Measuring Monetary Conditions in US Asset Markets - A Market Specific Approach

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Abstract

We analyze monetary conditions in US asset markets — corporate equity, real estate, Treasury bond and corporate & foreign bond — from a market specific perspective, proposing the concept of market leverage. Market leverage measures the average leverage of all asset holders in a particular asset market. The concept builds on an accounting-based network that links balance sheet leverages of asset holders to their corresponding shares of ownership. Our empirical analysis yields the following results. Firstly, market specific monetary conditions can differ considerably among asset markets. Secondly, market specific monetary conditions are positively related to asset prices. Thirdly, US asset markets have experienced a loosening in market specific monetary conditions in the last decades. Fourthly, the loosening of market specific monetary conditions explains long-term increases in US asset prices. Fifthly, the recent convergence of market specific monetary conditions of real asset markets towards those of financial asset markets implies a rise in upside risk to future US asset price inflation.

Key words: market leverage, monetary conditions, asset prices
JEL classification: E4, E5, G1

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1 Motivation

Asset prices are often said to be driven by monetary conditions. Conventional monetary measures, such as money, credit or interest rates, focus on the economy as a whole and are not particularly helpful for explaining developments in specific asset markets. Taking an alternative perspective, we analyze monetary conditions in US asset markets from a market specific point of view using the concept of market leverage. To our knowledge no comparable measure exists that focuses on monetary conditions in particular asset markets.[1] We address this shortcoming and ask: How can market specific monetary conditions be identified? How did market specific monetary conditions in US asset markets evolve? Can these developements explain long-term movements in US asset prices? What do market specific monetary conditions imply for future risks on US asset price inflation?

We contribute to the literature by proposing the concept of market leverage.[2] The market leverage captures monetary conditions in a specific asset market by measuring the average leverage of asset holders. This average leverage indicates to what extent assets in a particular asset market are financed by debt. A high market leverage points to loose monetary conditions since asset purchases are financed to a high degree by debt. The concept of market leverage is consistent with the recent zeitgeist of an emerging strand of literature that uses balance sheet leverages to measure monetary conditions (see, e.g., Adrian and Shin, 2008b, 2009, 2010; Fostel and Geanakoplos, 2008; Geanakoplos, 2009). In general, an adequate monetary indicator for a particular asset market should incorporate the following four aspects.

Firstly, the pure focus on the classical lending sector only insufficiently captures monetary conditions in market-based financial systems (see Adrian and Shin, 2006, p. 307).

[1] Adrian and Shin (2008b, 2009, 2010) are among the first that focus on monetary conditions in asset markets. However, they refer to security brokers and dealers to measure monetary conditions in the entire financial system instead of referring to particular asset markets.

[2] The concept of market leverage has to be distinguished from the conventional term of market or micro liquidity, which points to the market's ability to absorb temporary imbalances between demand and supply without having any significant impact on the price (see Baks and Kramer, 1999, p. 3).

Accordingly, we follow Geanakoplos (2003, pp. 203) and consider monetary conditions as the endogenous outcome of the interaction of market participants. The concept of market leverage incorporates this aspect by taking all asset holders of an asset market into account.[3]

Secondly, every asset market is subject to a unique composition of asset holders. Depending on its specific situation each individual asset holder perceives the prevailing monetary conditions differently. The concept of market leverage incorporates this diversity by taking the specific monetary conditions of different asset holders into account.

Thirdly, conventional measures of monetary conditions, such as interest rates, merely capture the incentive to incur debt. Another important but often neglected aspect of monetary conditions are financial frictions such as collateral requirements and haircuts.[4] The concept of market leverage incorporates financial frictions of borrowing sectors (see Adrian and Shin, 2008b, 2010) and lending sectors (see Bernanke and Gertler, 1989; Bernanke et al., 1996).

Fourthly, conventional measures of monetary conditions primarily focus on consumer price stability.[5] The concept of market leverage incorporates asset prices by taking a balance sheet perspective so that changes in asset prices are reflected in revaluations of balance sheet items.

The paper is organized as follows. Section 2 derives the concept of market leverage. Section 3 discusses the influence of monetary policy and other important determinants. Section 4 presents a descriptive analysis of market leverages and empirically estimates the influence of market leverages on asset prices. Section 5 summarizes our main findings.

[3] This is in contrast to other measures of monetary conditions, such as monetary overhang, real and nominal money gap, that focus in particular on the money holding sector.

[4] Usually the allowance of credit requires collateral to be pledged as security. The haircut on the collateral determines how much of an investment in asset markets can be financed by debt.

[5] For instance, money based measures of monetary conditions, such as the monetary overhang, the real and nominal money gap, are mostly confined to consumer markets by employing a consumer price index as proxy for the aggregated price level. This formulation neglects that asset prices do also serve as balancing variable for (real) money imbalances.

2 The concept of market leverage

The concept of market leverage is a market specific approach to identify monetary conditions in a particular asset market. The market leverage is the average balance sheet leverage of all asset holders in a particular asset market. A high (low) market leverage points to loose (tight) monetary conditions for the asset market in question since asset purchases are financed to a high (low) degree by debt.

2.1 Some elementary balance sheet arithmetic

We begin with some elementary balance sheet arithmetic to build an intuition for the concept of market leverage. A balance sheet shows on the asset side the uses of funds and on the liability side the sources of funds.

assets	liabilities
real assets	liabilities
financial assets	net worth

Table 1: A stylized balance sheet

As illustrated in table 1 a stylized balance sheet consists of real and financial assets on the asset side and of liabilities and net worth on the liability side. Please note that liabilities comprehend debt and further obligations. Moreover, net worth is defined as the residual balance item given by the difference between assets and liabilities.

In our sectoral analysis we focus on aggregated balance sheets of different sectors in an economy, such as households and financial business. Generally, for a sector s the relationship between the asset and liability side of its balance sheet can be expressed formally by the identity:

$$RA_s + FA_s \equiv L_s + NW_s, \tag{1}$$

where RA denotes real assets, FA financial assets, L liabilities and NW net worth, respectively. Any change of a balance sheet item has to be matched by a change of at

least one other balance sheet item. In a closed one-sector economy, sectoral net worth is determined by the value of sectoral real assets since all financial instruments net out:

$$NW \equiv RA. \tag{2}$$

By contrast, in an (open) multi-sector economy sectoral net financial assets NFA_s — defined as sectoral holdings of financial assets minus total liabilities — do not necessarily net out due to transactions vis-à-vis other sectors. Hence, sectoral net worth is determined by the sum of sectoral real and net financial assets:

$$NW_s \equiv \sum RA_s + \sum NFA_s. \tag{3}$$

Financial assets vis-à-vis other sectors add to sectoral net worth, whereas liabilities vis-à-vis other sectors reduce net worth.

2.2 Balance sheet leverages of asset holders

Following the concept of market leverage, sectoral monetary conditions can be inferred from the structure of the liability side of aggregated balance sheets. More specifically, we follow Adrian and Shin (2008b, 2009, 2010) and Adrian et al. (2010) and measure monetary conditions by leverage ratios. The balance sheet leverage BSL_s of sector s is defined as:

$$BSL_s = \frac{D_s}{A_s}, \tag{4}$$

where D_s denotes the value of debt and A_s denotes the value of assets. The balance sheet leverage is the average leverage of all institutional units in the sector and should indicate the average monetary conditions of the sector by referring to its access to debt.[6]

[6] In line with the Pecking Order Theory of corporate finance we assume that institutional units prefer debt to equity finance (Myers, 1984). Hence, changes in monetary conditions should show up first in debt finance and then in equity finance.

Although we depart from Adrian and Shin (2008b, 2009, 2010) and Adrian et al. (2010) by using debt-asset ratios instead of asset-equity ratios, both leverage ratios have much in common. We employ a debt-asset ratio for the following reasons. Firstly, we incorporate sectors which can exhibit negative net worth, such as government and rest of the world. In these cases a debt-asset ratio ensures that the outcome remains positive and is located on a continuous function. Secondly, following Fostel and Geanakoplos (2008) and Geanakoplos (2003, 2009) we want to highlight the importance of collateral to incur debt. We assume that the access to debt depends on a credible commitment to repay debt in the future while a collateral serves as a pledge from debtor to debtee. In this respect, debt-asset ratios indicate how much debt is incurred by the debtor and accepted by the debtee for every unit of asset on the debtor's balance sheet. In line with Adrian and Shin (2009, p. 602) we interpret the incurred debt in the long-term as the implicit accepted maximum of debt.

Clearly, an increase in the balance sheet leverage does not necessarily lead to asset or consumer price inflation. In the long-term only the process of net credit creation should have an impact on asset and consumer price inflation since it creates additional purchasing power. By contrast, pure credit transactions between non-financial sectors, i.e. transactions outside of the process of net credit creation, should not affect the aggregated price level since they merely redistribute purchasing power. Hence, pure credit transactions only affect relative prices, whereas the process of net credit creation also changes the aggregated price level in an economy.

2.3 Shares of sectoral ownership

The impact of an asset holder's monetary conditions on an asset market is approximated by its share of ownership. The share of ownership $SSO_{s,a}$ of sector s in asset market a is defined as:

$$SSO_{s,a} = \frac{A_{a,s}}{A_a}, \tag{5}$$

where $A_{a,s}$ denotes the value of assets a of sector s and A_a denotes the value of total outstanding assets a. Shares of ownership should indicate to what extent monetary conditions of asset holders could impinge on an asset market as they mirror their engagement in the market. Put differently, shares of ownership indicate how much each asset market should be affected by monetary conditions of each asset holder.

2.4 The market leverage

Conventional measures of monetary conditions usually focus on selected balance sheet items and sectors. For instance, money based measures merely refer to assets of the money holding sector and liabilities of the money creating sector that qualify due to their degree of moneyness (see IMF, 2000, §§287-288). By contrast, the concept of market leverage takes a much broader view. Due to complexity of financial markets it is not always straight forward to make a clear-cut distinction between balance sheet items and sectors that are relevant and those that are not.

The concept of market leverage is based on the idea that the behavior of institutional units in asset markets is influenced by their monetary conditions. It builds on an accounting-based network of balance sheets that links monetary conditions of asset holders to their influence on asset markets. We define market leverage ML_a in an asset market a as the sum of the sectors' balance sheet leverages weighted by their shares of ownership:

$$ML_a = \sum_{s=1}^{S} \underbrace{\frac{A_{a,s}}{A_a}}_{\substack{share\ of \\ ownership}} \times \underbrace{\frac{D_s}{A_s}}_{\substack{balance\ sheet \\ leverage}}. \tag{6}$$

The interpretation of the market leverage depends on the time horizon. In the long-term, a high (low) market leverage indicates that monetary conditions for the asset market

in question are loose (tight) since asset purchases are financed to a high (low) degree by debt. In the short-term, the interpretation depends on the prevailing drivers of the market leverage.

On the one hand, if movements of the market leverage arise from revaluations on the asset side then the market leverage runs temporarily contrary to the underlying monetary conditions. For instance, rising asset prices result in a decrease of the market leverage since the value of assets increases relative to the value of debt. In the medium-term an adjustment process should set in which lifts the market leverage since the increase in collateral values increases the incentive to further incur debt. This interpretation highlights the role of collateral values for monetary conditions.

On the other hand, if movements arise from other sources, e.g. incurrences of debt or changes in shares of ownership, then the market leverage moves in line with the underlying monetary conditions. For instance, the incurrence of debt leads to an increase in the market leverage which in turn indicates a loosening in monetary conditions since the debt accepted by the debtee for every unit of asset on the debitor's balance sheet has increased.

3 What determines market leverage?

3.1 Incentives to leverage

An important incentive to leverage is the expected return differential, which we discuss in the framework of the weighted average cost of capital (WACC) approach (Modigliani and Miller, 1958):

$$E\left[r_a\right] = i_D \times \frac{D}{A} + E\left[r_{NW}\right] \times \frac{D}{NW}. \tag{7}$$

The expected return on an asset a is given by $E\left[r_a\right]$, i_D denotes the interest on debt and the expected return on net worth is $E\left[r_{NW}\right]$. The interest on debt has to be served out of the return on assets whereas the residual return belongs to the investor. Rearranging

equation (7) with respect to the residual return on net worth and restating the structure of the liability side of the balance sheet leads to:

$$E\left[r_{NW}\right] = E\left[r_a\right] + \left(E\left[r_a\right] - i_D\right)\frac{D}{A} \times \frac{A}{NW}. \tag{8}$$

Obviously, the expected return on net worth $E\left[r_{NW}\right]$ increases with the expected return on the asset $E\left[r_a\right]$, the expected return differential $\left(E\left[r_a\right] - i_D\right)$ and the leverage which mirrors the structure of the liability side. In case of a positive expected return differential the leverage has a positive effect on the expected return on net worth.

3.2 Collateral function of assets

Following the continuous mark-to-market principle, changes in asset prices are mirrored on the asset side as balance sheet extensions and contractions. These changes on the asset side do not leave the structure and magnitude of the liability side unaffected. For instance, an increase in the value of assets $(RA_0 + FA_0 < RA_1 + FA_1)$ results in a balance sheet extension that implies an increase of net worth $(NW_0 < NW_1)$, the residual position on the liability side. In the short-term, this change in the structure of the liability side implies a smaller balance sheet leverage:

$$BSL_{s,0} = \frac{\bar{D}}{RA_0 + FA_0} \qquad > \qquad BSL_{s,1} = \frac{\bar{D}}{RA_1 + FA_1}.$$

In the medium-term, a contrary effect should set in since assets also serve as collateral. Most debt has to be collateralized so that the increased value of collateral enhances future capacity to incur debt (see Adrian and Shin, 2010, p. 3) since the amount of debt for every unit of asset has decreased. This fall in the leverage bears the incentive to incur further debt to reach its leverage potential, i.e. the long-term debt-to-asset ratio given the current value of assets. Empirical evidence presented by Adrian and Shin (2010, p. 4) indicates that the leverage of security brokers and dealers is procyclic so that leverages would even exceed their leverage potentials.

The argument for long-term potentials of balance sheet leverages builds on the quality of assets as collateral. Assets qualify to a different degree as collateral, but the total value of assets should provide a reasonable proxy for the capacity to incur debt. The quality of collateral is reflected in its margin rate (haircut). Geanakoplos (2003) argues that margin rates are endogenously determined by the equilibrium forces of supply and demand. This rationale for endogeneity should also hold for market leverages since Adrian and Shin (2008a) demonstrate that margin rates influence leverages by determining the maximum level of debt. For example, if the margin rate for US T-Notes is 4 % and they are priced at 100 USD, a maximum credit of 96 US-dollar can be generated per 100 USD of T-Note.

3.3 Market participation of asset holders

Shares of ownership in asset markets are quite trend persistent with rather flat trend slopes. For instance, figure 1 illustrates these characteristics for shares of ownership in the US corporate & foreign bond market between 1960q4 and 2008q4 (see figures 4 to 7 in appendix A.2 for shares of ownership of selected US asset markets).

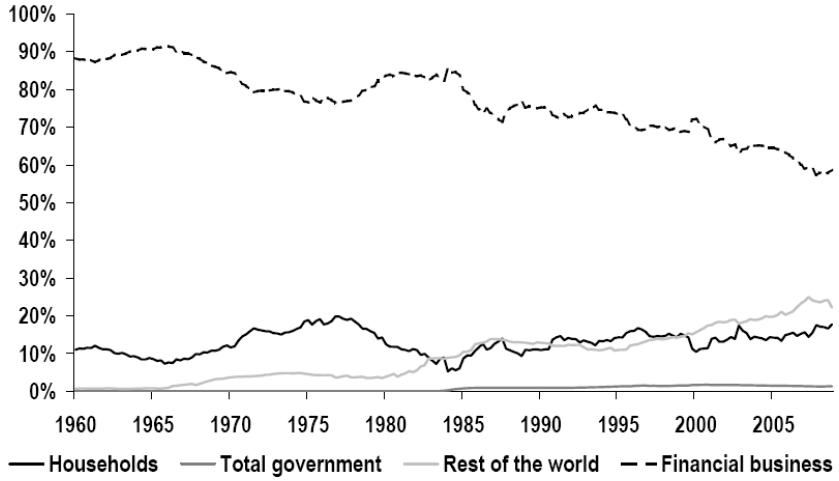

Figure 1: Shares of ownership in US corporate & foreign bond market

Possible reasons are stable preferences, statutory provisions and costs of adjustment. Preferences are often assumed to be stable due to habituation. Statutory provisions

limit changes in asset allocation for some industries, such as insurance and pension funds, as they include restrictions on the investment spectrum. Costs of adjustment dampen corrections of imbalances in asset allocation if costs of imbalances are lower than those of adjustment. In our context, trend persistence and flat trend slopes imply that in the short- and medium-term changes in market leverages are primarily driven by changes in sectoral balance sheet leverages while changes in ownership are of secondary importance. In the long-term, both characteristics can have a significant impact on market leverages.

3.4 Monetary policy

Monetary policy affects monetary conditions in asset markets via various transmission channels.[7] The market leverage captures these effects in both components — balance sheet leverages and shares of ownership. Firstly, monetary policy affects balance sheet leverages via two main channels — the interest rate and asset price channel. Through the interest rate channel, any change in the policy rate affects the cost of debt. For instance, lower cost of debt make debt more attractive and create an incentive to increase the balance sheet leverage (see section 3.1). Through the asset price channel, any change in the discount rate of the expected stream of payoffs translates into adjustments of asset prices. For instance, an expansionary monetary impulse in the wake of a cut in the policy rate leads to rising asset prices. This increase has an effect on the balance sheet leverage through the balance sheet total and the value of collateral (see section 3.2). In the short-term, the increase in the balance sheet total translates into falling balance sheet leverage since the value of assets rises relatively to the value of debt. Meanwhile, the increase in the value of collateral enhances future capacity to incur debt. In the long-term, the depletion of this capacity by incurring debt is likely to increase the balance sheet leverage. As a result, the effects of interest rate and asset price channels

[7] For an overview on transmission channels see, e.g., Mishkin (1996) and Kuttner and Mosser (2002).

should lead to an increase in the market leverage potential, i.e. the long-term debt-to-asset ratio given the current value of assets. Secondly, market leverage accounts for the possibility that markets can be exposed asymmetrically to impulses of monetary policy. Monetary policy can trigger sectoral portfolio re-allocations and hence changes in shares of ownership in asset markets through its influence on relative prices (see section 3.3).

4 Empirical analysis

4.1 Data

We base our calculations of market leverages for US asset markets on two data sources, namely the *Integrated Macroeconomic Accounts for the United States (IMA)*[8] and the *Flow of Funds Accounts of the United States (FFA)*[9]. The IMA is an integrated account which provides information on the magnitude and composition of sectoral balance sheets by considering financial and real accounts. By contrast, the FFA merely captures information on the financial account of balance sheets but provides more sophisticated information on the sectoral shares of ownership in different asset classes. As we prefer the highest possible frequency for our analysis, IMA data — which originally come with annual frequency — are linearily interpolated to match the quarterly frequency of FFA data. Hence, calculations of balance sheet leverages are based on IMA data (see appendix A.1),[10] whereas information on shares of ownership are drawn from FFA (see appendix A.2). Based on these components we calculate measures of market leverages (see appendix A.3). In our analysis we adopt the sectorization from the Bureau of Economic Analysis[11] and subdivide the US economy into the following seven sectors, namely households and nonprofit institutions serving households (henceforth households), finan-

[8] http://www.bea.gov/national/index.htm.

[9] http://www.federalreserve.gov/releases/z1/current.

[10] We calculate debt as the sum of shares other than equity, loans and other accounts payable.

[11] The FFA provide a more detailed sectorization which can be aggregated to the sectorization of the Bureau of Economic Analysis.

cial business, nonfinancial noncorporate business, nonfinancial corporate business, federal government, state & local governments as well as rest of the world.

Our analysis of market specific monetary conditions focuses on the following four US asset classes. Real assets are represented by corporate equity and real estate, whereas Treasury bond and corporate & foreign bond represent financial assets. Corporate equity market prices are approximated by the Standard & Poor's 500 Index and real estate markt prices are taken from the FHFA Housing Price Index. Shares of ownership in the real estate market are not directly available. We approximate shares of ownership in the real estate market by shares of home mortgage liabilities. These should provide a rough proxy since most real estates in the US are encumbered with mortgage. Corporate & foreign bond market prices are generated from Moody's Seasoned Aaa Corporate Bond Yields and US Treasuries prices are generated from 10-year Treasury bond yields with constant maturity. As we are interested in asset prices and not yields, all yields of financial assets are subtracted from 100 to generate artificial prices (see Kuttner, 2001) due to a lack of price data. The approach is motivated by the fact that asset prices and their yields are inversely related.

4.2 Descriptive analysis

In the following we analyze market specific monetary conditions for four US asset markets with respect to market leverage. As our market specific point of view comes at the cost of a lacking market specific equilibrium theory, we do not assess monetary conditions normatively. Market leverages indicate the development of monetary conditions but these do not clarify whether monetary conditions are too loose or too tight. Figure 2 illustrates market leverages for corporate equity, real estate, Treasury bond and corporate & foreign bond markets between 1960q4 and 2008q4.

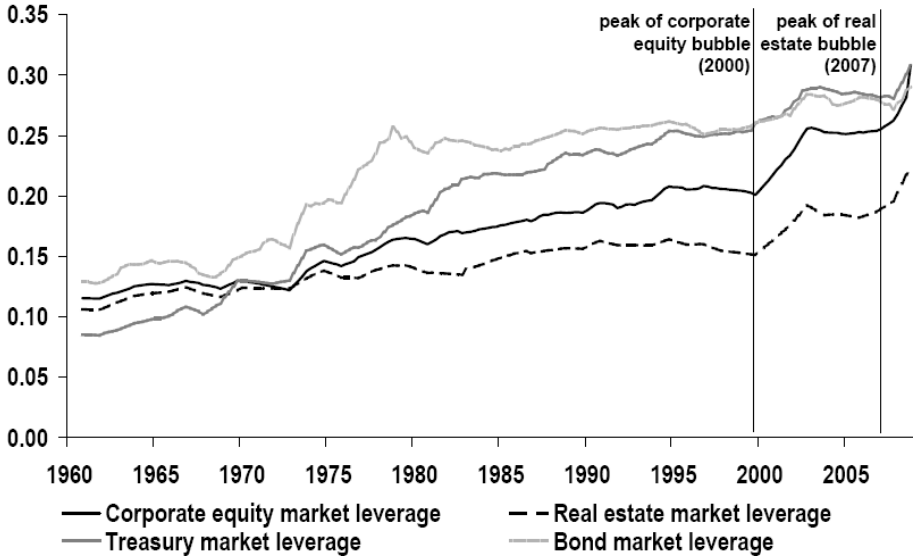

Figure 2: US asset market leverages

Three developments are of special interest. Firstly, market leverages in these asset markets have increased over time. Secondly, market leverages of financial asset markets have exceeded those of real asset markets for most of the time. Thirdly, market leverages ran parallel during the 60s, began to diverge during the 70s, 80s and 90s and began to converge again in recent times.

But how can these developments be explained? Firstly, the simultaneous easing in market specific monetary conditions over the entire period of analysis is most likely the result of factors that have a common impact on these four asset markets, such as expansionary monetary policy and financial innovations. Secondly, the divergence of market specific monetary conditions among asset markets could have been driven by the stronger involvement of the financial business sector in financial asset markets compared to real asset markets. Thirdly, the subsequent convergence of market specific monetary conditions is probably the outcome of two processes, namely the sectoral democratization of asset markets and bursts of asset price bubbles. Sectoral democratization of asset markets refers to the integration of different sectors in asset markets.[12] This process

[12]See the discussion on the "democratization of financial markets" which is characterized by a deeper integration of various asset holders in the financial system (see Browne and Doran, 2007, pp. 141).

is mirrored by converging sectoral shares of ownership and results in a more diversified involvement of sectors in asset markets. An exception is the real estate market which converged more slowly since this market is in general not as much subjected to the sectoral democratization as other markets. Moreover, the accelerating convergence of market specific monetary conditions in recent times could probably be explained by bursts of asset price bubbles, such as in the corporate equity market in 2000 and in the real estate market in 2007. Bursts of asset price bubbles reduce the value of assets on balance sheets. This decrease is typically not immediately compensated by an equivalent reduction of debt since in the short-term some sectors do not actively manage their leverage (see Adrian and Shin, 2010, pp. 3).

Now, we turn to the specific monetary conditions in each asset market by referring to the two components of market leverage. We analyze balance sheet leverages and shares of ownership separately to identify the driving forces of monetary conditions. Figures 3 to 11 display the developments of balance sheet leverages (see appendix A.1), shares of ownership (see appendix A.2) and balance sheet leverages weighted by shares of ownership (see appendix A.3) for the analysis of market leverages.

The corporate equity market leverage has almost tripled from 1960 to 2010 (see figure 2). The main contributor to this development was the financial business sector (see figure 8). Not only did the balance sheet leverage of financial business more than triple since then (see figure 3), there was also a surge in its share of ownership in corporate equity (see figure 4). Hence, financial business used the loosening in their monetary conditions mainly for investments in corporate equity. The balance sheet leverage of the rest of the world sector decreased but this was overcompensated by a surge in its share of ownership, indicating that the rest of the world has channelled additional funds towards corporate equity markets. By contrast, the balance sheet leverage of households increased but their shares of ownership decreased from about 85% in the early 60s to less than 40% today. These figures point to looser monetary conditions for households

but indicate that households reduced direct ownership in corporate equity. According to FFA data households increased their indirect ownership of corporate equity via intermediation services provided by the financial business sector.

The household sector is the biggest player in the real estate market (see figure 5) so that monetary conditions of households dominate monetary conditions in the real estate market (see figure 9). The market leverage of real estate very closely mirrors the development of households' balance sheet leverages (see figures 2 and 3). In the recent decade the market leverage of real estate showed a general upward trend which accelerated after the burst of the corporate equity price bubble. The impact of the corporate equity price bubble on households was noticeable since corporate equity makes up a considerable portion in households' asset allocation. As a result the balance sheet leverages of households significantly increased since the value of their assets fell relatively to their debt. The same mechanism was at work when the recent real estate price bubble bursted.

The Treasury bond and corporate & foreign bond market are subject to similar developments. The market leverage of both financial markets are dominated by the financial business sector (see figures 10 and 11), whose increase in balance sheet leverage is mirrored by easier monetary conditions in both markets. The loosening was attenuated by a reduction in its shares of ownership (see figures 6 and 7). By contrast, the rest of the world sector increased its share of ownership in these markets. Since the middle of the 90s the increase in balance sheet leverage of the rest of world sector (see figure 3) has also positively contributed to the loosening of market specific monetary conditions.

4.3 Estimation results

To assess the role of market leverages for asset prices we perform generalized method of moments (GMM) time series and panel analyses. In doing so, we regress asset prices on market leverages and a set of control variables. In line with theoretical discussions on the long-term interpretation of market leverage we use market leverage potentials.

Market leverage potentials are approximated by the Hodrick-Prescott (HP) filter generated trend components (Hodrick and Prescott, 1997) (see figures 12 to 15 in appendix A.4).[13] The set of control variables consists of one-year-ahead expectations on inflation and real output gap. We calculate our control variables by means of real-time data to account for issues of data availablity (see Orphanides, 2001). Expected inflation is the one-year-ahead forecast for consumer price inflation taken from the Survey of Professional Forecasters. An increase in inflation expectations should be negatively related to asset prices since it reduces the real value of each asset's expected stream of income. Expectations of the real output gap are generated from the real-time database of the Federal Reserve Bank of Philadelphia. The expected real output gap is the difference between expectations on its potential and realization, both expressed in natural logarithm. The expected realization is forecasted 12 quarters ahead by means of autoregressive estimations of the first order differences. Expectations of the real output gap should be positively related to asset prices since these anticipate economic activity, which in turn is directly linked to each asset's expected stream of income.

The simultaneous determination of asset prices and market leverages leads to well-known endogeneity problems, as both affect each other in the same period. As a result, estimated parameters would be endogeneity biased and inconsistent. Due to the presence of this reverse causality we perform GMM estimations. As instruments we employ the lagged own realizations of each market leverage since these are uncorrelated with the error term and are highly correlated with their future realizations.

We perform panel and time series analyses since we are interested in the general and market specific explanatory power of market leverages for asset prices, respectively. To capture unobserved time invariant effects across asset classes we employ cross-sectional fixed effects in the panel analysis. The estimation equations are given by:

[13] As is common in empirical literature for data with quarterly frequency we have set λ to 1,600.

$$Panel: \qquad p_{a,t} = \lambda^P + \lambda_a^P + \beta_{mlp} ml_{a,t}^{pot} + \beta_y E_t[y_{t+4}] + \beta_\pi E_t[\pi_{t+4}] + \epsilon_{a,t} \tag{9}$$

$$Time\ series: \qquad p_{a,t} = \lambda_a^{TS} + \beta_{mlp,a} ml_{a,t}^{pot} + \beta_{y,a} E_t[y_{t+4}] + \beta_{\pi,a} E_t[\pi_{t+4}] + \epsilon_{a,t} \tag{10}$$

with $\epsilon_{a,t} \sim IID(0, \sigma_\epsilon^2)$. The endogenous variable $p_{a,t}$ denotes the price of asset a at time t. Parameter λ^P is the common constant of all assets and λ_a^P are the asset specific (cross-sectional) fixed effects for the panel estimation. The parameter λ_a^{TS} represents the asset specific constant for time series estimations. The variable $ml_{a,t}^{pot}$ denotes the estimated market leverage potentials. The control variables are given by expected real output gap $E_t[y_{t+4}]$ and expected inflation $E_t[\pi_{t+4}]$. All variables — except expected inflation — are expressed in natural logarithm.

estimation	β_{mlp}	β_y	β_π	F-ADF/ADF	F-PP/PP	LCC
panel	2.79*** (0.43)	16.87*** (5.91)	-0.23*** (0.05)	16.06**	20.06**	-2.08**
corp. equities	1.12** (0.55)	26.92 (17.76)	-0.65*** (0.14)	-2.64***	-2.64***	–
real estates	2.89*** (0.19)	9.41*** (3.67)	-0.13*** (0.02)	-1.85*	-2.47**	–
c. & f. bonds	0.16*** (0.06)	-0.28 (0.87)	-0.01 (0.00)	-2.28**	-2.05**	–
Treasury bonds	0.21*** (0.07)	-1.10 (0.80)	-0.01** (0.00)	-4.12***	-3.98***	–

Notes: The null hypotheses of the ADF, PP and the LLC, F-ADF, F-PP tests claim the presence of a unit root. The alternative hypothesis of the LLC test is no common unit root whereas the alternative hypotheses of the F-ADF and F-PP tests are no unit roots in some cross-sections.

Table 2: Results of GMM estimations

The estimation results for the period 1983Q2-2008Q4 are reported in table 2.[14] The application of J-statistics indicate that the overidentifying restrictions are valid.[15] In all cases, the null hypothesis of valid overidentifying restrictions are not rejected. Moreover, to check for possible problems of spurious regressions (Granger and Newbold, 1974) we conduct unit root tests for each error term.[16] In the case of time series we conduct

[14] As inflation forecasts of the Survey of Professional Forcasters began in 1981q3 and as we use lagged realizations up to 6 quarters as instruments, our estimations start in 1983q2.

[15] The product of the J-statistic and number of regression observations is asymptotically χ^2-distributed.

[16] The alternative approach to deal with non-stationary variables by means of the first order differences is neglected since too much economic relevant information would be neglected.

augmented Dickey-Fuller (ADF) tests and Phillips-Perron (PP) tests for the presence of a unit root (Dickey and Fuller, 1979; Phillips and Perron, 1988). In the case of panel analysis we perform the Levin-Lin-Chu (LLC) test for the presence of a common unit root (Levin et al., 2002) as well as Fisher-type augmented Dickey-Fuller (F-ADF) and Fisher-type Phillips-Perron (F-PP) tests for the presence of individual unit roots (Maddala and Wu, 1999; Choi, 2001). The unit root analyses give indication of cointegration relationships at the 10 % significance levels or below which point to the absence of spurious regressions. In the case of time series estimations the ADF and PP tests reject the null hypotheses of a unit root. In the case of panel estimations the LLC test rejects the null hypothesis of a common unit root and the F-ADF and F-PP tests reject their null hypotheses of individual unit roots.

Backed by these empirical tests the estimation results on market leverages in general seem to confirm the theoretical discussions on the long-term interpretation of market leverages since all parameters depict plausible signs and are statistically significant. The positive market leverage potential elasticities of asset prices indicate that a loosening in market specific monetary conditions causes asset prices to rise. This holds for panel and time series estimations. The different coefficients of market leverage potentials for time series estimations indicate that market specific monetary conditions translate differently to asset prices. Changes in monetary conditions in real asset markets have stronger influences on asset prices than those in financial asset markets. In this respect, the high coefficient of the panel estimation seems to be particularly driven by the real estate market. Regarding the set of control variables, expected real output gap and expected inflation depict plausable signs. Expected real output gap indicates that the real estate market anticipates one-year-ahead real economic developments. The positive coefficient implies that an expected increase in the real output gap is positively related to asset prices. By contrast, asset prices of other markets seem to be unaffected by the expected real output gap. The expected inflation consistently shows negative

and statistical significant coefficients, except for the corporate & foreign bond market. The negative coefficient implies that an increase in expected one-year-ahead inflation is negatively related to asset prices.

5 Conclusions

To characterize monetary conditions in a specific asset market we propose the concept of market leverage. The market leverage is the average balance sheet leverage of all asset holders in a particular asset market. The concept links monetary conditions of asset holders to their influence on asset markets. Considering the former, monetary conditions are approximated by balance sheet leverages thereby indicating to what extent assets are financed by debt. Considering the latter, the influence of asset holders on asset markets is approximated by their share of ownership. In general, a high (low) market leverage points to loose (tight) monetary conditions for the asset market in question since asset purchases are financed to a high (low) degree by debt.

In general, we draw the following conclusions from our analysis. Firstly, market specific monetary conditions can differ considerably among asset markets. From a monetary point of view markets should then also be differently exposed to changes in asset prices. The market specific perspective of the market leverage might provide an approach to quantify to what extent monetary conditions in specific asset markets promote these changes. Secondly, market specific monetary conditions are positively related to asset prices. In the long-term, an increase in the market leverage is accompanied by a surge of asset prices. In particular, this result should motivate further research in the measurement and assessment of market specific monetary conditions, especially with regard to the concept of market leverage.

Moreover, with a particular focus on four representative US asset markets — corporate equity, real estate, Treasury bond and corporate & foreign bond — we further conclude as follows. Thirdly, US asset markets have experienced a loosening in market

specific monetary conditions over time. Our finding of long-term increases in market leverages of US asset markets is consistent with a broad strand of literature that holds loose monetary conditions — caused by various factors — accountable for rising asset prices in recent years (see, e.g., Caballero, 2006; Rajan, 2006; Ferguson and Schularick, 2007; Taylor, 2009). Fourthly, the loosening in market specific monetary conditions explains long-term increases in US asset prices. These findings indicate that the concept of market leverage might be a reasonable approach to fill frequently used phrases, such as "flooded with liquidity", in the context of specific asset markets with a conceptual framework and empirical evidence. Fifthly, the recent convergence of market specific monetary conditions of real asset markets towards those of financial asset markets implies a rise in upside risk to future US asset price inflation. The remarkable surge in market leverages of real asset markets suggest that the possibility of further asset price increases has grown. Moreover, market leverages of financial asset markets are still high compared to historic standards.

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A Appendix

A.1 Appendix: Balance sheet leverages

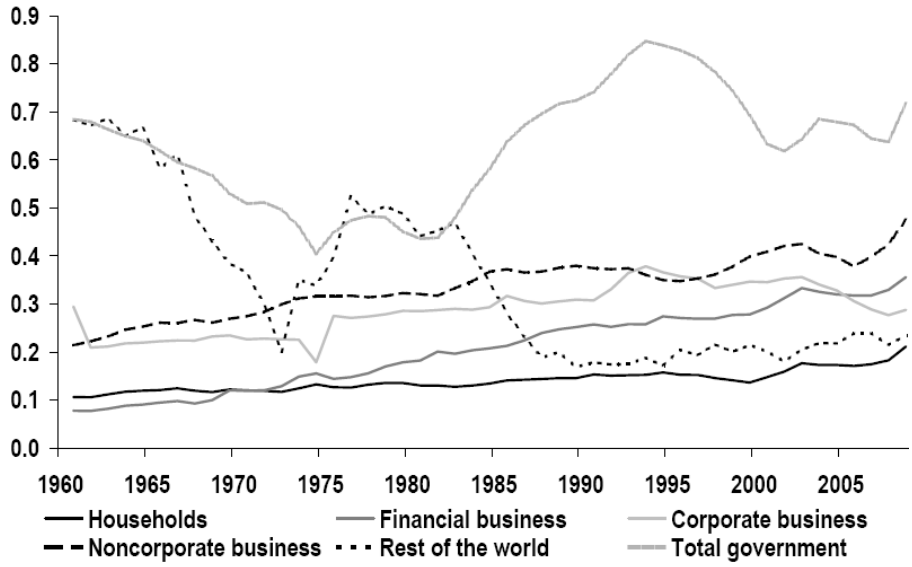

Figure 3: US sectoral leverages

A.2 Appendix: Shares of asset market ownership

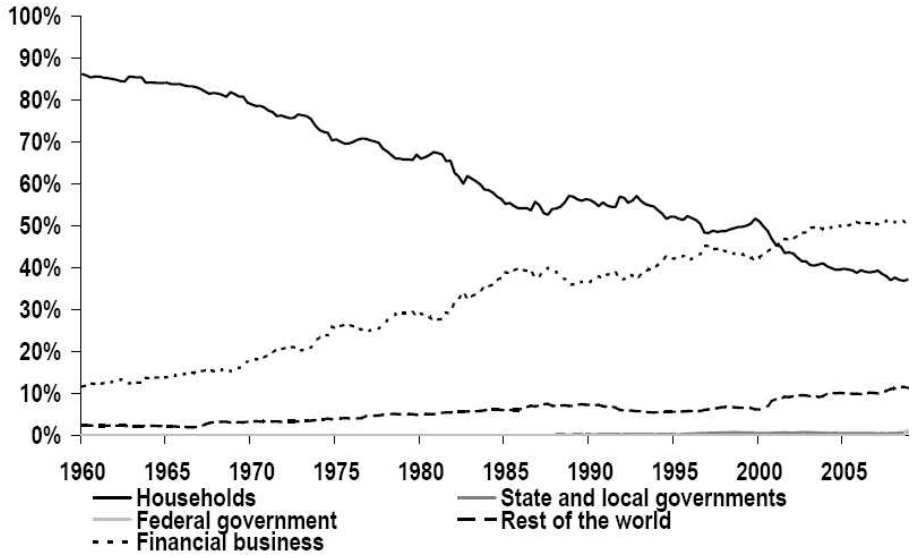

Figure 4: US corporate equity market

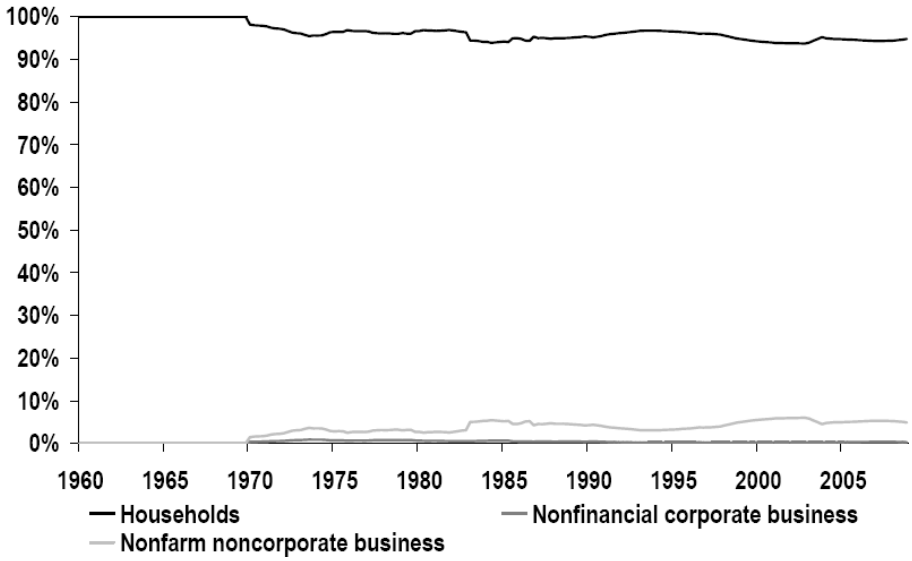

Figure 5: US real estate market

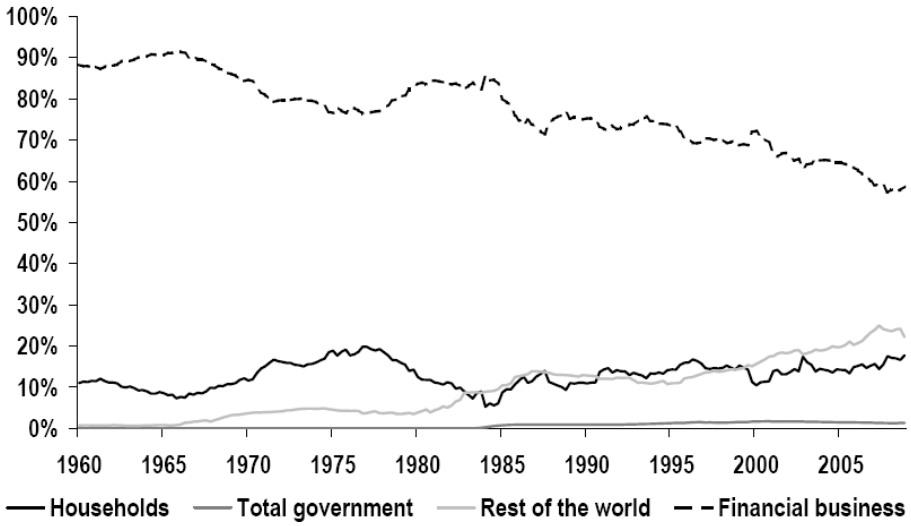

Figure 6: US corporate & foreign bond market

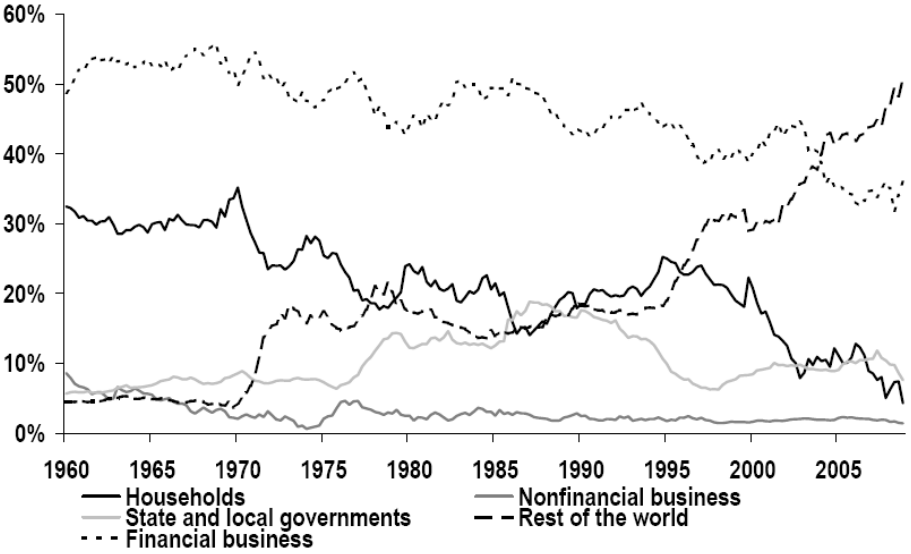

Figure 7: US Treasury bond market

A.3 Appendix: Ownership weighted balance sheet leverages

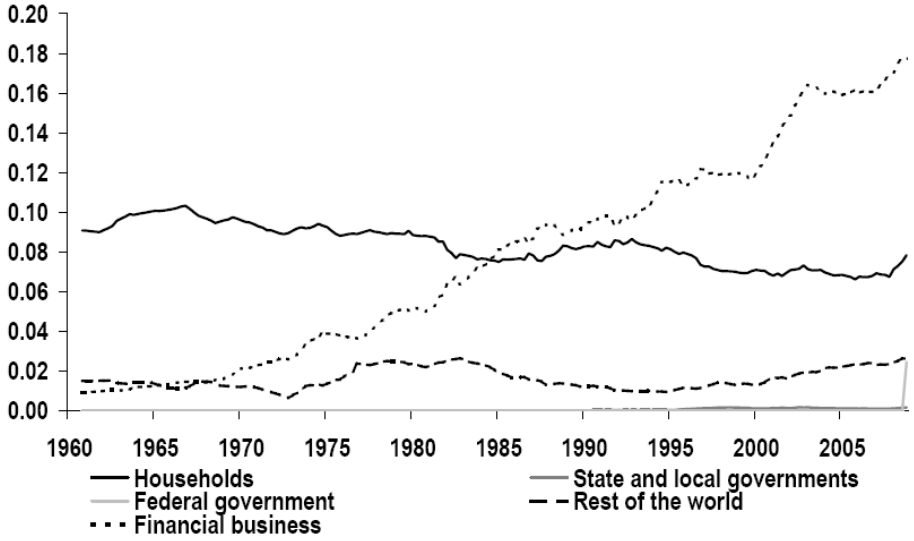

Figure 8: US corporate equity market

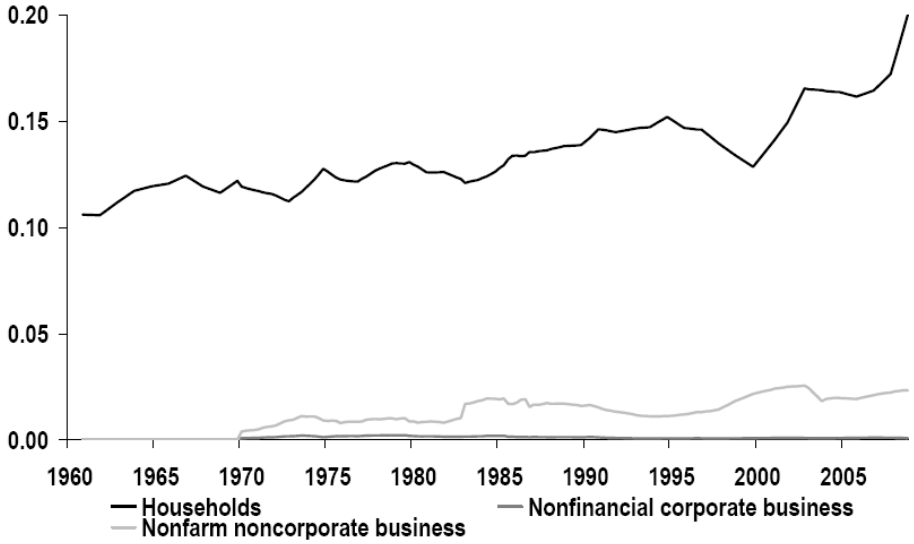

Figure 9: US real estate market

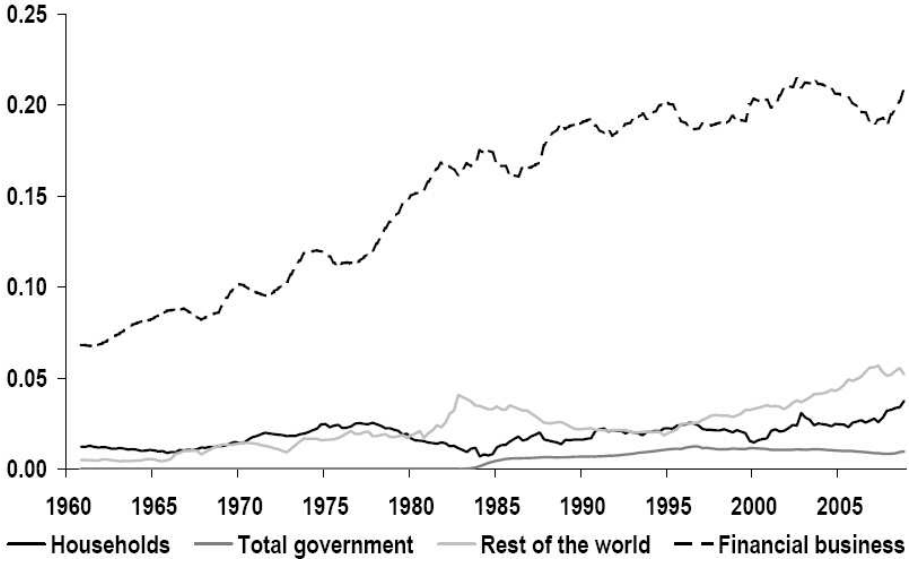

Figure 10: US corporate & foreign bond market

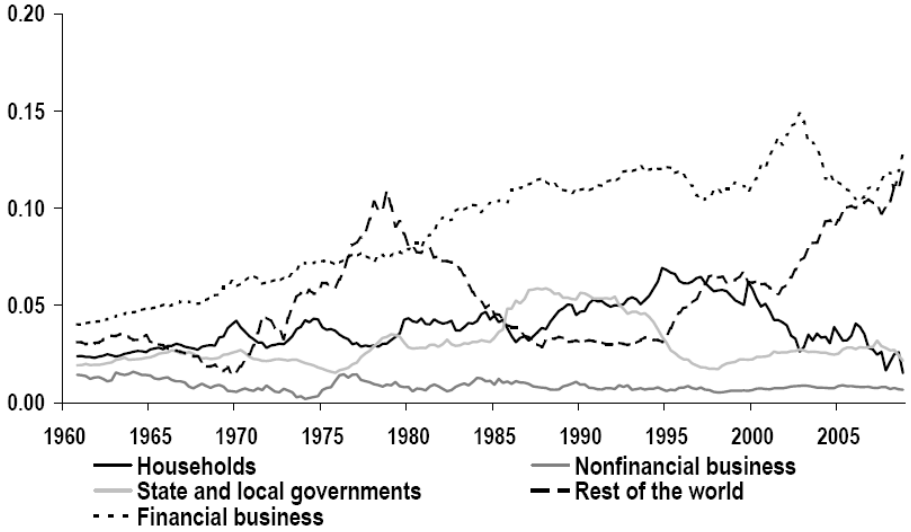

Figure 11: US Treasury bond market

A.4 Appendix: Trend and cyclic market leverages

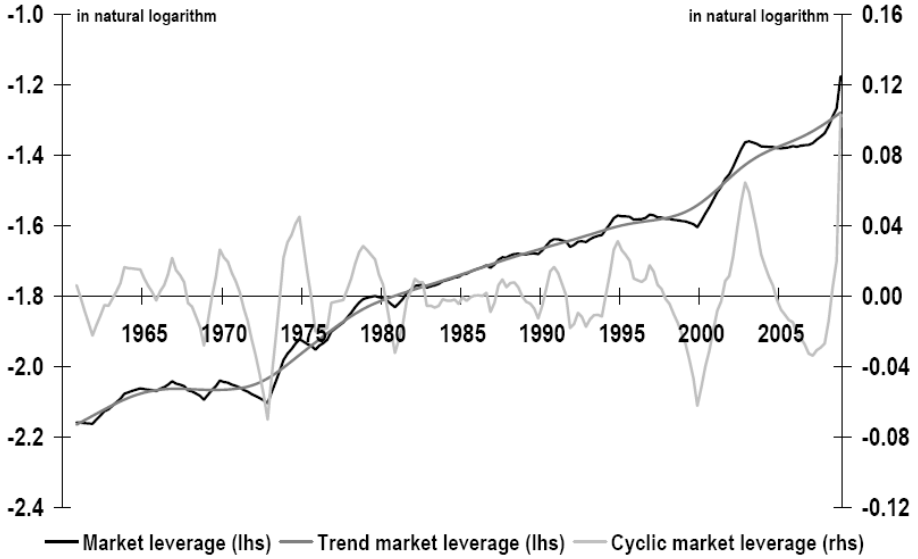

Figure 12: US corporate equity market

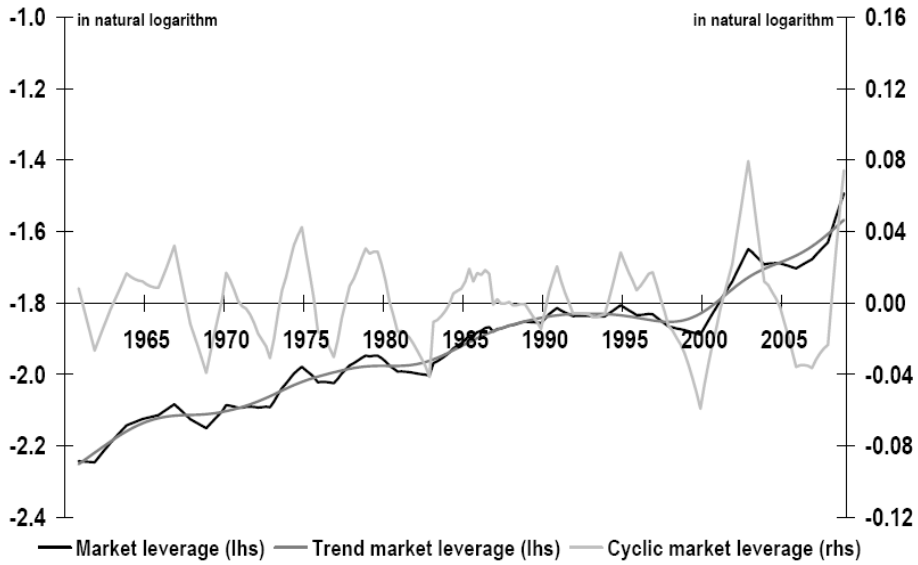

Figure 13: US real estate market

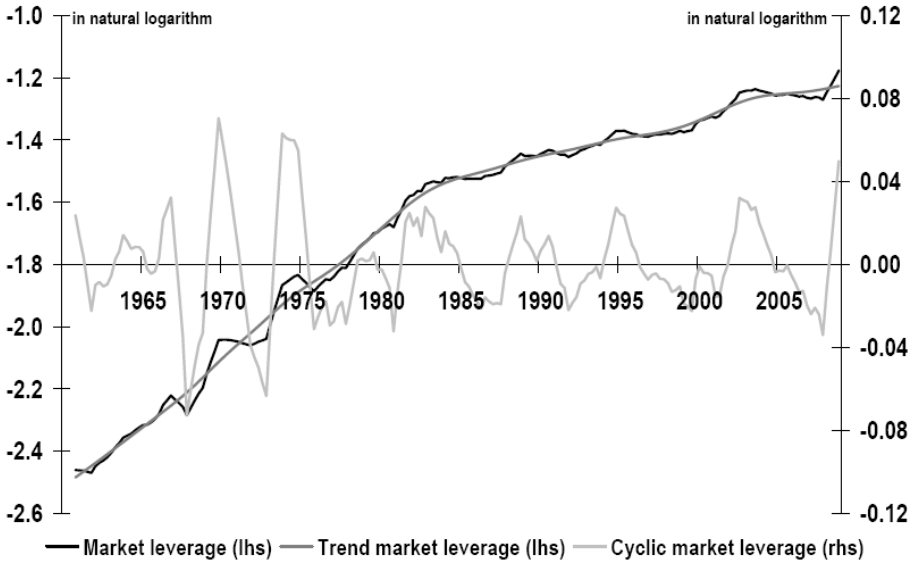

Figure 14: US corporate & foreign bond market

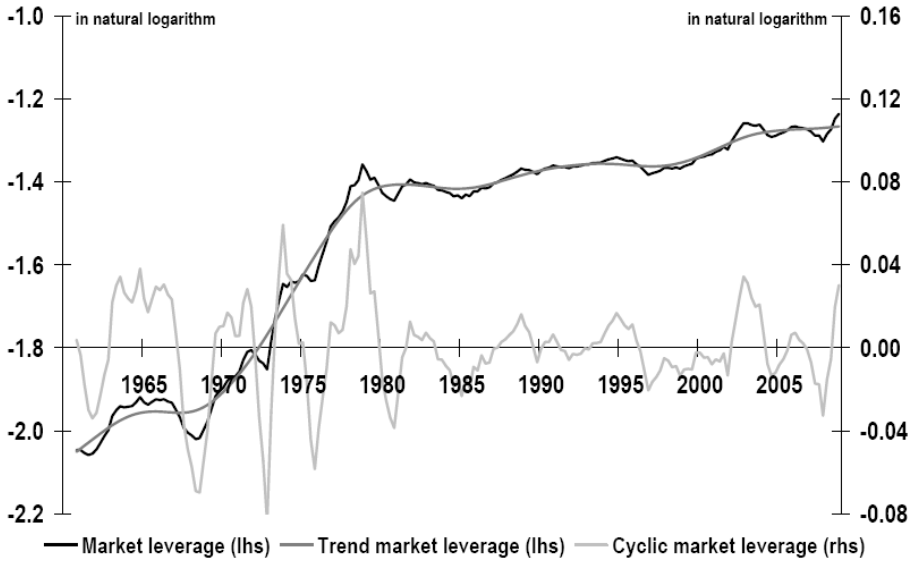

Figure 15: US Treasury bond market

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