax increases in Farum brought on by fraud conducted by then Mayor in Farum, Peter Brixtofte.

To proxy for the quality of public service in a municipality we use a calculated measure from www.noegletal.dk. It equals the net expenses used on public service divided by the calculated need of public service taking the demography of the municipality into account. It should, thus be a better measure of public service than simply the total expenditure per capita, since the latter for example would overstate the service level in municipalities with many elderly. A value of 1 indicates that the municipality uses the amount on service justified by the demography and social needs of the municipality. A municipality could thus for example spend a lot on the elderly, without it resulting in a higher service level, if there are many elderly in the municipality. Hence, it should be a better service variable than for example total expenditure per capita. A service value higher than 1 indicates that the municipality uses more than its calculated need, and a value less than 1 would indicate using less than the need. Our service variable will most likely be measured with error. To alleviate this problem we instrument it with the total expenditure spent on schooling per pupil and the total expenditure spent on general education per pupil in the municipality.

3.4.3 Summary Statistics

The dataset includes 64,299 sales in 2006 and 67,500 sales in 2007. Thus significantly expanding the number of observations compared to the earlier studies. As an example, Palmon and Smith [1998] relies on only 501 sales in the Houston area. The reason why we focus on 2006 and 2007 is that the municipality reform took effect on January 1st 2007. For each sales we have collected the market price of the house, structural characteristics of the house such as the size, the number of rooms, the age, and the distance to the nearest city center. Furthermore, we have collected the municipal property tax, the income tax, and the public service level. The summary statistics are shown in table 3.2.

2006 and 2007 had similar amounts of sales. And in both years most villas were sold. The structural housing variables are distributed similarly in the two years. The income tax rates in 2006 vary from 15.5% to 23.2% and the property tax rates vary from 6‰ to 24‰, thus providing substantial variation to estimate the tax effect on house prices. The reform led to 256 tax changes geographically located all over Denmark as seen from figure 3.1. 32 municipalities did not partake in a merger, and some municipalities were split, and the split parts merged with different municipalities.

The service variable equals the total expenditure on service in the municipality relative to its calculated need given its demography. In 2007 the dispersion of both property tax rates, the income tax rates, and the service levels were lower than in 2006. This is a direct result of the merging municipalities setting common rates and service levels.

Both the income tax rates and the property tax rates vary substantially due to the reform. From the summary statistics in table 3.2 it is seen that the changes in the income tax rates ranged from -2.97 percentage points to 3.76 percentage points with a mean of -0.22 percentage points, and the changes in property tax rates ranged from -12.76‰ to 13.86‰. Thus, the reform had substantial impact on the tax rates in some municipalities. The large variation in tax changes will help us in identifying the effect on house prices.

3.5 Estimation Strategy and Identification

To estimate the degree of tax capitalization we use a hedonic regression model (see Rosen [1974]). The idea is that housing, even though being a differentiated product, can be described by a vector of characteristics, over which individuals have preferences. These characteristics can be house specific, location specific, or relate to the local public taxes and services etc. The basic regression model is the following

$$log(Price_{ijt}) = \alpha + \beta x_{ijt} + \gamma_{IT} IT_{jt} + \gamma_{PT} PT_{jt} + \gamma_S S_{jt} + \lambda_k + \rho_t + \varepsilon_{ijt}, \quad (3.1)$$

where i indexes the individual sales, j indexes the municipalities, and t indexes time. The variables contained in x describe the house specific characteristics relevant for the price. IT_{jt} denotes the municipal income tax, PT_{jt} denotes the municipal property tax, and S_{jt} denotes the public service level in the municipality. λ_k are dummy variables for each of the regional areas in Denmark called "Amter", and ρ_t are monthly dummy variables to capture the general time effect. The ε_{ijt} is the error term for each sale.

The semi-log specification in equation 3.1 is chosen because it provides the best fit of the data. The interpretation of the parameters in the semi-log specification is the relative change in the selling price, $Price$, of a 1 unit of change in the relevant explanatory variable as seen from a simple application of the chain rule on equation 3.1. Shown below for the property tax effect (suppressing subscripts for clarity):

$$\begin{aligned}\gamma_{PT} &= \frac{\partial log(Price)}{\partial PT} \\ &= \frac{1}{Price}\frac{\partial Price}{\partial PT} \\ &= \frac{\frac{\partial Price}{Price}}{\partial PT}\end{aligned}$$

The number of rooms, the size of the house and the distance to the nearest city are in natural logarithms. This gives a better fit of the model. With the log specification of the explanatory variables the interpretation of the coefficients becomes (suppressing subscripts for clarity):

$$\begin{aligned}\beta &= \frac{\partial log(Price)}{\partial log(x)} \\ &= \frac{1}{Price}\frac{\partial Price}{\partial log(x)} = \frac{1}{Price}\left(\frac{\partial log(x)}{\partial Price}\right)^{-1} \\ &= \frac{1}{Price}\left(\frac{1}{x}\frac{\partial x}{\partial Price}\right)^{-1} = \frac{\partial Price}{Price}\Big/\frac{\partial x}{x}\end{aligned}$$

Hence, a coefficients in front of a variable in natural logarithm equal to 0.5 means that a 1% increase in the explanatory variable results in a 0.5% increase in the house price.

After the reform, the merging municipalities were allowed to set the new tax rates lower than or equal to the average of the previous tax rates in the merging municipalities plus an addition due to increased costs because the municipalities took over some public service tasks that were previously handled by the state.

This means that some of the non-merging municipalities actually raised their taxes, and that the merging municipalities could set their tax rates higher than the average of previous rates. Furthermore, municipalities could also choose to set the tax rates lower than this calculated maximum. Using the actual tax rates could introduce bias, if for example municipalities in a good economic situation chose to set lower rates.

We therefore choose to instrument the tax rates by the average of the previous rates in the merging municipalities. These instruments are functions of the municipalities being bigger or smaller than 20,000 inhabitants, and the tax rates in the merging/neighboring municipalities. The instrumental variables are thus unrelated to the economic situation in the municipalities, and therefore pose good instruments, if their are related to the actual tax rates. We estimate the model by two stage least squares (2SLS).

The instruments are, however, not unrelated to the level of public service. One could easily imagine that a municipality with high tax rates and high service levels merging with a municipality with low tax rates and service levels, would experience a drop in public service. We will thus need to control for the public service level.

For the 2SLS regression we use median values of sales prices, sizes, number of rooms, etc. for each of the municipalities. This is done to deal with error correlation between sales within the same municipality. The specification hence becomes:

$$log(Price_{jt}) = \alpha + \beta x_{jt} + \gamma_{IT} IT_{jt} + \gamma_{PT} PT_{jt} + \gamma_S S_{jt} + \lambda_j + \rho_t + \varepsilon_{jt}, \quad (3.2)$$

3.6 Results

The results from estimating equation (3.1) by simple ordinary least squares (OLS) are presented in table 3.3. In the M1 column the standard errors are clustered on the old municipalities, to deal with residual correlation between sales within the same municipality. We include monthly time dummy variables to pick up any common time series effect. To account for geographical differences in the pricing of houses in Denmark a regional factor is included corresponding the old Danish regions called “Amter”, which were replaced by 5 bigger regions, "Regionerne", as part of the reform. Ideally the model should include fixed effects for each old municipality to isolate the pure effect of the reform (difference over time), and not allow for any cross-sectional variation driving the results. However, in unreported results include old municipality fixed effects, both the income tax and property tax loose statistical significance. The model including municipal fixed effects only has the time series variation to estimate the tax effects. Unfortunately, we need the cross-sectional variation between municipalities in order to get statistical significance.

It is noticeable that the model with an R^2 of 44% does a reasonably good job explaining the variation in the data, even though the dataset covers sales from all of Denmark. This indicates that the housing characteristics explain most of the house price variation, which is needed to pick up any tax effects.

All the housing characteristic have the expected signs. Not surprisingly, the size of the house and the distance to the nearest city are most important in explaining the sales price. A 1% increase in the distance to the nearest city leads to a 0.097% drop in house prices. A 1% increase in the size leads to an increase in price of 0.748%. The number of rooms also positively influence the house price. The age of the house is negatively related to the price, but the squared age is positively related, indicating that really old houses often are better located and have more charm. Townhouses and villas sell at a discount compared to apartments, but the effect of townhouses disappears in M1, where the standard errors are clustered on old municipalities, and the discount on villas is only barely significant at the 5% level.

In column M2, without standard error clustering, both the income tax rate and the property tax rate are statistically significant and influence house prices negatively. A 1 percentage-point increase in income tax rate leads to a 4.4% drop in house prices. A 1 permille-point increase in the property tax rate, leads to house prices falling by 0.3%. When clustering standard errors on old municipalities (column M1), the property tax is no longer significant.

However, using the actual 2007 post reform tax rates might bias the results, since municipalities were free to set taxes below the average of the previous tax rates plus an addition due to municipalities taking over some public service tasks from the state. This addition do not constitute a tax increase, but merely a redistribution of taxes and tasks between the state and the municipal level.

Furthermore, the freedom to set the tax rates below the threshold, might introduce a bias, since municipalities in good economic situations might choose to lower taxes. Becuase the overall economic situation in the municipalit also directly affect house prices, this will lead to endogeneity.

The problem can be circumvented by instrumenting the tax rates by a variable that for the 2006 values equal the 2006 tax rates, but for 2007 equals the average of the previous rates in the merging municipalities. For municipalities not participating in a merger, the 2007 values just equal their 2006 values. These two instruments, one for the income tax and one for the property tax, will be independent of the economic situation in each of the municipalities, since it is simply a function of the merger rule (below 20,000 inhabitants), and the tax rates in the neighboring municipalities. Intuitively, the instruments should also be highly correlated with the actual tax rates, since the average previous tax rates were also part of the actual 2007 tax rates.

Table 3.4 shows the 2SLS estimation instrumenting the income tax and the property tax by the aforementioned variables. All variables are in medians per old municipality, to avoid error correlation between sales in the same municipality. The "First Stage" columns shows that the instruments are indeed highly correlated with the actual tax rates conditional on the exogenous covariates. We, thus, avoid the potential pitfalls in using weak instruments. The "First Stage" regressions are only to show the correlation between the instruments and the actual tax rates. The model is not actually estimated in 2 stages, since this would lead to incorrect standard errors in the second stage.

The "Second Stage" column shows the results from the 2SLS estimation using the two tax rate instruments. The housing characteristics all have the expected signs and are of similar magnitude to the OLS results in table 3.3. Both the R^2 and the adjusted R^2 are 71%. The increased fit is due to the data being median values per municipality in the 2SLS regressions as opposed to individual sales in the simple OLS estimation. The effects of both tax rates are more significant both economically and statistically compared to the OLS results in table 3.3. A 1 percentage-point increase in income tax rate lead to a 6.8% drop in house prices. A 1 permille-point increase in the property tax rate, lead to house prices falling by 0.9%.

The results does, however, not control for differences in public service. To address this, we add a service variable to the specification. It equals the net expenses used on public service divided by the calculated need, given the demography of the municipality. Acknowledging that public service is hard to measure, we instrument it by school expenditure per pupil and total educational expenditure per pupil. The results are shown in table 3.5.

Again the "First Stage" columns show the conditional correlation of the instruments with the respective variables. It is noticeable that the two instruments for service are not as strongly related to our service variable as the tax rate instruments. It is not a major concern for us, as we are not interested in the effect of public service on house prices, but only wish to control for public service differences.

The "Second Stage" column shows the results of the 2SLS estimation. Again, all the housing characteristics have the right signs and similar magnitude as in the previous regressions. The service level is positively related to house prices, but is only significant at the 5% confidence level. The economic magnitude is also quite small. Increasing the service level from 1 to 2, indicating spending twice as much on service as the calculated need, only increases house prices 11.9%. The low estimate is probably partly due to measurement error inducing attenuation bias (estimate is biased towards 0), given that our service instruments are far from perfect.

Controlling for service raises the estimates of both the property tax rate and the income tax rate as expected. A 1%-point increase in income tax rate leads to a 7.9% drop in house prices. A 1‰-point increase in the property tax rate, leads to house prices falling by 1.1%.

One obvious question to consider when using a political reform as a natural experiment, is whether people foresaw the tax changes prior to January 1st 2007. The actual 2007 tax rates were announced on October 15th 2006, however, the tax changes could have been incorporated into property values before this, if people foresaw the changes. This could bias our results towards 0. The number of Google searches related to the reform in figure 3.2) does indicate some peaks in attention prior to January 1st 2007.

To control for this we have tried using 2003 as the pre-event period and 2007 as the post-event period. In 2003 there was no talk about the municipality reform. The estimated coefficients in front of the income and the property tax rates become -5.6% and -0.9%, respectively. These estimates are in the same order of magnitude (and actually a bit closer to 0) as the previous results. The anticipation bias, hence, does seem to be a serious issue.

If people assume tax rates to be constant over time, then it is possible to calculate the present value for a 1% tax difference by assuming a discount rate. We can then compare this theoretical tax benefit/loss to the estimated results in table 3.5, and find the degree of tax capitalization.

The present value for the median household of a perpetual 1%-point difference in the income tax rate, assuming constant household income, is

$$\frac{\Delta IT * \text{median taxable income}}{r} = \frac{1\% * 315,043}{0.3} = 105,014.$$

We follow Yinger et al. [1988] and Palmon and Smith [1998] and use a discount rate of 3%. With a median house price in 2007 of 1,500,000, this gives a relative effect of -7,0% for a 1%-point tax increase[6]. This is very close to the estimated -7.9 from table 3.5, and it corresponds to a capitalization of $-7.9/-7 \approx 110\%$, indicating that the housing market fully incorporates the effect of tax differences and changes into house prices. This result is in line with Oates [1973], Reinhard [1981], and Gallagher et al. [2013] that all find close to a 100% tax capitalization. They, however, focus on property taxes.

Assuming property taxes are paid out of sales prices, or equivalently, that appraisal values equal sales prices, and infinite lifetime for properties, the present value of a 1‰-point difference in property tax rate (assuming constant house values) for the median household equals

$$\frac{\Delta PT * \text{median house value}}{r} = \frac{1‰ * 1,500,000}{0.3} = 50,000$$

The relative effect of a 1‰-point increase in property tax rates thus equals $\frac{0.001}{0.03} = 50,000/1,500,000 \approx 3.3\%$. This is indicates a degree of property tax capitalization of 33%. This assumes that property taxes are paid on property sales prices. In reality, property taxes are paid on the assessed value of the lot, on which the property is placed. The true property tax capitalization will thus probably be higher than 33%.

Another way to get the degree of property tax capitalization is by noting

[6]The 2007 median taxable income of 315,043 is from Statistics Denmark www.dst.dk

that that the house price is a function of housing characteristics, $f(x)$, ie. size, location etc. less the property taxes

$$P = f(x) - \alpha \frac{PT * P}{i} \leftrightarrow P = \frac{f(x)}{1 + \alpha \frac{PT}{i}}$$

where α is the degree of property tax capitalization, i is the relevant discount rate, and PT is the property tax rate. By taking the natural logaritm of both sides, this becomes

$$\ln(P) = \ln(f(x)) - \ln(1 + \alpha \frac{PT}{i}) \approx \ln(f(x)) - \alpha \frac{PT}{i} \tag{3.3}$$

where the approximation works well for small values of $\frac{PT}{i}$. Equation (3.3) corresponds to the estimated equation, and the degree of property tax capitalization can thus be recovered directly from our results as the coefficient in front of the property tax rate divided by $-i$. This assumes that the approximation in equation (3.3) is accurate, and that property taxes are paid on property sales prices. As previously mentioned, property taxes are paid on the assessed value of the lot, on which the property is placed. Using this methodology the degree of tax capitalization becomes

$$\alpha = \frac{-1.1\%}{-3\%} = 36.7\%,$$

which is close the previous result. Since the precise degree of capitalization is highly dependent upon the assumed discount rate, the overall conclusion is that our findings are in line with predicted values, and suggest that the housing market does incorporate taxes into house prices.

3.7 Conclusion

Everything else equal people should prefer lower taxes to higher taxes. So if one municipality has higher tax rates than another municipality with the same level of public service, people can "vote with their feet" and move to the municipality with lower as argued by Charles Tiebout in Tiebout [1956]. This mechanism should lead to taxes being capitalized into house prices.

We utilize the 2007 municipality reform in Denmark as a natural experiment to estimate the effect of property tax rates and income tax rates on house prices.

We are, hence, able to obtain exogenous cross-sectional and time series variation in tax rates, yielding a dataset of about 600 municipal-year observations.

We find that a 1%-point increase in income tax rate lead to a 7.9% drop in house prices, and 1‰-point increase in the property tax rate, lead to house prices falling by 1.1%. Calculating simple present values of tax changes for the average household yields effects of 7% and 3.3% for the income tax and the property tax, respectively. Our results fall quite close to these, and indicates that the residential housing market does incorporate taxes into house prices.

3.8 Figures and Tables

Figure 3.1: Map of merging and non-merging Danish municipalities under 2007 municipality reform.

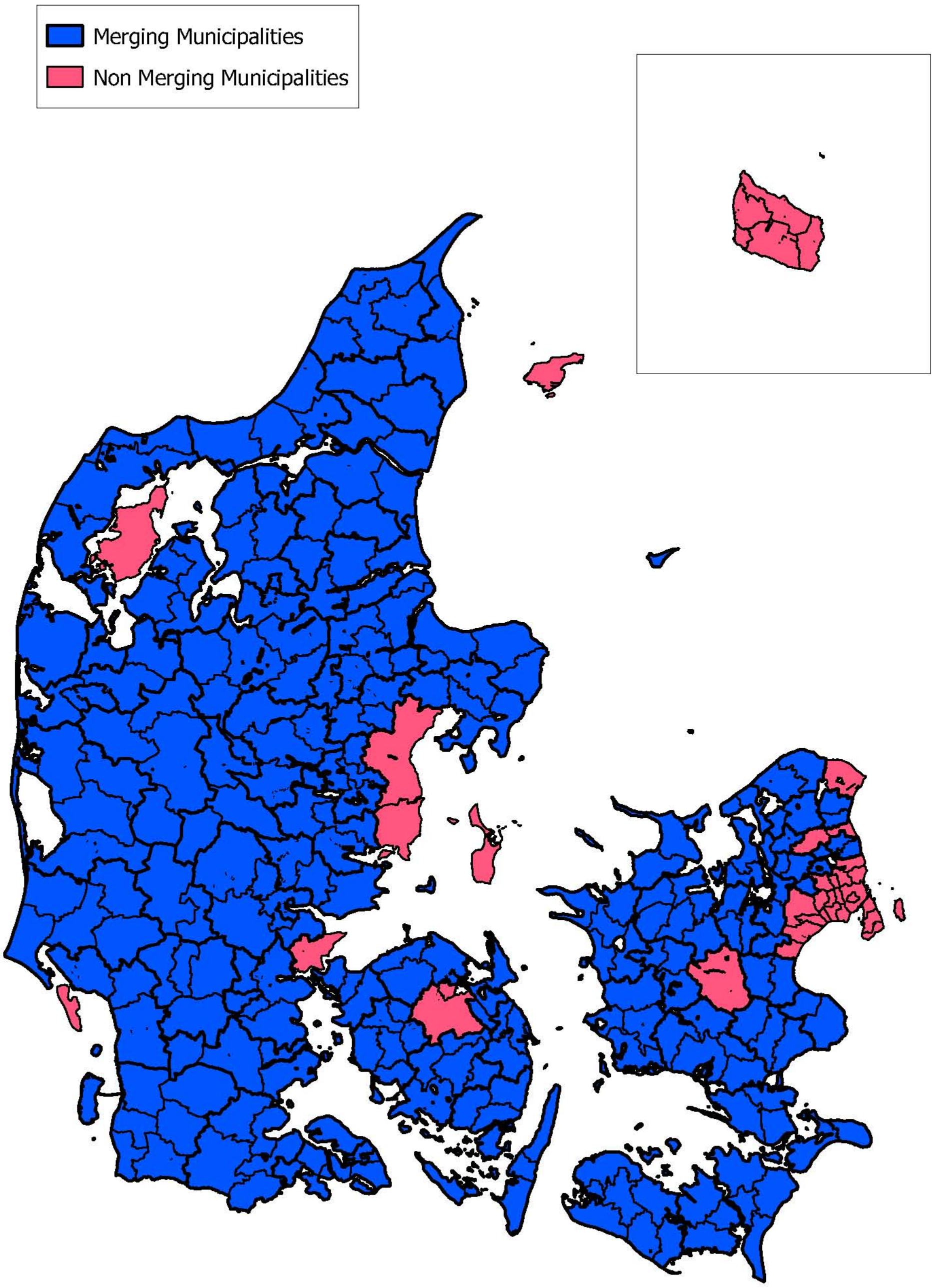

Figure 3.2: Graph of Google searches related to the reform over time.

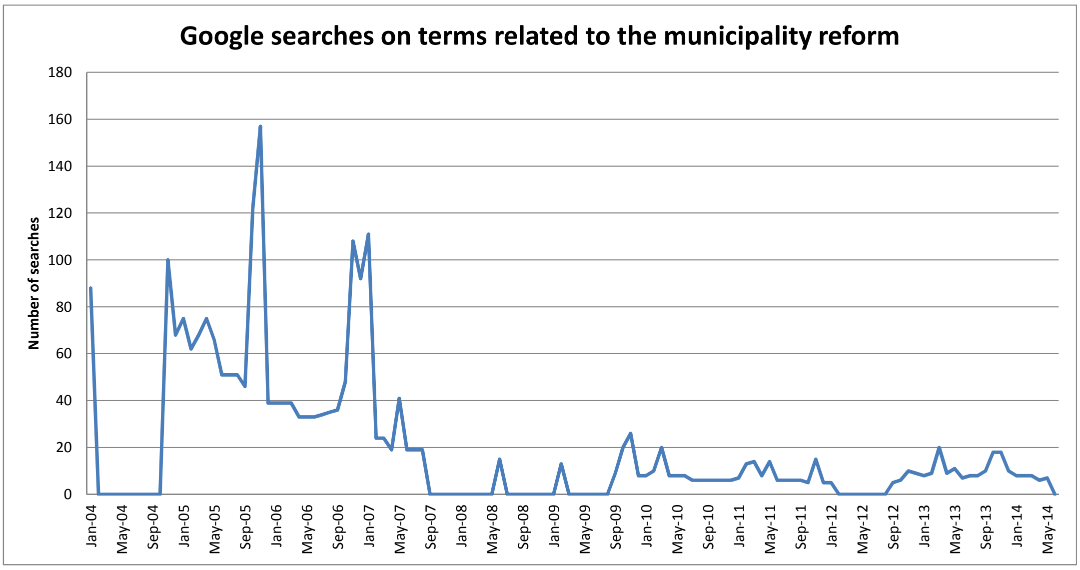

Table 3.1: A fictitious example of how the tax rates changed because of the reform for households living in two merging municipalities, A and B. The municipalities in the example belonged to different counties ("Amter") before the reform.

		A	B
Before the reform	Municipal income tax rate	20%	16%
	Municipal property tax rate	8‰	10‰
	County income tax rate	12%	14%
	County property tax rate	10‰	10‰
		AB	
After the reform	Municipal income tax rate	$\frac{20+(12-8)+16+(14-8)}{2} = 23\%$	
	Municipal property tax rate	$\frac{8+10+10+10}{2} = 19‰$	
		A	B
Relevant tax changes	Municipal income tax rate	23-20-(12-8)=-1%	23-16-(14-8)=1%
	Municipal property tax rate	19-8-10=1‰	19-10-10=-1‰

Table 3.2: Summary statistics for housing and municipal characteristics in 2006 and 2007.

2006						
	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
Price	50000	885000	1350000	1634000	2035000	25000000
Size (m^2)	17	93	121	126	152	1205
Number of rooms	1	3	4	4	5	19
Age in years	1	32	45	58	77	2005
Distance to city center (m)	16	2184	7365	9733	14770	79520
Price/m^2	2059	7644	11510	13660	17770	46830
Income tax (%)	15.50	20.70	21.20	21.13	21.60	23.20
Property tax (‰)	6.00	9.00	12.00	12.99	16.00	24.00
Service Level	0.89	0.98	1.01	1.02	1.05	1.28
Housing types	Townhouse	Apartment	Villa			
No. of sales	11135	7798	45366			
2007						
	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
Price	50000	995000	1500000	1766000	2246000	30000000
Size (m^2)	11	89	118	123	149	834
Number of rooms	1	3	4	4	5	54
Age in years	1	33	47	58	77	1007
Distance to city center (m)	11	2233	6446	9209	14000	78940
Price/m^2	2059	8667	13330	15340	20860	46850
Income tax (%)	19.26	20.29	20.96	20.91	21.42	22.21
Property tax (‰)	6.56	11.17	12.86	13.89	16.34	24.00
Service Level	0.91	0.97	0.99	1.01	1.03	1.21
Housing types	Townhouse	Apartment	Villa			
No. of sales	15179	7822	44499			

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
Income tax rate changes (%)	-2.97	-0.73	-0.21	-0.22	0.23	3.76
Property tax rate changes (‰)	-12.76	-1.45	0.56	0.90	2.93	13.86

Parameter	M1	M2
Intercept	12.382	12.382
	(35.83)	*(214.09)*
Income Tax(%)	-0.044	-0.044
	(-2.69)	*(-19.48)*
Property Tax(‰)	-0.003	-0.003
	(-0.96)	*(-7.67)*
log(No. of rooms)	0.094	0.094
	(8.56)	*(12.76)*
log(Distance to city) (m)	-0.097	-0.097
	(-9.78)	*(-80.54)*
log(Size) (m^2)	0.748	0.748
	(50.68)	*(99.65)*
Age in years	-0.008	-0.008
	(-25.47)	*(-68.07)*
$\text{Age}^2 \cdot 10^3$	0.030	0.030
	(21.13)	*(44.58)*
Housing Type:	-0.031	-0.031
Townhouse	*(-0.71)*	*(-4.28)*
Housing Type:	-0.091	-0.091
Villa	*(-2.02)*	*(-14.85)*
Monthly dummy variable	Yes	Yes
Amt Fixed Effect	Yes	Yes
Municipality Error Clustering	Yes	No
R^2	0.44	0.44
Adj-R^2	0.44	0.44

Table 3.3: This table presents OLS panel regressions for period 2006-2007, where log house price is regressed on the municipality income and property tax, and a vector of house characteristics such as log number of rooms, log distance to the city, log size, age, squared age, house type dummy variable (townhouse, villa and apartment). There is month fixed effect included in both of the regressions. In the first model (M1) there is also amt fixed effect and errors are cluster by each old municipality. In the second model (M2) there is amt fixed effect as well, however the errors are not clustered. The t-statistics are provided in the brackets.

Parameter	First Stage		Second Stage
	Property Tax	Income Tax	log(House Price)
Intercept	0.562 *(0.73)*	-1.799 *(-7.39)*	13.274 *(85.68)*
Tax Income (%)			-0.068 *(-14.86)*
IV-Intended Income Tax (%)		1.046 *(142.48)*	
Tax Property (%)			-0.009 *(-10.90)*
IV-Intended Property Tax (%)	1.007 *(205.15)*		
log(No. of rooms)	-0.244 *(-1.51)*	-0.011 *(-0.27)*	0.063 *(2.37)*
log(Distance to city) (m)	0.062 *(2.97)*	0.012 *(2.28)*	-0.078 *(-22.95)*
log(Size) (m^2)	0.145 *(0.81)*	0.124 *(2.78)*	0.675 *(23.01)*
Age in years	-0.002 *(-0.49)*	0.000 *(0.39)*	-0.007 *(-11.96)*
$\text{Age}^2 \cdot 10^3$	-0.005 *(-0.18)*	-0.009 *(-1.43)*	0.024 *(5.62)*
Housing Type: Townhouse	-1.220 *(-4.95)*	-0.029 *(-0.46)*	-0.115 *(-2.83)*
Housing Type: Villa	-0.894 *(-4.49)*	-0.121 *(-2.41)*	-0.324 *(-9.84)*
Monthly dummy variable	Yes	Yes	Yes
Amt Fixed Effect	Yes	Yes	Yes
R^2	0.92	0.85	0.71
Adj-R^2	0.92	0.85	0.71

Table 3.4: This table presents two stage least square estimation with two endogenous variable: income tax and property tax. The intended income and property tax are used as instrumental variables for income and property tax, respectively. Amt and month fixed effect are included in each of the regressions. The second and third column show coefficient estimates from the first stage least square estimation, whereas the last column presents the coefficients from the second stage where the median log house price in each old municipality is regressed on income tax and property tax from the first stage and other covariates: median old municipality log number of rooms, log distance to city, log size, age, squared age, house type. The two last raw show the R^2 and adjusted R^2 for each of the regression. The t-statistics are provided in the brackets.

Parameter	First Stage			Second Stage
	Property Tax	Income Tax	Service	log(House Price)
Intercept	0.535 *(0.69)*	-1.794 *(-7.33)*	1690.7 *(3.91)*	13.358 *(76.11)*
Income Tax (%)				-0.079 *(-11.95)*
IV-Intended Income Tax (%)		1.045 *(141.65)*		
Property Tax (‰)				-0.011 *(-7.66)*
IV-Intended Property Tax (‰)	1.007 *(204.62)*			
Service$\cdot 10^3$				0.119 *(2.14)*
Education Expenditure			-0.108 *(-2.26)*	
State School Expenditure			-69.02 *(-5.59)*	
log(No. of rooms)	-0.241 *(-1.49)*	-0.011 *(-0.28)*	84.050 *(0.94)*	0.049 *(1.65)*
log(Distance to city) (m)	0.059 *(2.83)*	0.012 *(2.31)*	-38.96 *(-3.38)*	-0.072 *(-16.19)*
log(Size) (m^2)	0.156 *(0.87)*	0.125 *(2.77)*	-152.8 *(-1.54)*	0.696 *(20.88)*
Age in years	-0.002 *(-0.49)*	0.000 *(0.39)*	4.602 *(2.28)*	-0.008 *(-10.99)*
$\text{Age}^2 \cdot 10^3$	-0.005 *(-0.21)*	-0.009 *(-1.43)*	-13.681 *(-0.95)*	0.025 *(5.23)*
Housing Type: Townhouse	-1.232 *(-4.98)*	-0.027 *(-0.44)*	502.56 *(3.67)*	-0.153 *(-3.13)*
Housing Type: Villa	-0.909 *(-4.54)*	-0.120 *(-2.39)*	534.616 *(4.84)*	-0.367 *(-8.81)*
Monthly dummy variable	Yes	Yes	Yes	Yes
Amt Fixed Effect	Yes	Yes	Yes	Yes
R^2	0.92	0.85	0.32	0.67
Adj-R^2	0.92	0.84	0.32	0.67

Table 3.5: This table presents two stage least square estimation with multiple endogenous variable: income tax, property tax and service. The intended income and property tax are used as instrumental variables for income and property tax, respectively. Service is instrumented by education expenditures and state school expenditures. Amt and month fixed effect are included in each of the regressions. The second, third and fourth column show coefficient estimates from the first stage least square estimation, whereas the last column presents the coefficients from the second stage where the median log house price in each old municipality is regressed on income tax, property tax and service from the first stage and other covariates: median old municipality log number of rooms, log distance to city, log size, age, squared age, house type. The two last raw show the R^2 and adjusted R^2 for each of the regression. The t-statistics are provided in the brackets.

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Essay 4

House Prices and Local Public Debt[1]

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Abstract

By using the 2002 case of fraud in the Danish municipality Farum as an exogenous shock to public debt of about 125 million USD or 6600 USD per capita, I estimate the effect of local public debt on house prices. I find that the average home ownership lost between 13.6% and 16.0% in the 3 months after the debt increase. The aggregate effect corresponds to between 100% and 118% of the total debt increase. Also, I document that the initial 1-month aggregate reaction equals about 175% of the total debt increase, and that the reaction is dampened in the following months to between 37% to 75% of the total debt increase. The speed at which the housing market reacts to the increased public debt indicates a very efficient housing market, and the initial overreaction can be fully rational if the housing market initially fears further debt revelations.

4.1 Introduction

The efficiency of the residential housing market, that is the ability to correctly incorporate news into prices, have long been examined. Rayburn et al. [1987], Case and Shiller [1989], Case and Shiller [1990], and Guntermann and Norrbin [1991] all find that the lagged house price changes, to some extent, can predict future house price changes. Had the residential house market been completely efficient, then historical prices should not reveal anything about the future, since this information would be incorporated in the prices. The existing literature on housing market efficiency look at the aggregate housing market. This study focuses on one event in February 2002, in which municipal debt were exogenously increased by approximately 125 million USD in 1 month, and examines whether the housing market efficiently incorporate the new information. The increase in debt was approximately 6600 USD per capita. The municipality in question, Farum, had no long term debt prior to the increase, but the average long term debt for the surrounding municipalities was about 1000 USD per capita in 2002. Thus, the municipal debt increase was substantial. The degree of market efficiency depends both upon the speed at which the market reacts, and whether the reaction is correct/rational.

The residential housing market is naturally less efficient than financial markets such as stock and bond markets. The transaction costs associated with housing sales reduces the potential rent, informed agents gain by acting on their private information. Moreover, the long duration of a sale prolongs the time it takes for news to be incorporated into prices. Finally, the inability to short sell houses limits the agents who can benefit from negative news to current home owners.

To assess the efficiency of the residential housing market, I examine the price reaction to a sudden and large increase in the need for financing due to the discovery of fraud in the Danish municipality Farum in February 2002. In February 2002 journalists discovered that illegal accounting practices had led to an artificially high liquidity buffer. An unreported loan of 250 million DKK was uncovered, and the interior ministry granted Farum a long term loan of 750 million DKK, to recover from the financial distress. Effectively, the debt in Farum rose by 1 billion DKK or about 125 million USD in the month of February 2002.

The price reaction to major news events has been widely studied for financial markets (see e.g. Bondt and Thaler [1985], Ederington and Lee [1993], or Brooks et al. [2003]) but it has hardly been studied for the housing market. The only exception to the author's knowledge is Deng et al. [2013], which uses the 2008 Wenchuan earthquake in China to examine how the housing market reacts to extreme events. They look at the relative price reaction of low and high floor apartments after the earthquake, and find not only that prices fell, but that prices of apartments on high floors decreased more than apartments on low floors. They argue that the price drop is irrational, since the risk of future earthquakes has not changed, and the fact that prices for upper floor apartments decreased more than lower floor apartments, is even more irrational, because it is not riskier to live on upper floors than lower floors in case of an earthquake.

Contrary to the earthquake in Deng et al. [2013], an increase in public debt should, everything else equal, lead to lower house prices, because it increases the probability for future tax increases and/or lower public service. In this way, public debt can be seen as a signal of future taxes and public service. Hence, this study is related to the empirical literature on tax capitalization (see e.g. Oates [1969], Palmon and Smith [1998], and Gallagher et al. [2013]). However, the tax capitalization literature relies on an arbitrary choice of discount rate to discount the future value of taxes. Not surprisingly, the findings varies from under capitalization, to full and even over capitalization. And so, it is hard to take the degree of tax capitalization as a measure of the efficiency of the housing market.

Since debt is a signal of future taxes, and because the value is easily observed, I will automatically know whether the house price reaction is exaggerated or understated. A rational drop in house prices should equal the expected part of future tax increases attributable to home ownerships. It is, of course, hard to define exactly how big a part of future tax increases is attributable to home ownerships, since aside from property taxes, Danish municipalities also finance public service by e.g. income taxes, which affect all residents in the municipality and not just home owners[2]. Nonetheless, the aggregate price reaction should not exceed the increase in debt. The public debt increase thus functions as a

[2]It should be noted however, that renters easier can move to another municipality than home owners, and hence avoid the tax increase. And so, one could argue that home owners will carry a larger part of the future tax burden.

cap on a rational aggregate price effect.

I find that the average home ownership lost between 13.6% and 16.0% in the 3 months after the debt increase. The aggregate effect corresponds to between 100% and 118% of the total debt increase. Also, I document that the initial 1-month aggregate price drop equals about 175% of the total debt increase, and that the reaction is dampened in the following months to between 37% to 75% of the total debt increase. This shows that the housing market initially overreacts to debt increases but quickly adjusts to long-run levels. The speed at which the housing market reacts to the increased public debt indicates a very efficient housing market, and the initial overreaction can be fully rational if the housing market initially fears further debt revelations.

The results are contrary to the findings in the stock market, where among others Bernard and Thomas [1989], Bernard and Thomas [1990] and Michaely et al. [1995] find that stock returns, conditional on public events such as earnings and dividend announcements etc., exhibit post-event drift in the direction of the initial event reaction. That is, the stock market initially underreact to news. However, where most explanations of underreaction in the stock turn to behavioral biases, the reaction in this case could as mentioned be fully rational if the market fears further debt revelations.

The rest of the paper is organized as follows. Section 4.2 reviews the related literature. Section 4.3 discusses the identification strategy. Section 4.4 describes the data and presents summary statistics. Section 4.5 deals with the estimation strategy. Section 4.6 presents the results and section 4.7 concludes.

4.2 Related Literature

There is a wide agreement in the capitalization literature that local taxes and public service are capitalized into house prices - that is house prices tend to be higher in jurisdictions with lower taxes and higher levels of public service. However, the degree of capitalization is somewhat mixed. Chinloy [1978] and Gronberg [1979] find limited capitalization effects, whereas Oates [1969], Edel and Sclar [1974], Gustely [1976], and Yinger et al. [1988] report varying degrees of tax capitalization. Oates [1973], Reinhard [1981], and Gallagher et al. [2013] find close to full or even over capitalization.

In addition to taxes, the literature suggests the capitalization of several other factors. Greenstone and Gallagher [2008] analyze the impact of hazardous waste sites on house prices. Davis [2004] examine the effect of a cancer cluster on house prices, and Black [1999] shows that school quality is capitalized into house prices.

The relation between public debt and house prices has not received the same attention. Banzhaf and Oates [2012] examine the relationship between the public financing choice and the proportion of tenants versus owner-occupied houses, and Stadelmann and Eichenberger [2012] hypothesize that debt capitalization results in house owners have stronger preferences against debt than tenants, but none of the two studies provide any direct test of the capitalization of debt into house prices. To my knowledge, the only other study examining the impact of public debt on house prices is Stadelmann and Eichenberger [2013]. However, the current study differs from Stadelmann and Eichenberger [2013] in a few ways. First of all, Stadelmann and Eichenberger [2013] uses data over several years, and so have to control for all factors affecting house prices. The uses of data over several years could potentially confound their results. I side-step this problem by utilizing the increase in municipal debt by 125 million USD in the month of February 2002 as an exogenous shock to debt. Secondly, the focus of this paper is not on whether or not debt is capitalized into house prices, but how the housing market reacts to news about public debt.

In this light the current study has more in common with studies of major news events on prices and whether these reactions are exaggerated or understated. This has been widely examined for financial markets (see for example Bondt and Thaler [1985], Ederington and Lee [1993], and Brooks et al. [2003]). For the housing market the only study to my knowledge is Deng et al. [2013]. However, Deng et al. [2013] focuses on the house price reaction of earthquakes that alone provide no new information on the occurrence of earthquakes, and so rationally there should not be a house prices reaction.

In the current study the event indeed offers new information, and so the goal is to examine how the housing market reacts to this new information.

4.3 Identification Strategy

I identify whether house prices over- or underreact to news by using the 2002 case of fraud in the Danish municipality of Farum by then mayor Peter Brixtofte as a natural experiment. The national Danish newspaper BT reveals large expenditures from dinners and very expensive wines by then mayor in Farum Peter Brixtofte on February 6th, 2002. The initial scandal turns all the media's attention onto Farum, and on February 17th, an unreported loan of 250 million DKK was uncovered. On February 19th, the interior ministry in Denmark placed Farum under its administration due to a violation of municipal liquidity rule in Denmark known as "Kassekreditreglen", which states that the average municipal liquidity over the previous 12 months has to be positive. The ministry granted Farum a long term loan of 750 million DKK, to recover from the financial distress, contingent on future public service cuts and tax increases. Effectively, the debt in Farum rose by 1 billion DKK or about 125 million USD in the month of February 2002. A substantial amount in a municipality of only 18,854 inhabitants. Prior to the fraud, Farum had listed no long term debt, but the average long term debt in the 4 neighboring municipalities was about 1000 USD per capita in 2002. The discovery corresponds to a long term debt increase of about 6600 USD per capita, so the debt increase was substantial. (See Farum-kommissionen and Justitsministeriet [2012] for more on the scandal).

Since the value of the debt increase is observable, the setup poses a unique possibility to assess the efficiency of the residential housing market, by examining whether and how fast the house prices reacts to the increase in debt, and whether the aggregate price reaction equals the total debt increase.

To control for unobserved factors influencing house prices but unrelated to the increase in debt, I use the 4 neighboring municipalities of Værløse, Stenløse, Allerød, and Birkerød as control group. A map of Farum and the municipalities used as controls are shown in figure 4.1. The municipalities of Lyngby-Tårbæk and Søllerød are not included in the control group, because they are not completely adjacent to Farum, but separated by the lake Furesø.

Table 4.1 shows 2001 key figures for Farum and the surrounding 4 municipalities. It is noticeable that Farum has a lower overall tax level and still has higher overall public service expenditures than each of the other four municipalities. Only the "monthly child care fee" and the "net school expenditures" are more favorable in some of the surrounding municipalities. The high service/low tax combination in Farum makes it hard to choose a perfect control group. In fact, the service level[3] in Farum in 2001 was 1.4 with a country average of 1, and no other municipality in Denmark had as high a service level or as low a tax-service relationship.

I use the three months prior to February 2002 as the pre-event period and the 3 months after February 2002 as the post-event period. Hence, I leave out February 2002, as an information discovery period. This is done to ensure that no agents either buying or selling in the pre-event period could have known about the debt increase, and all agents buying or selling in the post-event period knew about the increase. The time line of the experiment is shown in figure 4.2. A one month event window might seem like a lot especially when comparing to classic policy studies in which the event is a change in law. However, it is hard to define a precise date of discovery, since the size of the debt grew over several days as more articles uncovered the fraud. The wider the event window, the bigger the risk of other factors influencing the results. However, as long as the factors affect both Farum and the control group equally, the results will still be unbiased. It does not seem likely that something affecting house prices in Farum (aside from the increase in debt), would not also affect the control group (the surrounding municipalities).

4.4 Data

All Danish housing sales[4] are recorded by the Danish tax authorities and are available through the Danish public information server through www.OIS.dk. It includes sale dates, prices, size, number of rooms etc. for all Danish addresses back to 1992. The sale date is when the sales agreement was signed, and not when the sale was registered in the public database.

I exclude family transactions. Family sales are easily identified in the dataset, because all family sales are registered and marked as such. I also exclude forced

[3]The service level is defined as the net municipal service expenditure per capita divided by the estimated municipal service expenditure need and then scaled by the average across municipalities. Values above 1 hence indicate that the actual service spending relative to the predicted need is above the average of the Danish municipalities.

[4]Sales of the housing type "Andelsbolig", which is a Danish cooperative housing type, are not recorded, so it is unfortunately not possible to say anything about the size of this market.

sales, and thus only include regular arms length sales in the dataset.

I focus only on the three biggest housing types in Denmark; regular houses (villas), apartments, and townhouses[5]. This is done to avoid special house types, that might be priced differently than regular owner-occupied housing.

All the addresses of the sold houses are geocoded with latitude and longitude coordinates, and the municipal affiliation of each location is determined through the Danish Geodata Agency's (Geodatastyrelsen) mapping services "GeoVA" and "GeoK7".

The house characteristics are supplemented by the distance to the nearest big city in Denmark. This spatial variable is meant to catch the effects of living close to a big city, like better job opportunities, better shopping facilities, closer proximity to schools etc.

4.4.1 Summary Statistics

Table 4.2 shows the summary statistics for the houses sold in Farum and the 4 surrounding municipalities the three months before the event (November and December 2001 and January 2002) and the three months after the event (March, April, and May 2002).

One of the first things to note is the low number of sales in Farum both before and after the debt increase of only 37 and 47 respectively. The control group has respectively 218 and 342 sales in comparison. A few observations in Farum could, hence, influence the results significantly. In fact, one sale taking place in the month prior to the debt increase has a $price/m^2$ of 87,500 DKK, corresponding to more than 5.5 standard deviations above the mean.[6] As a control, I perform the analysis on a sample trimmed on the $price/m^2$ variable for the top and bottom 1%.

Both the mean and median price and price per square meter are higher in Farum than in the control group. However, after the event, both the mean and median price and square price drops in Farum, whereas it increases a bit in the control group. This already hints to an effect of the increased public debt. This could, of course, be driven by a change in the characteristics of the houses sold, especially considering the low number of sales in Farum both before and after

[5] Villaer, ejerlejligheder, and rækkehuse in Danish.

[6] The sale is not a incorrect registration, but a villa with attached commercial properties.

the event.

4.5 Estimation Strategy

I use the February 2002 increase in municipal debt of 125 million USD in the Danish municipality Farum as an exogenous shock to debt, to examine the effect of public debt on house prices.

To estimate the effect of debt on house prices I use the difference-in-differences methodology. I do both simple difference-in-differences regression in the following form:

$$\log(Price_{itj}) = \beta_0 + \delta_0 \cdot 1_{Farum} + \delta_1 \cdot 1_{After} + \delta_2 1_{After} \cdot 1_{Farum} + u_{itj}, \quad (4.1)$$

where i indexes the individual housing sales, t indexes time, and j indexes the treatment (Farum) and control group (the 4 surrounding municipalities). 1_{Farum} is a dummy variable indicating whether the sale took place in Farum (then equalling 1) or in the surrounding municipalities. 1_{After} is a dummy variable equalling 1 if the sale took place after the debt increase and 0 otherwise. $1_{After} \cdot 1_{Farum}$ is the term of interest. It equals 1 if the sale took place in Farum after the scandal, and captures the effect of the increase in debt. The semi-log specification in equation 4.1 is chosen because it provides the best fit of the data. The interpretation of the parameters in the semi-log specification is the relative change in the selling price, $Price$, of a 1 unit of change in the relevant explanatory variable as seen from a simple application of the chain rule on equation 4.1:

$$\begin{aligned} \delta_2 &= \frac{\partial \log(Price)}{\partial 1_{After} \cdot 1_{Farum}} \\ &= \frac{1}{Price} \frac{\partial Price}{\partial 1_{After} \cdot 1_{Farum}} \\ &= \frac{\frac{\partial Price}{Price}}{\partial 1_{After} \cdot 1_{Farum}} \end{aligned}$$

The OLS estimator of δ_2, $\hat{\delta}_2$, has the usual interpretation of

$$\hat{\delta}_2 = (\bar{y}_{Farum,After} - \bar{y}_{Farum,Before}) - (\bar{y}_{Control,After} - \bar{y}_{Control,Before}), \quad (4.2)$$

with the only difference being that $\bar{y}_{Farum,After}$ denotes the average of the *log* house prices in Farum after the debt increase. The other terms are defined likewise.

However, the specification of equation (4.1) does not take into account that the houses sold before the debt increase for the most part will not be the same selling after the reform. Thus, I supplement equation (4.1) with the following regression:

$$\log(Price_{itj}) = \beta_0 + \beta X_{itj} + \delta_0 \cdot 1_{Farum} + \delta_1 \cdot 1_{After} + \delta_2 1_{After} \cdot 1_{Farum} + u_{itj}, \quad (4.3)$$

where X_{itj} includes housing characteristics of the sold houses, to account for possible quality differences before and after the event. The OLS estimator for δ_2 no longer has the simple representation in equation (4.2) but the interpretation is basically the same. I.e. the effect in equation (4.2) conditioned on information about houses sold.

To examine the longer run effects of the debt increase I change the specification of equation (4.3) to

$$\log(Price_{itj}) = \beta_0 + \beta X_{itj} + \delta_0 \cdot 1_{Farum} + \rho_t + \sum_{t=1}^{m} \delta_t \rho_t \cdot 1_{Farum} + u_{itj}, \quad (4.4)$$

where ρ_t is a factor indicating the period in which the sale took place. With this specification, the coefficient, δ_t, captures how the debt increase affects house prices in m periods after the event.

4.6 Results

A first indication of the effect of public debt on house prices is seen in figure 4.3. The graph depicts the median residuals per quarter in Farum and the 4 neighboring municipalities (the control group) from running the regression

$$Price_{itj} = \beta_0 + \beta_1 t + \beta_2 X_{ijt} + u_{itj} \quad (4.5)$$

estimated on data from 1997 until the end of 2001. I.e. estimated over a period ending before the increase in the municipal debt. t denotes time in quarters, and X_{ijt} includes housing characteristics such as size, number of rooms, distance to nearest big city etc. The estimated model is used to predict values in 2002, and the residuals are obtained by subtracting the predicted values from the observed values. The graph clearly shows that until 2001 the model explains the sales prices in Farum and the control group equally well, but when the model is used to predict values for 2002, the sales in Farum are overestimated, while the sales in the 4 surrounding municipalities are still well explained.

However, better estimates of the effect of the debt increase can be obtained. Firstly, the fraud discovery were not made before February 2002, so January should not be part of the post-event period. Secondly, stopping the estimation analysis in the end of 2001 neglects the information in 2002. Hence, a proper difference-in-differences analysis is more appropriate for capturing the effect of public debt on house prices.

Table 4.3 shows the results of running the simple difference-in-differences regression in equation (4.1) using the 3 months before February 2002 as pre-event period and the 3 months after February 2002 as the post-event period. I leave out February 2002 for people to receive the new information. As previously mentioned, this is done to ensure that no agents either buying or selling in the pre-event period could have known about the debt increase, and all agents buying or selling in the post-event period knew about the increase.

The results show a large economic loss of -27.0% for the average home ownership, which is statistical significant even at the 1% confidence level. However, the R^2 is only 1.3% due to the missing housing characteristics relevant for properly explaining the house price variation. Hence, the estimate could be biases by the missing explanatory variables.

A better estimate is obtained by including housing characteristics as in the difference-in-differences specification in equation (4.3). The results of this regression are shown in table 4.4. Most interestingly, the effect of the 125 million USD debt increase is now much lower than in the simple difference-in-differences estimation in table 4.3. However, the estimate is still -16.0% and it is still significant at the 1% level. Assuming that all home ownerships are equally affected, the aggregate mean loss in house prices equals $-16.0\% \cdot 3,600 \cdot 2,060,416 \approx$

$1,190,000,000$ or about 148,000,000 USD, since Farum had a total of 3600 home ownerships in 2002 (See www.dst.dk/en/), and the mean house price in Farum the 3 months before the debt increase where 2,060,416 DKK (on the trimmed data). This corresponds to 118% of the 125 million USD increase in debt. It is probably unrealistic to assume that home owners will be carrying the entire expected future tax burden and/or service reductions. Thus, the price reaction is exaggerated compared to the 125 million USD debt increase.

Including the housing characteristics leads to a higher R^2 of 63.6%, indicating that excluding the housing characteristics might lead to significant omitted variable bias in the estimate of the debt effect. The coefficients related to the housing characteristics all have the expected signs except the number of rooms which has a small negative effect - probably due to the high correlation with the size variable. Houses in Farum trade at a premium of 17.8% compared to the control group, and villas and townhouses are on average significantly more expensive than apartments. The age of the property has a negative (though economically small) impact on the price. The squared age has a positive impact, in line with old houses having charm and tend to have better and more central locations. The size of the house is highly significant and positively related to the selling price. The distance to the nearest big city is also very significant and negatively related to the price. The coefficient in front of the dummy variable, 1_{After}, capturing the time effect, is positive in line with the general appreciation of houses in Denmark in the period.

The summary statistics in table 4.2 indicate that at least one extreme observation might influence the results. Looking at the standardized residuals against the fitted values in figure 4.4 indeed confirms that especially one observation is far from the predicted value. To examine the impact of extreme observations, I run the regression in equation (4.3) on data trimmed on the $price/m^2$ variable for the top and bottom 1%. The results are shown in table 4.5. The R^2 rises to 70.2% from 63.6% in table 4.4 using the full sample, indicating a better fit without the extreme observations. The effect of the debt increase falls to -13.6% but is still both economically and statistically significant. Hence, the extreme observations influence the results, but they are not driving the debt effect. The aggregate effect of the debt increase with this specification corresponds to $-13.6\% \cdot 3600 \cdot 2,060,416 \approx 1,000,000,000$ DKK or about 125,000,000 USD.

This equals the entire debt increase. A large drop considering that home owners are not likely to bear the entire future tax burden and/or lower public service.

Since the extreme observations are indeed real sales, it is not completely clear that excluding these are the correct approach. However, leaving them in will bias the estimates of the variance-covariance matrix of the estimates in regular OLS, since the residuals do not exhibit constant variance, and thus might lead to wrong inferences. In fact, the White [1980] heteroscedasticity test leads to rejection of the H0 hypothesis of homoscedasticity even at the 0.001% confidence level. The White [1980] heteroscedasticity-robust standard errors are computed in table 4.6 for the sample including all observations. The debt effect is still statistically significant, though only at the 5% level.

4.6.1 Long Run Results

The economically large estimates of the debt effect in table 4.4 and 4.5 suggest that the housing market do incorporate new information about local public debt into prices quite fast, though the magnitude of the effect is exaggerated compared to the total debt increase. However, to assess the efficiency one needs to examine the long-run effect. Table 4.7 shows the results from running the regression in equation (4.3) but expanding the post-event period to go from March 2002 to and including December 2004. The estimated debt effect is now -8,4%, and thus significantly lower than the -13.6% in table 4.5 with a 3-month post-event period. This suggest that the initial exaggerated debt effect is diminished over time.

To better examine whether the effect is temporary or permanent, I run two specifications of the regression in equation (4.4); one where δ_t captures the time effect in quarters and one in months. The estimated debt effect is depicted in figure 4.5. From figure 4.5 it is seen that the debt effect is biggest in the beginning and is lessened over time. In the 3-month specification, the initial effect is -13.7%, but then falls to between 5 and 10%. From the 1-month specification it is seen that the effect in the first month is as much as -23.6%, but already in the following month recovers to -13.6%, and then also settling between 5 and 10% after the third month. The number of sales in Farum the month before the debt increase and the months following were 14, 15, 15, 17, 9, 12, 10 respectively. Thus, even though the number of sales drop significantly when moving to 1-month periods, there are still about 15 sales each month, adding some confidence to the reliability of the estimates.

The drop in the first month corresponds to an aggregate effect of $-23.6\% \cdot 2,060,416 \cdot 3,600 \approx 1,750,000,000$ DKK or about 175% of the total debt increase. The long-run effects corresponds to an aggregate effect in the range of ($-5\% \cdot 3,600 \cdot 2,060,416/1,000,000,000 \approx$) 37% to ($-10\% \cdot 3,600 \cdot 2,060,416/1,000,000,000 \approx$) 75% of the total debt increase. This further indicates that the housing market initially overreacts to the debt increase, but quickly adjust to more rational levels.

This suggests an overreaction, since home ownerships should not rationally be expected to carry the entire future tax burden and/or service reductions due to the increased debt. Rationally, renters and corporations in Farum should carry some of the burden through for example income tax increases or increased taxation of corporate properties (dækningsafgift in Danish). It should be noted, that the initial overreaction might still constitute rational behaviour if the market fears further debt revelations in the first month after the event.

The result that public debt affect house prices is in line with Stadelmann and Eichenberger [2013] who also find that public debt influence house prices. The speed at which the housing prices react to the increased public debt indicates a very efficient housing market. The initial overreaction could be in line with the results of Deng et al. [2013] who find that the housing market irrationally reacts to news on earthquakes even though the news contain no new relevant information on the risk earthquakes, however it could also indicate a fully rational housing market, if the market initially fears further debt revelations.

The results are contrary to the findings in the stock market, where among others Bernard and Thomas [1989], Bernard and Thomas [1990] and Michaely et al. [1995] find that stock returns, conditional on public events such as earnings and dividend announcements, exhibit post-event drift in the direction of the initial event reaction. That is, the stock market initially underreact to news. However, where most explanations of underreaction in the stock turn to behavioral biases, the reaction in this case could be fully rational as previously mentioned.

4.6.2 Robustness Checks

One concern regarding the analysis, is the choice of control group. One way to examine this is buy looking at the median residuals per quarter from the regression

$$price_{ijt} = \beta_0 + \beta X_{ijt} + u_{ijt} \tag{4.6}$$

for Farum, each of the 4 surrounding municipalities, and the 4 surrounding municipalities grouped together. In equation (4.6) i indexes individual sales, t denotes time, and j municipalities. X_{ijt} are housing characteristics such as size, number of rooms etc. Figure 4.6 depicts the residuals, i.e. the part of the prices unexplained by the housing characteristics. This indicates that the sales in the 4 surrounding municipalities grouped together tracks the prices of the houses sold in Farum better than each of the municipalities individually, when controlling for the characteristics of the houses sold. Using the group of all 4 surrounding municipalities as control group thus seems like a reasonable choice.

Another potential concern with the results is the choice to include Værløse in the control group. The concern stems from the fact that Farum and Værløse merged as part of the municipality reform that took effect on January 1st 2007.[7] And even though the municipality reform was not presented until 2004, there was still a debate about the need for a reform in 2002. Hence, a potential concern could be that houses in Værøse were affected by the debt increase too. To ameliorate this concern, Værløse is excluded from the control group in the results in table 4.8. Excluding Værøse from the control group, the estimate of the debt effect is 15.4% compared to 13.6% when including Værøse. Thus, including Værløse - if anything - understates the debt effect, further confirming the large initial debt effect on prices.

Figure 4.7 shows that the long-run results are not significantly different when excluding Værløse, and resembles figure 4.5, though the first month effect is higher.

Overall I document that local public debt do affect house prices. Furthermore, I find an effect in the 3 months after the debt increase between -13.6% and 16.0%, depending on the whether the data is trimmed or not. The aggregate

[7]The Danish municipality reform stated basically that municipalities with less than 20,000 inhabitants should should merge with neighboring municipalities to have at least 30,000 inhabitants to better harvest economies of scale benefits.

mean effect corresponds to 100% and 118% of the total debt increase.

Also, I find that the house price reaction in the the first month after the debt increase exceeds the total debt increase by about 50%, but that the reaction is dampened over time.

4.7 Conclusion

By using the 125 million USD increase in municipal debt in the Danish municipality Farum in February 2002 as an exogenous shock to public debt, I am able to directly examine the efficiency of the residential housing market's price reaction to the increases in local public debt. I find that the housing market initially overreacts to the debt increase, but that the overreaction is lessened over time.

Specifically, I document that local public debt do affect house prices. In the 3 months after the debt increase the house prices drop between -13.6% and 16.0% due to the debt increase, depending on the whether the data is trimmed or not and the choice of control group. The aggregate mean effect ranges from 100% and 118% of the total debt increase.

Moreover, I find that the house price reaction in the the first month after the debt increase exceeds the total debt increase by about 75%, but that the reaction is reduced over time. The long-run effect lies in the range of 37% to 75% of the total debt increase.

The result that public debt affects house prices is in line with Stadelmann and Eichenberger [2013] who also find that public debt influence house prices. The speed at which the housing prices react to the increased public debt indicates a very efficient housing market. The initial overreaction could be in line with the results of Deng et al. [2013] who find that the housing market irrationally reacts to news on earthquakes even though the news contain no new relevant information on the risk earthquakes, however it could also indicate a fully rational housing market, if the market initially fears further debt revelations.

4.8 Figures and Tables

Figure 4.1: Map of Farum (treatment group) and the surrounding municipalities (control group).

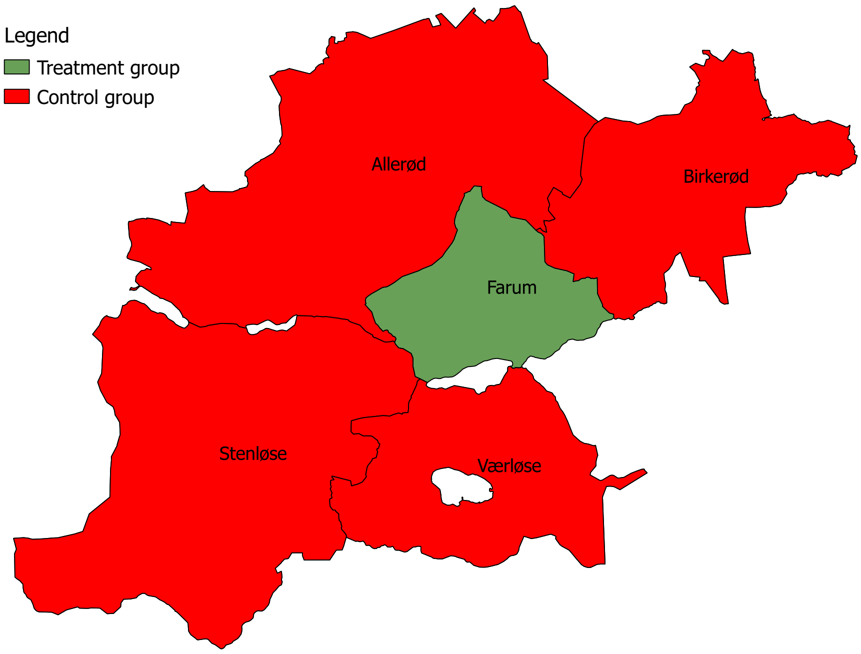


Figure 4.2: Time line of the experiment.

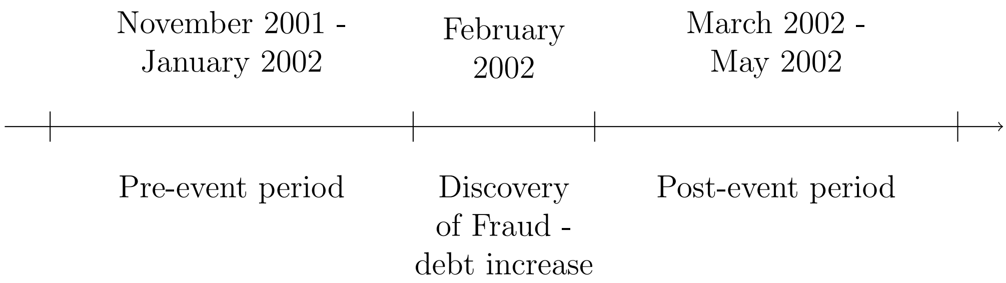


Figure 4.3: The median residuals per quarter from Farum and the 4 neighboring municipalities (the control group) from running the regression $Price_{itj} = \beta_0 + \beta_1 t + \beta_2 X_{ijt} + u_{itj}$ from 1997 till the end of 2001. From 2002 the estimated model is used to predict values and the residuals are obtained by subtracting the predicted values from the observed values.

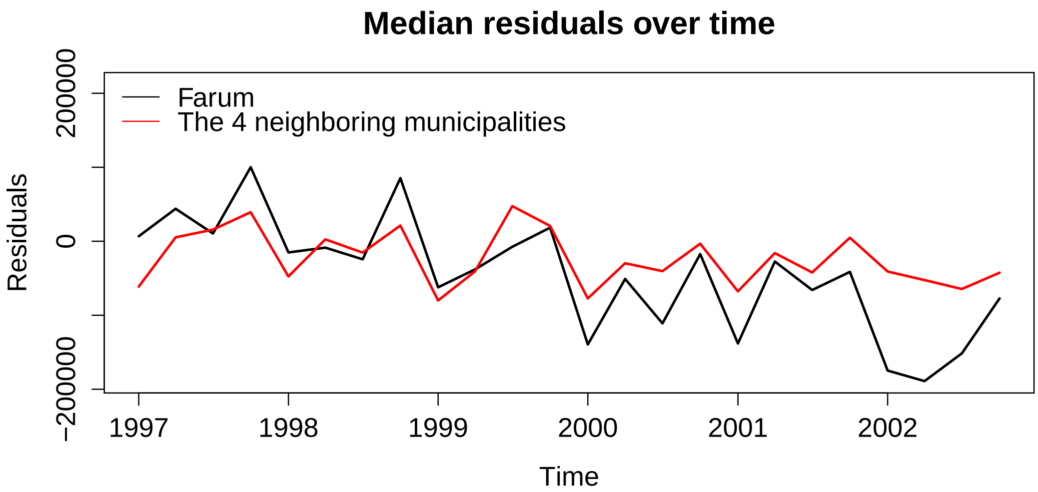


Figure 4.4: The graph shows the standardized residuals against the fitted values of the regression presented in table 4.4.

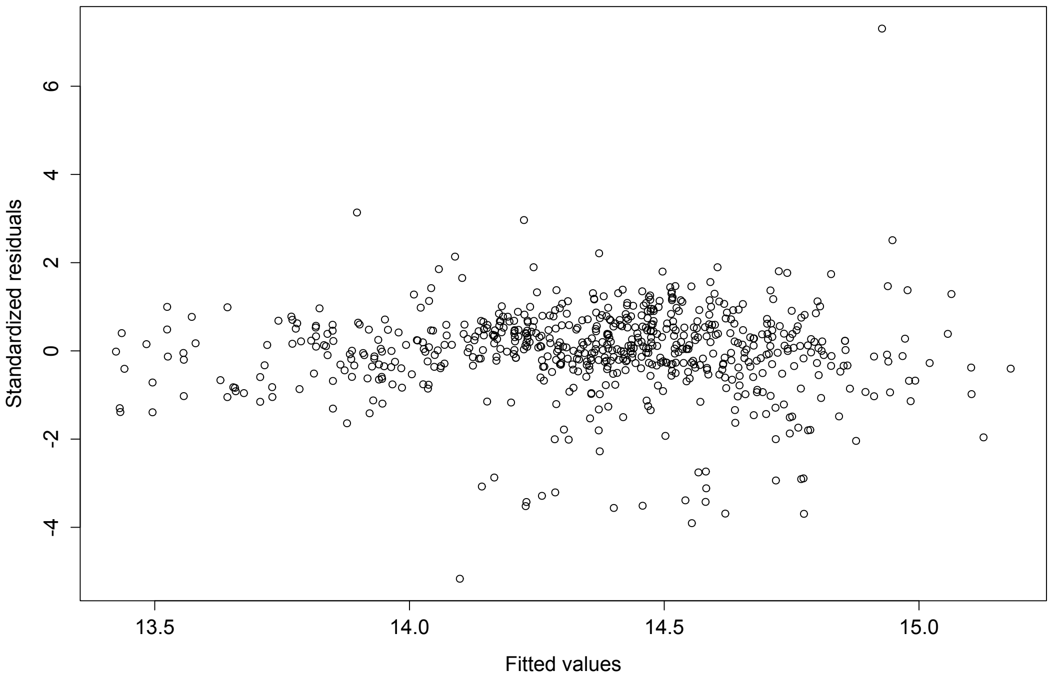
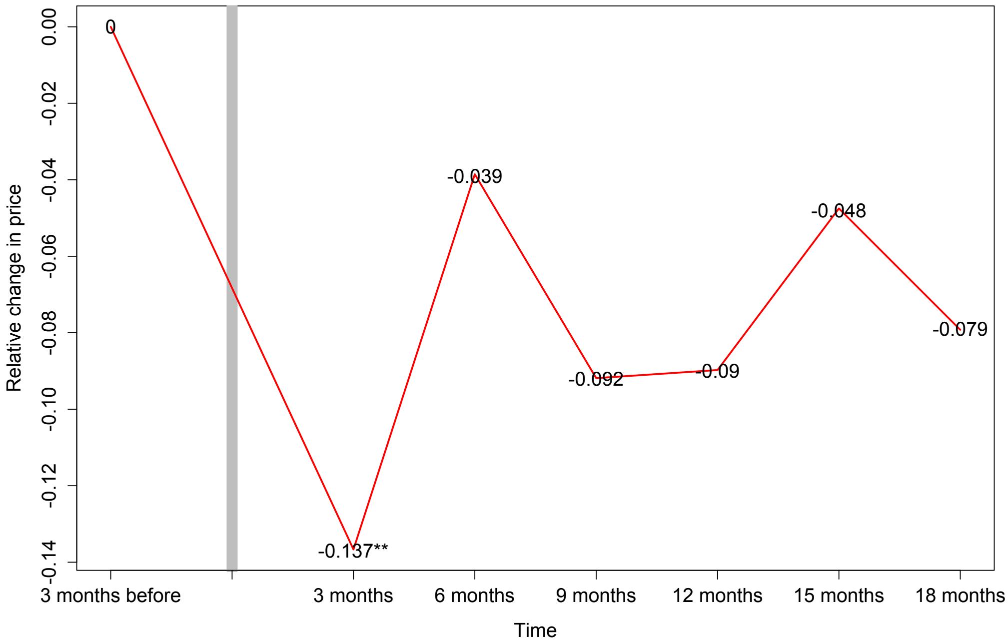


Figure 4.5: The graph shows difference-in-differences estimates from running the regression in equation (4.4). The event time, $t = 0$, is February 2002. ** denotes rejection at the 1% confidence level of the H_0 hypothesis that the effect of debt is equal to 0.



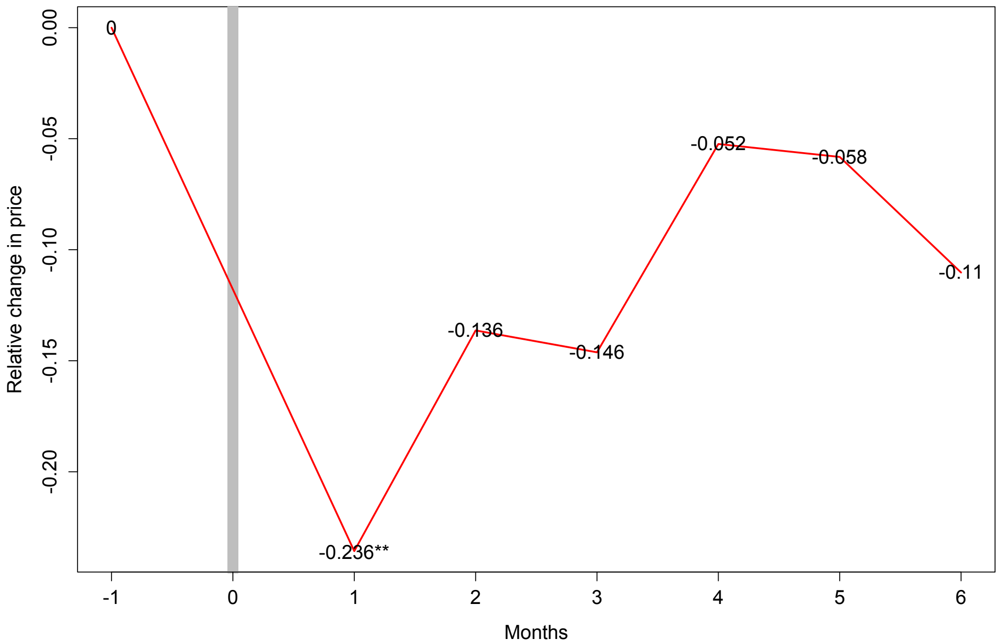


Figure 4.6: Median residuals per quarter from the regression $price_{ijt} = \beta_0 + \beta X_{ijt} + u_{ijt}$ for Farum, each of the 4 surrounding municipalities, and the 4 surrounding municipalities grouped together. X_{ijt} are housing characteristics such as size, number of rooms etc. The graph hence shows the part of the prices unexplained by the housing characteristics.

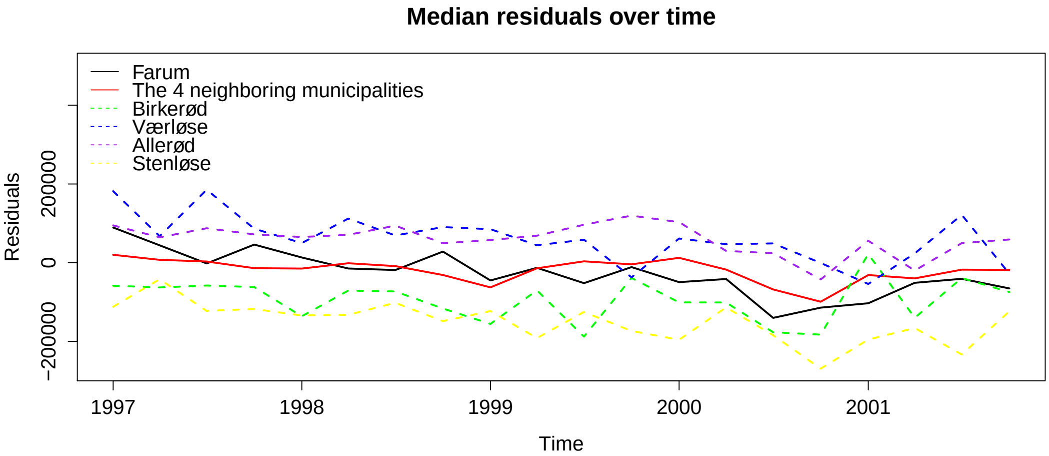
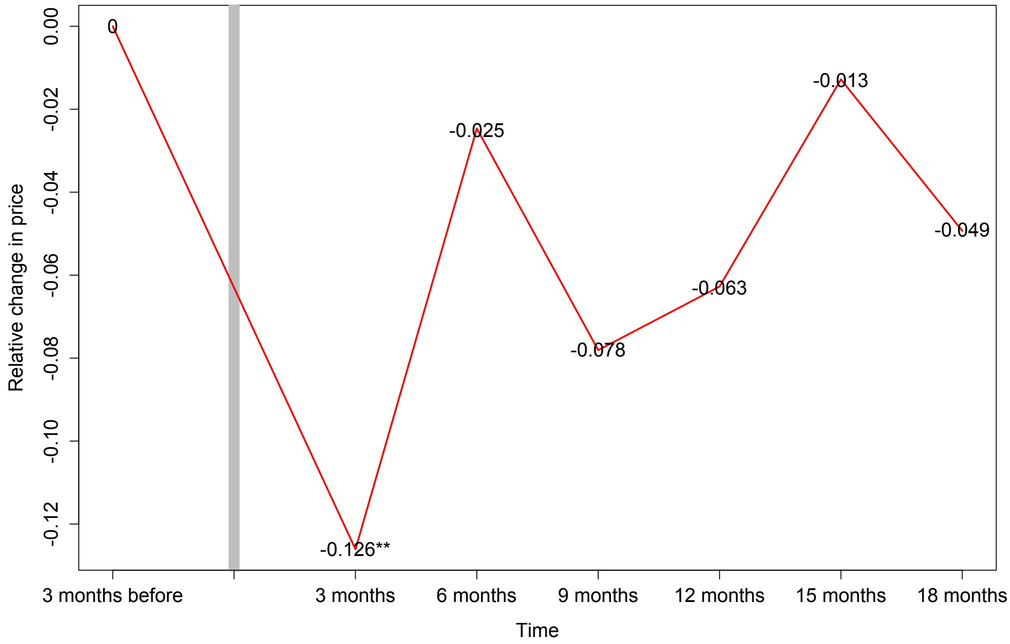


Table 4.1: 2001 values on select municipal tax and public service figures for Farum and the 4 surrounding municipalities in the control group. The overall tax level is a weighting of all the municipal taxes including income taxes, private property taxes, and corporate property taxes. Net public service expenditure pr. capita is the total expenditure used on public service in the municipality in relation to the number of inhabitants. The service level is a relative measure of how much the municipality spends on service compared to the average municipality (an average municipality has a service level of 1). Monthly child care fee is the user payment for child care. Net school expenditure pr. pupil are the total expenditure used on public schools (age 6 to 16). Cultural expenditure pr. capita is the money spend on libraries, Arts and Theater etc. Expenditure on sport and leasure pr. capita covers subsidies for children's soccer practice etc.

	Farum	Birkerød	Værløse	Allerød	Stenløse
Overall tax level (%)	19.36	20.27	20.68	21.54	22.04
Net public service expenditure pr. capita	38275	26186	27375	27079	26470
Service level	1.4	1.06	1.1	1.09	1.15
Tax-service relation	0.78	0.89	0.92	0.94	0.93
Monhtly child care fee for 0-2-year olds	2189	2095	2432	2075	2030
Monhtly child care fee for 3-5-year olds	1451	1274	1346	1415	1320
Net school expenditure pr. pupil	50747	48120	43715	48796	53696
Cultural expediture pr. capita	884	286	196	533	228
Expenditure on leasure pr. capita	3291	1075	1023	1143	1049

Figure 4.7: The graph shows difference-in-differences estimates from running the regression in equation (4.4) but excluding Værløse from the control group. The event time, $t = 0$, is February 2002. ** denotes rejection at the 1% confidence level of the H_0 hypothesis that the effect of debt is equal to 0.



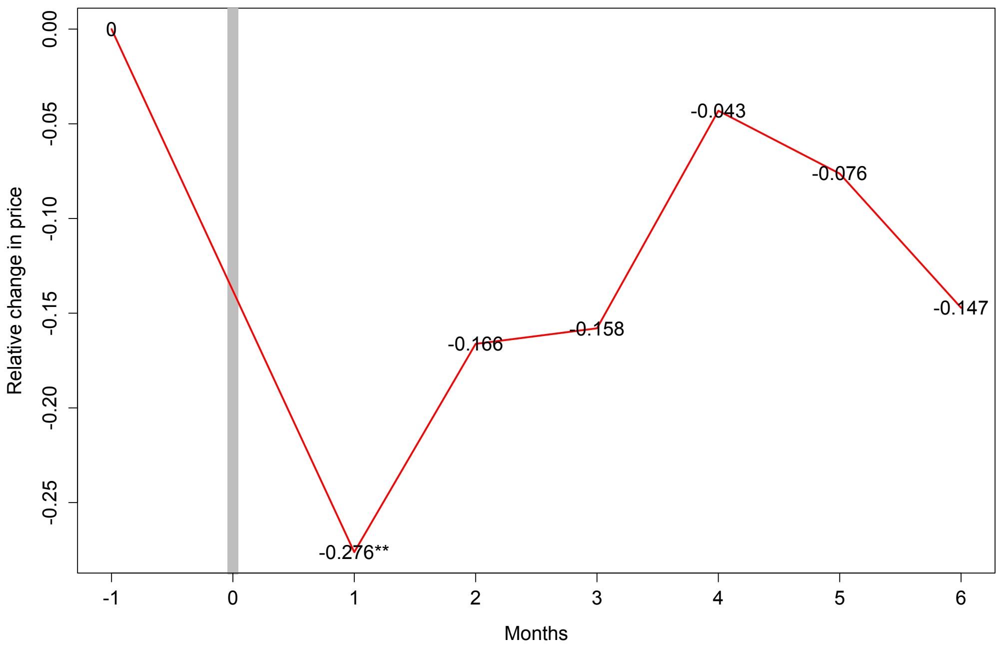


Table 4.2: Summary statistics for the housing sales in Farum (treatment group) and the surrounding municipalities (control group) the 3 months before the revelation of the scandal (November and December 2001 and January 2002) and the 3 months after the scandal (March, April and May 2002).

Before							
				Farum			
	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	S.D.
Distance (m)	18468	19471	19781	19913	20442	21572	793
Rooms	2	4	5	4.865	6	10	1.7
Price	785000	1580000	2025000	2450638	2557495	17500000	2633547
Size (m^2)	61	120	136	146.7	171	350	57.6
Price/m^2	5243	13110	14465	16514	16244	87500	12484
Age	6	30	35	40.35	42	142	25
No. of sales	Apartments	Townhouses	Villas	Total			
	5	9	23	37			
				Control group			
	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	S.D.
Distance (m)	2084	4713	17778	16579	25270	27538	9184
Rooms	1	4	4	4.491	5	10	1.5
Price	372000	1320314	1731811	1852258	2375000	4777777	727099
Size (m^2)	46	105.2	129	133.1	159.8	267	45.4
Price/m^2	3543	12255	13858	14203	16247	43074	4122
Age	1	26	33	36.8	41.75	201	23
No. of sales	Apartments	Townhouses	Villas	Total			
	39	52	127	218			
After							
				Control group			
	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	S.D.
Distance (m)	18244	19612	19742	19787	20079	21582	672
Rooms	2	3	5	4.574	5.5	8	1.7
Price	824230	1144365	1720000	1669357	2083063	2573180	500161
Size (m^2)	53	82	125	124.6	165.5	195	41.5
Price/m^2	5558	12203	14254	13870	15656	21534	2887
Age	4	32	37	37.17	40	122	18
No. of sales	Apartments	Townhouses	Villas	Total			
	13	16	18	47			
				Control group			
	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	S.D.
Distance (m)	2066	4775	17873	16904	25480	27555	9242
Rooms	1	4	4	4.36	5	10	1.5
Price	515722	1450000	1825000	1874154	2256750	5750000	684604
Size (m^2)	44	99.25	129	128.79	154	295	43.6
Price/m^2	4500	12911	14791	14880	17059	24475	3445
Age	1	28	35	41.56	43	192	27
No. of sales	Apartments	Townhouses	Villas	Total			
	79	62	201	342			

Table 4.3: Results of a simple difference-in-differences regression of equation (4.1) without housing characteristics for the properties sold 3 months before and after the debt increase. The regressand is the log sales price. The log sales price is regressed against a constant, a dummy variable equalling 1 if the sale is in Farum and 0 if it is in the control group, a dummy variable equalling 1 if the sale took place after the debt increase and 0 otherwise, and a interaction between the dummy variable indicating treatment (Farum) and the dummy variable indicating whether the sale took place after or before the debt increase. The regression is estimated by Ordinary Least Squares. *** denote significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

	Estimate	Std. Error	t-value	p-value
Intercept	14.347***	0.027	522.100	0.000
1_{Farum}	0.175*	0.072	2.421	0.016
1_{After}	0.027	0.035	0.775	0.439
$1_{\text{After}} \cdot 1_{\text{Farum}}$	-0.270**	0.096	-2.813	0.005
R^2	1.3%			

Table 4.4: Results of difference-in-differences type regressions with housing characteristics as in equation (4.3) to account for quality differences in the houses sold 3 months before and after the increase in debt. The regressand is the log sales price. The log sales price is regressed against a constant, a dummy variable equalling 1 if the sale is in Farum and 0 if it is in the control group, a dummy variable equalling 1 if the property is a townhouse and 0 otherwise, a dummy variable equalling 1 if the property is a villa and 0 otherwise, the age of the property, the age of the property squared, the size of the property, the number of rooms, a dummy variable equalling 1 if the sale took place after the debt increase and 0 otherwise, and a interaction between the dummy variable indicating treatment (Farum) and the dummy variable indicating whether the sale took place after or before the debt increase. The regression is estimated by Ordinary Least Squares. *** denote significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

	Estimate	Std. Error	t-value	p-value
Intercept	12.312***	0.272	45.325	0.000
1_{Farum}	0.178***	0.045	3.985	0.000
$1_{\text{townhouse}}$	0.174***	0.037	4.642	0.000
1_{villa}	0.225***	0.038	5.970	0.000
log(Age)	-0.099***	0.018	-5.645	0.000
Age^2	0.000***	0.000	4.406	0.000
log(Size) (m^2)	0.752***	0.053	14.073	0.000
Rooms	-0.025*	0.011	-2.201	0.028
log(Distance) (m)	-0.143***	0.014	-10.240	0.000
$1_{\text{After}} \cdot 1_{\text{Farum}}$	-0.160**	0.059	-2.709	0.007
1_{After}	0.064**	0.022	2.977	0.003
R^2	63.6%			

Table 4.5: Results of difference-in-differences type regressions with housing characteristics as table 4.4 but where data is trimmed on the price/m^2 variable for the top and bottom 1%. The log sales price is regressed against a constant, a dummy variable equalling 1 if the sale is in Farum and 0 if it is in the control group, a dummy variable equalling 1 if the property is a townhouse and 0 otherwise, a dummy variable equalling 1 if the property is a villa and 0 otherwise, the age of the property, the age of the property squared, the size of the property, the number of rooms, a dummy variable equalling 1 if the sale took place after the debt increase and 0 otherwise, and a interaction between the dummy variable indicating treatment (Farum) and the dummy variable indicating whether the sale took place after or before the debt increase. The regression is estimated by Ordinary Least Squares. *** denote significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

	Estimate	Std. Error	t-value	p-value
Intercept	11.954***	0.242	49.339	0.000
1_{Farum}	0.137***	0.040	3.454	0.001
$1_{\text{townhouse}}$	0.151***	0.033	4.571	0.000
1_{villa}	0.172***	0.034	5.094	0.000
log(Age)	-0.090***	0.015	-5.912	0.000
Age^2	0.000***	0.000	3.415	0.001
log(Size) (m^2)	0.802***	0.047	16.953	0.000
Rooms	-0.020*	0.010	-2.014	0.044
log(Distance) (m)	-0.130***	0.012	-10.626	0.000
$1_{\text{After}} \cdot 1_{\text{Farum}}$	-0.136**	0.052	-2.624	0.009
1_{After}	0.063***	0.019	3.312	0.001
R^2	70.2%			

Table 4.6: Results of difference-in-differences type regressions with housing characteristics as table 4.4 but using the White [1980] heteroscedasticity-consistent covariance matrix estimation method. The regressand is the log sales price. The log sales price is regressed against a constant, a dummy variable equalling 1 if the sale is in Farum and 0 if it is in the control group, a dummy variable equalling 1 if the property is a townhouse and 0 otherwise, a dummy variable equalling 1 if the property is a villa and 0 otherwise, the age of the property, the age of the property squared, the size of the property, the number of rooms, a dummy variable equalling 1 if the sale took place after the debt increase and 0 otherwise, and a interaction between the dummy variable indicating treatment (Farum) and the dummy variable indicating whether the sale took place after or before the debt increase. The regression is estimated by Ordinary Least Squares. *** denote significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

	Estimate	Std. Error	t-value	p-value
Intercept	12.312***	0.308	39.941	0.000
1_{Farum}	0.178**	0.062	2.868	0.004
$1_{\text{townhouse}}$	0.174***	0.035	5.000	0.000
1_{villa}	0.225***	0.038	5.989	0.000
log(Age)	-0.099***	0.017	-5.846	0.000
Age^2	0.000**	0.000	2.625	0.009
log(Size) (m^2)	0.752***	0.058	12.866	0.000
Rooms	-0.025*	0.011	-2.197	0.028
log(Distance) (m)	-0.143***	0.014	-10.504	0.000
$1_{\text{After}} \cdot 1_{\text{Farum}}$	-0.160*	0.067	-2.367	0.018
1_{After}	0.064**	0.022	2.903	0.004
R^2	63.6%			

Table 4.7: Results of difference-in-differences type regressions with housing characteristics to account for differences in the houses sold 3 months before and all the time through 2004 after the debt increase. The regressand is the log sales price. The log sales price is regressed against a constant, a dummy variable equalling 1 if the sale is in Farum and 0 if it is in the control group, a dummy variable equalling 1 if the property is a townhouse and 0 otherwise, a dummy variable equalling 1 if the property is a villa and 0 otherwise, the age of the property, the age of the property squared, the size of the property, the number of rooms, a dummy variable equalling 1 if the sale took place after the debt increase and 0 otherwise, and a interaction between the dummy variable indicating treatment (Farum) and the dummy variable indicating whether the sale took place after or before the debt increase. Data is trimmed on the price/m^2 variable for the top and bottom 1%. The regression is estimated by Ordinary Least Squares. *** denote significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

	Estimate	Std. Error	t-value	p-value
Intercept	11.944***	0.094	126.415	0.000
1_{Farum}	0.112**	0.038	2.930	0.003
$1_{\text{townhouse}}$	0.199***	0.014	14.725	0.000
1_{villa}	0.238***	0.014	17.169	0.000
log(Age)	-0.073***	0.006	-12.113	0.000
Age^2	0.000**	0.000	2.999	0.003
log(Size) (m^2)	0.736***	0.019	38.773	0.000
Rooms	-0.009*	0.004	-2.260	0.024
log(Distance) (m)	-0.110***	0.005	-23.505	0.000
$1_{\text{After}} \cdot 1_{\text{Farum}}$	-0.084*	0.040	-2.119	0.034
1_{After}	0.090***	0.015	6.017	0.000
R^2	71.8%			

Table 4.8: Results of difference-in-differences type regressions leaving out Værløse of the control group with housing characteristics to account for differences in the houses sold 3 months before and after the debt increase. The regressand is the log sales price. The log sales price is regressed against a constant, a dummy variable equalling 1 if the sale is in Farum and 0 if it is in the control group, a dummy variable equalling 1 if the property is a townhouse and 0 otherwise, a dummy variable equalling 1 if the property is a villa and 0 otherwise, the age of the property, the age of the property squared, the size of the property, the number of rooms, a dummy variable equalling 1 if the sale took place after the debt increase and 0 otherwise, and a interaction between the dummy variable indicating treatment (Farum) and the dummy variable indicating whether the sale took place after or before the debt increase. Data is trimmed on the price/m^2 variable for the top and bottom 1%. The regression is estimated by Ordinary Least Squares. *** denote significance at the 0.1% confidence level, ** significance at the 1% confidence level, and * denotes significance at the 5% confidence level.

	Estimate	Std. Error	t-value	p-value
Intercept	12.221***	0.269	45.479	0.000
1_{Farum}	0.169***	0.041	4.140	0.000
$1_{\text{townhouse}}$	0.141***	0.037	3.842	0.000
1_{villa}	0.175***	0.037	4.693	0.000
log(Age)	-0.093***	0.017	-5.463	0.000
Age^2	0.000***	0.000	3.688	0.000
log(Size) (m^2)	0.746***	0.054	13.906	0.000
Rooms	-0.017	0.011	-1.558	0.120
log(Distance) (m)	-0.133***	0.013	-10.541	0.000
$1_{\text{After}} \cdot 1_{\text{Farum}}$	-0.154**	0.053	-2.908	0.004
1_{After}	0.076***	0.022	3.469	0.001
R^2	67.8%			

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Conclusion

This thesis contains 4 essays concerning real estate finance. The topics of the 4 essays range from trying to understand the commonalities and differences between publicly and privately traded commercial real estate and macroeconomic risk, through utilizing the special institutional nature of Real Estate Investment Trusts (REITs) to estimate the effect of corporate taxes and agency problems on the capital structure of companies, to the effect of local municipal taxes and debt on residential house prices. All 4 essays are empirical.

The first essay examines the relationship between public and privately traded commercial real estate and macroeconomic risk. I use a large macroeconomic dataset of 122 time series and extract the underlying factors. I find that the macroeconomic dataset can be efficiently described by 4 fundamental factors, which I interpret as a Recession factor, a Housing and Credit factor, an Inflation factor, and an Interest Rate factor. I use these factors along with stock market factors to explain the time series variation of publicly traded Real Estate Investment Trusts (REITs) and direct and privately traded real estate proxied by the MIT trade based index (TBI).

I find that REITs are driven by stock market factors and the interest rate factor. REITs lead private real estate, and private real estate also reacts with a lag to the interest rate factor and a recession factor. REITs and private real estate are thus related both directly through their lead-lag relationship and indirectly through a common exposure to US interest rates.

The second essay analyzes the effect of the tax advantage of debt and the mitigating effect of debt on free cash flow agency problems on firm capital structure choices. Specifically, I examine how the two effects affect the level of leverage and the tendency of firms to have dynamic target leverage ratios that they revert to as predicted by the dynamic Trade-off theory.

I do this by comparing publicly listed real estate investment trust (REITs), which are effectively tax exempt and not prone to free cash flow agency problems, because they are required to pay out at least 90% of the taxable income as dividends and can deduct the dividends from their taxable income, to regular listed real estate companies without the REIT status (non-REITs).

I find that REITs have similar or even higher leverage ratios than similar non-REITs real estate firms. More so, I document that REITs have higher target leverage ratios than non-REITs and that the speed at which they revert to the targets are equal for the two groups. This is not line with the largest benefits of debt being the tax advantage and the reduction in free cash flow agency problems, as is often mentioned in the literature, and could suggest that firms have other benefits of debt.

The third essay is co-authored with Aleksandra Rzeźnik from Copenhagen Business School. It deals with the effect of municipal income and property tax rates on residential house prices. By utilizing the 2007 municipality reform in Denmark as an exogenous shock to municipal income and property tax rates, we are able to estimate the influence of taxes on house prices.

We find that a 1%-point increase in the income tax rate lead to a drop in house prices of 7.9% and a 1‰-point increase in the property tax rate lead to a 1.1% drop in house prices. The simple present value of a 1%-point perpetual income tax increase and of a 1‰-point property tax increase, relative to the median house price correspond to 7% and 3.3%, repectively. Our findings are thus in line with predicted. This indicates that the housing market efficiently incorporates taxes into house prices.

The fourth essay examines the efficiency of the residential housing market by utilizing the 2002 case of fraud in the Danish municipality of Farum as an exogenous shock to municipal debt. Using a difference-in-differences methodology with the surrounding municipalities as a control group, I find that the average house price dropped between 13.6% and 16.0% due to the debt increase in the 3 months after the debt revelation. The aggregate effect corresponds to between 100% and 118% of the total debt increase. Furthermore, I document that the initial 1-month aggregate price drop equals about 175% of the total debt increase, and that the reaction is dampened in the following months to between 37% to 75% of the total debt increase. This shows that the housing market initially overreacts to the debt increase but quickly adjusts to more rational levels. The speed at which the housing market reacts to the increased public debt indicates a very efficient housing market, and the initial overreaction can be fully rational if the housing market initially fears further debt revelations.

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