The Contribution of Wealth Concentration to the Subprime Crisis: A Quantitative Estimation

Thomas Goda and Photis Lysandrou[•]

Abstract

The crisis that broke out in mid-2007 was caused by the fact that the CDO market had grown to a size sufficient to wreak general havoc when it suddenly collapsed. Several authors have argued that economic inequality was important to the growth of this market. This paper attempts to strengthen this argument by concentrating attention on global wealth concentration. After summarising recent evidence on the negative impact of investor demand on US bond yields in the pre-crisis period, new evidence regarding the specific contribution of high net worth individuals to this negative impact is presented. The paper then goes on to show how, after having helped to cause a yield problem in the major US debt markets, high net worth individuals (via hedge funds) continued to be a major source of the pressure on US banks to resolve this yield problem through the mass production of CDOs.

Key Words: wealth concentration; income inequality; CDOs; subprime crisis; bond yields

JEL Classification: D31; G01; G12

1. Introduction

The toxic securities at the epicentre of the financial crisis of 2007-8 were collateralised debt obligations (CDOs). The market for these products had remained fairly small up to about 2002, but between that time and early 2007 it had grown twelvefold in size, from US$ $^1/_4$ trillion to approximately US$3 trillion, in other words, to a size sufficient to spread panic in the money and interbank markets when it totally collapsed in August that year. This fact suggests that economic inequality had to figure somewhere in the crisis given that it was subprime and other non-conforming mortgage loans that formed the basic raw material needed for the construction of CDOs and given that many of those who took out these loans belonged to the poorer end of the American population (see e.g. Fernandez *et al.*, 2008; Horn *et al.*, 2009; Wade, 2009; Palma, 2009; Stockhammer, 2009; Rajan, 2010; van Treeck, 2013). However, what remains in doubt is

• Goda, Universidad EAFIT, School of Economics and Finance, Medellín, Colombia; (tgoda@eafit.edu.co); Lysandrou, London Metropolitan University, Business School (p.lysandrou@londonmet.ac.uk). We would like to thank Engelbert Stockhammer, Gary Dymski, Maria Fernanda Quintero, and two autonomous referees for their helpful comments. The usual disclaimers apply.

whether inequality had a more centrally causal role, for although low incomes can explain the demand for mortgage loans they cannot on their own explain why these loans were securitised and then re-securitised into the collateralised debt obligations (CDOs) that were sold to investors.

This paper attempts to rectify this shortfall in explanatory power by directing attention to a hitherto underexplored aspect of inequality. While most studies of the role played by inequality in the financial crisis have focussed on its 'dispersion' aspect, the distribution of income and wealth across different groups of people, this study will focus on its 'concentration' aspect, the accumulation of wealth in the hands of one very small group of people, the high net worth individuals (HNWIs). The central argument is that just as stagnant incomes of the bottom 90% in the US were among the 'supply-push' factors driving CDO growth inasmuch as mortgage loans constituted the raw material for these products, so was wealth concentration among the world's richest individuals one of the 'demand-pull' factors. The wealth holdings of these HNWIs more than doubled between 1997 and 2007 (from US$ 19 to US$ 41 trillion) and their share of total global private sector wealth increased from 31.6% in 2001 to 35.3% in 2007[1]. The subsequent increase in HNWI's investment demand not only helped to lower the yield of highly rated traditional bond classes, which contributed to a 'search for yield' by all investors, but also led to increasing assets being placed under the management of hedge funds who were the major buyers of CDOs.

The argument is developed in three stages. The first concerns the demand for traditional US debt securities. To give credibility to the claim that the production of CDOs was rapidly expanded between 2002 and 2007 partly in order to absorb the overspill of demand for yield flowing from the other US debt markets, it helps to show that the unusually low yields in these other markets over this same period was in large part caused by the pressure from investors. The second stage concerns the estimation of HNWIs' contribution to the downward pressure on US bond yields. This contribution needs to be separated out from the various other sources of US bond demand and quantified if the concentration of private wealth ownership is to be shown to have been a major driver behind the growth of CDOs. The third stage concerns the relation between HNWIs and hedge funds. As HNWIs were excluded from the CDO market due to the highly complex nature of these structured credit products the claim that they contributed to the pressure to create these products can only hold up if there is a clear explanation as to how they were involved. A close examination of the HNWI – hedge fund relation helps provide that explanation.

The structure of the paper is as follows. Section two reviews some recent evidence on the impact of US bond demand on US bond yields in the pre-crisis period. Section three presents new evidence on the impact of high net worth individuals (HNWIs) on US bond yields. Section four specifies why US income inequality and global wealth concentration provided the all-encompassing framework for the mass production of CDOs. Section five concludes.

2. The impact of investor demand on US bond yields

The rapid growth of CDO production between 2002 and 2007 closely correlated with some other unusual developments in the US financial system over this period. One was the persistently low nominal long-term yields in all of the major US bond markets, a development that eventually gave rise to a much discussed bond yield 'conundrum' after June 2004 in that long term yields continued to remain low even as the Federal Funds rate began to rise sharply from this date (see Figure 1**).** The other was the steep increase in the volumes of private domestic investor demand and more importantly of foreign inflows into the US bond market (see Figure 2). The latter appears to have been due not only to inflows from Asian and other emerging market economies but also to inflows from Western European economies (albeit that in their case leverage rather than export surpluses was the major source of funds (Bernanke *et al.*, 2011)).

< Figure 1 >

< Figure 2 >

There are basically two views regarding the correlation between US bond yields and CDO growth. The majority view is that there is no deeper causal link behind this correlation. Yields in the traditional US debt markets may have been unusually low in the immediate pre-crisis period and so investors would have been happy to accept the higher yielding CDOs[2], but this admission aside, the general belief continues to be that greed, overconfidence, market failures and lax regulation were the more important motivating forces behind the rapid acceleration in CDO production prior to mid-2007 (see e.g. IMF, 2008; Akerlof and Shiller, 2009; Ashcraft and Schuermann, 2008; Financial Crisis Inquiry Commission, 2011; Demyanyk and van Hemert, 2011). A number of authors (see e.g. Caballero and Krishnamurthy, 2009; Gros, 2009; Lysandrou, 2009; Caballero, 2010; Bernanke *et al.* 2011) have advanced the complementary view that there was in fact a line of causality running from the pressure of aggregate foreign and

domestic demand on yields in the traditional US bond markets through to the CDO market but this has remained to date a minority view.

The most likely explanation for this state of affairs is that there has been relatively little work done to quantify the impact of aggregate investor demand on US bond yields in the pre-crisis period. It is true that in response to the post-2004 bond yield 'conundrum' a number of studies investigated the impact of demand on US Treasury yields and found that impact to have been significantly negative (e.g. Idier *et al.*, 2007; Bandholz *et al.*, 2009; Craine and Martin, 2009; Warnock and Cacdac Warnock, 2009; Bertaut *et al.*, 2011). However, while these results represent a first step towards strengthening the demand-pull version of the CDO growth story they are not sufficient. CDOs are in the end 'second-floor' debt securities, securities backed by securities. Thus if credibility is to be given to the claim that the US CDO market was expanded just prior to 2007 partly in order to take the overspill of demand for yield flowing from the other US debt markets it helps to show that investors had a significant negative impact not only on the Treasury yield but also on the yields in the other 'ground floor' markets (those for corporate and municipal debt securities) and also on the yield in the 'first floor' market (that for agency debt securities). Evidence to this effect has been recently provided by Goda *et al.* (2011) using autoregressive distributed lag (ARDL) based econometric models (for more details see the Appendix). Here we briefly present their main findings regarding the marginal cumulative impact (MCI) of investor demand on US bond yields during the 'conundrum' period[3].

Treasury yield

The results of the Treasury model show that the increase in the holdings ratio[4] of foreign governments had a negative impact on the 10-year Treasuries yield in the short-run and in the long-run (see Appendix, Table A1). Thus, the increase in their holdings ratio (from 32.4% to 42%) depressed the yield by as much as 60 bp during the 'conundrum' period, as shown in Figure 3a. This finding is similar to that reported in previous studies. By contrast, foreign private investors had no discernible impact on the Treasury yield in this period (see Figure 3b).

< Figure 3 >

Agency bond yield

Foreign official demand also had a significant negative impact on the 10-year agency bond yield in the short-run and in the long-run (see Appendix, Table A2 and Table A3, column 1). As

shown in Figure 4a, the increase in the foreign official holdings ratio depressed the yield by as much as 107 bp during the 'conundrum' period. Other sources of demand also had a negative, albeit smaller, impact on the agency yield in this period. As shown in Figures 4b-4d, private foreigners, US individuals, and US pension funds helped to reduce the long-term agency bond yield by as much as 39 bp, 17 bp, and 11 bp respectively.

< Figure 4 >

Corporate bond yield

Between 1994 and mid-2007 foreign private investors invested heavily in the AAA-rated corporate bond market (their holdings ratio more than doubling, from 11% to 24.5%) with the result that they put significant downward pressure on corporate bond yields in the short-run and long-run (see Appendix, Table A2 and Table A3). As shown in Figure 5a, between June 2004 and June 2007 the AAA-rated corporate bond yield was lowered by as much as 69 bp by foreign private investors' demand pressure. US individual investors and banks also had some negative impact in the short-run when they increased their holdings ratio (see Appendix, Table A2); as shown in Figures 5b and 5c, they respectively decreased the yield by as much as 12 bp and 13 bp in the 'conundrum' period.

< Figure 5 >

Municipal bond yield

Although the increase in foreign holdings of municipal bonds was relatively modest during the 'conundrum' period, their increasing holdings ratio had a negative impact on the yields of AAA-rated 10-year municipal bonds (see Appendix, Table A2 and Table A3). As shown in Figure 6a, foreign investors helped to lower the yield by as much as 31 bp in the 'conundrum' period. Although the MCI of foreign investors was higher than the MCIs of domestic individual investors, banks and insurance companies (see Figures 6b-6d), domestic investors as a group lowered the municipal bond yield in this period by as much as 34 bp. The relatively strong market reaction to the small increase in the foreign holdings ratio can be probably explained by the fact that the entry of this new market player reduced investment opportunities that the big domestic market players would have liked to have retained for themselves.

< Figure 6 >

In sum, the results from Goda *et al.* (2011) appear to give solid empirical support to the claim that aggregate investor demand was a major source of the downward pressure on US bond yields in the pre-subprime crisis period. In particular, they show that foreign official investors had a major suppressing effect on yields in the Treasury and agency bond markets and that foreign and domestic private investors had a similar effect in the corporate and municipal bond markets. This latter observation raises the question as to how significant a proportion of this private sector pressure on yields stemmed from an important subgroup of this sector, namely that comprising of the world's high net worth individuals. The next section tries to answer this question.

3. The impact of HNWIs on US bond yields

According to Capgemini and Merrill Lynch (2008) the number of HNWIs – individuals with net assets in excess of US$ 1 million (excluding primary residences) – was around 10 million in 2007, a figure that represented just 0.15% of the world's population of 6.6 billion. The supposition that these individuals could have had any significant impact in the US bond markets in the pre-subprime crisis era may seem incredible when one considers how small in number they were but not when one considers the amounts of wealth they concentrated in their hands and the forms in which this wealth was stored. As shown in Figure 7a, in 2007 the world's HNWIs had approximately US$ 41 trillion in assets (world GDP in that year was US$ 55 trillion) as compared with approximately US$ 19 trillion in 1997[5], which is to say that prior to the crisis HNWIs were the biggest global investor group with more assets under management than global pension funds (US$ 28 trillion), mutual funds (US$ 26 trillion) and insurance companies (US$ 20 trillion) (IFSL, 2008a). As can be seen in Figure 7b, financial securities represented one of the dominant forms in which HNWIs stored their wealth, accounting for an average of 54% for the whole period from 2002 to 2007.

< Figure 7 >

Given that HNWI asset allocation to debt securities accounted for US$ 11 trillion in 2007 (roughly 14% of the total global stock of debt securities in that year) and that private investor demand influenced US bond yields, it seems clear to us that HNWIs must also have had a negative influence on yields by virtue of what we can call their 'blocking' role. When Caballero (2010) argued that the US banking sector's response to the world's 'insatiable' demand for US safe assets between 2002 and 2007 was to expand the production of CDOs, he went on to

describe this response as "the minimum resistance path for the safe-assets imbalance to release its energy" (p.3). Our hypothesis is that the HNWIs contributed to this process because they held enough US assets during this same period as to help block any alternative exits through which the safe-assets imbalance could release its energy. Unfortunately, there exists no precise information about the actual wealth and holdings of HNWIs because existing global governance arrangements allow them to be highly mobile and secretive. However, some approximate estimates of the degree of HNWI involvement in the US bond markets in the immediate pre-2007 period can be extracted from the known HNWI investment figures. As concerns the estimate for US HNWI holdings of US bonds, these are derived in two steps: (i) we know the amount of assets held by North American HNWIs (see Figure 7a) and we know from Credit Suisse (2010, p. 82) that "...residents of the USA account for about 90% of the [HNWI population] figure for Northern America"; multiplying the resulting amount of US HNWIs wealth with the average global HNWI investment share in fixed income securities during this time (i.e.23%) gives us the totals for US HNWIs global bond investments as listed in column 1 of Table 1; (ii) we know from Capgemini and Merrill Lynch (2006) that about 78% of US HNWI portfolio holdings are invested domestically, so we apply this ratio to the total US HNWI global bond investments to derive the approximate figures for US HNWI holdings of US bonds that are listed in column 2 of Table 1. These figures on average represent about 58% of all US individual investments in US bonds according to the Flow of Funds data presented in column 3 of Table 1[6]. The application of this 58% ratio to the Flow of Funds data on US individual holdings in each bond class enables us to derive the equivalent estimated US HNWI holdings of Treasury, agency, corporate and municipal bonds, as listed in Table 2.

< Table 1 >

< Table 2 >

To calculate the rest of the world (ROW) HNWI US bond holdings some assumptions are again necessary. The first is that the total amount of fixed income holdings of ROW HNWIs is equal to total HNWI fixed income investment minus the amount of US HNWI global bond investment, see Table 3. The second assumption is that ROW HNWIs invested around 30% of their fixed income investment in foreign markets; according to data from Fidora *et al.* (2006) non-US investors on average placed around 70% of their investment in their home market. The third assumption is that ROW HNWIs investments in foreign bond markets are allocated according to their respective market sizes; thus multiplying ROW HNWI foreign bond holdings

by the global market share of the US debt security market gives us the estimated amounts of ROW HNWI US bond holdings (see Table 4).

< Table 3 >

< Table 4 >

It is unlikely that the holdings of ROW HNWIs were split evenly between Treasury, agency, corporate and municipal bonds. Therefore, one last assumption is necessary to get an idea about the size of ROW HNWIs holdings in the different US bond markets. It is known that a significant amount of wealth from HNWIs is held offshore (see e.g. Tax Justice Network, 2005). Consequently, it is reasonable to assume that the bond portfolio composition of ROW HNWIs is similar to the portfolio composition of foreign investors that bought Treasuries, agency and corporate bonds via tax havens and financial centres[7]. Furthermore, it can be assumed that a significant part of foreign municipal bond holdings (around one third) is held by HNWIs as these bonds are particular attractive for individuals due to their tax status[8]. The resulting estimates of ROW HNWIs US bond holdings according to bond type are given in Table 5.

< Table 5 >

Summing across the estimated holdings of US bonds by US HNWIs and ROW HNWIs for the period 2004 to 2007, see Table 6, two distinct patterns become clear. The first is that HNWIs, along with other private sector investors, appear to have been partially squeezed out of the US Treasury market as a result of the steep increase in the foreign official holdings of Treasuries. The second is that HNWIs, again in common with other private sector investors, reacted to the partial squeeze out of Treasuries by shifting substantial amounts of funds into the other major US bond markets.

< Table 6>

According to the models of Goda *et al.* (2011), private foreign and US individual investors put pressure on AAA-rated bond yields if they increased their holdings to a greater extent than the increase in the outstanding amount of these bonds. The same must be true for HNWIs because they are an important subgroup of private foreign and US individual investors as our estimates have shown. To obtain estimates for the impact of HNWIs on US long-term bond yields for the period June 2004 to June 2007 we therefore use the data contained in Table 2 and Table 5 and the MCIs of private foreign and individual investors. To be more precise, we first calculate the share of US HNWIs in total US individual holdings and the share of ROW HNWIs

in total foreign private holdings for each bond class and then multiply these shares with the respective MCIs of US individual investors and foreign private investors (see Figures 3 – 6) to obtain the MCIs of US and ROW HNWIs in each bond class; we finally sum these monthly MCIs of US and ROW HNWIs to obtain the total estimated impact of all HNWIs in each bond class. These MCIs reveal that, as expected, HNWIs had no discernible impact on the Treasury yield (Figure 8a), while they did have a significant negative impact on the long-term yields of agency bonds (by as much as 15 bp, Figure 8b), of AAA-rated corporate bonds (by a maximum of 18 bp, Figure 8c) and of AAA-rated municipal bonds (by as much as 12 bp, Figure 8d). Generally speaking, HNWIs seem to have depressed US long-term bond yields to a similar degree as changes in business cycle expectations, interest rate volatility and default risk (see Goda *et al.*, 2011).

< Figure 8 >

To sum up, apart from US Treasuries, HNWIs did have a consistently negative impact on US bond yields in the pre-crisis period according to our estimations. These are, we repeat, rough approximations. However, we believe that, while not totally accurate, these estimations are sufficiently accurate as to validate our HNWI 'blocking' hypothesis. In the pre-crisis period this small group of individuals occupied enough space in the US bond markets as to prevent them from being able to fully accommodate the demand pressure for debt securities stemming from other investor groups, a development that in turn helps to explain why the CDO market had to be rapidly expanded in this period in order to absorb the excess pressure. The precise mechanism through which the pressure for yield was transmitted to those institutions that created the CDOs is explained in the next section.

4. Income inequality, wealth concentration and the growth of the ABS and CDO markets

The global stock of CDOs outstanding in June 2007 amounted to some US$ 3 trillion as compared with approximately US$ 11 trillion worth of asset backed securities (ABS) and approximately US$ 66 trillion worth of government and corporate bonds (Blundell-Wignall, 2007b; Bank of England, 2007; BIS, 2011a, 2011b). While the US accounted for about 43% of the government and corporate bond volumes, its share of the ABS and CDO volumes was considerably higher, accounting for about 80%. Several economists both from the mainstream (e.g. UN, 2009; Rajan, 2010; Kumhof and Ranciére, 2010; Milanovic, 2011; Kumhof *et al.*,

2012; Stiglitz 2012) and from heterodoxy (e.g. Hein, 2011; Wade, 2011; Galbraith, 2012; Stockhammer, 2012; van Treeck and Sturn, 2012; van Treeck; 2013) have argued that the growth of debt-backed securities in the US can in large part be attributed to the rise in income inequality as many of the bottom 90% US families sought to maintain their living standards and social status in the face of their stagnant wage growth and increasing top-incomes by resorting to debt (the ´keeping up with the Joneses´ effect). The statistics would seem to give strong backing to this line of argument, as the richest 1% of the US population increased their pre-tax market income share from roughly 10% at the beginning of the 1980s to 23.5% in 2007 (Atkinson *et al.*, 2011)[9]. Furthermore, "after 1987 the amount of income considered necessary to get along again increased strongly, by more than 40 per cent until 2007" while the increase in median income was much lower (15%) during the same period (van Treeck and Sturn, 2012, p.17). As a consequence, the debt to income ratios of the bottom 95% of the US population in terms of income distribution increased from around 70% in the mid-1980s to around 140% in 2007, while the debt to income ratios of the richest 5% of the US population stayed relatively constant at around 70% (Kumhof and Ranciere, 2010).

However, these same statistics also point to a problem in the income inequality argument, namely, one of mismatching time frames. The trend rise in US inequality began in the early 1980s but the growth of the US ABS market only began to accelerate after 2001. Of the US$ 11 trillion outstanding in mid-2007, over half (US$ 5.6 trillions) had been created in the previous four years. In the case of CDOs the acceleration in growth was even more remarkable in that of the US$ 3 trillion outstanding in June 2007 over 90% of these products had been created in the preceding four years. Proponents of the income inequality hypothesis have sought to get round this problem by arguing that prior to the stock market crash of 2001 low- and middle-income households were relying mainly on rising stock prices to finance their consumption and only began to rely more heavily on debt after this date. However, while this argument explains the rise in debt it does not explain the rise in the securitisation and re-securitisation of this debt. The same criticism can also be applied to the accompanying argument that financial inflows into the US from surplus countries (which also had rising income inequality and partly circumvented their domestic demand problem by increasing their exports) were particularly strong after 2001. These inflows into the US financial system certainly helped fuel bank lending to households but they still do not explain the securitisation of much of this lending. In the end, the massive expansion in US ABS and CDO stocks in so short a time span helps to explain why the majority of both mainstream and heterodox opinion continues to trace the root cause of this expansion to

a combination of regulatory failures (most notably, the official encouragement of the shift from an 'originate and hold' model of mortgage lending to an 'originate and distribute' model, a shift that inevitably contributed to the drastic relaxation of risk controls in mortgage lending) and monetary policy errors (most notably the maintenance of the Federal Funds rate at an unusually low level between the end of 2001 and mid-2004), which led to a boom in mortgage lending that in turn fuelled a property price bubble and the resulting social contagion of boom thinking (see Shiller, 2008).

We do not underestimate the importance of regulatory and policy weaknesses, and the ensuing impact on social behaviour in financial markets, as drivers behind the pre-2007 growth of US ABS and CDO stocks. However, we also believe that economic inequality was as important a driver as becomes clear if attention is focussed on the vast accumulation of wealth in the hands of one small group of people. The rapid growth of US ABS stocks between 2002 and 2007 coincided with the prolonged maintenance of the Federal Funds rate at an unusually low level over much of this period but it also exactly coincided with the sharp upward spike in aggregate investor demand for these securities. The US banks and their associates certainly took advantage of lax regulation and monetary loosening to vastly increase the rate of supply of ABSs and CDOs[10] but it seems that despite their best efforts they were unable to fully satisfy investor demand as attested by the historically low US ABS yields and anecdotal evidence of market participants[11]. Once demand pressure is brought more centrally into the story behind the growth of these two markets so also is wealth inequality because HNWIs constituted an important source of demand for ABSs and CDOs. As we have seen, HNWIs were directly involved in the ABS market to the extent where they had a discernible negative effect on agency bond yields. By contrast, while HNWI involvement in the CDO market was as important as that in the ABS market, the form of that involvement was a good deal more complicated.

One complication concerns the opaque nature of CDOs. For demand-pull pressure to be exerted in any product market the characteristics of the product in question have to be sufficiently transparent as to allow for a broad customer base. Ordinary government and corporate debt securities generally meet this criterion but so do asset backed securities inasmuch as their backing collateral consists of a single, homogenous class of assets (e.g. mortgage loans, credit card loans and so on). CDOs by contrast do not meet this transparency criterion. CDOs may only be 'second-floor' securities, but the jump in complexity and opacity going from 'first-floor' ABSs to CDOs is considerably higher than the jump going from the 'ground-floor' Treasury, municipal and corporate bonds to ABSs. The securities backing CDOs consist of many

different types of asset classes. Given the heterogeneity of the backing assets, and the large variety of ways that these can be mixed together, it follows that no two CDOs are alike: each one is a unique, customized product that can be sold at a privately negotiated price but not so easily marketed on any standardized pricing terms. Although large institutional investors such as pension funds have the expertise to handle CDOs, regulatory and prudential constraints mean that they have to limit their exposure to the higher rated tranches of these products[12]. Individual investors by comparison have no such expertise, a fact that explains their complete absence in the CDO market. Given that HNWIs had no direct contact with CDOs between 2002 and 2007, the question arises as to how it was at all possible for these individuals to have been implicated in the rapid growth of these products over that period.

One suggested answer is to direct attention to the hedge funds (Lysandrou, 2011-12).The acceleration in CDO production between 2002 and 2007 appears to have been very closely paralleled by an acceleration in the growth of the hedge fund industry. As shown in Figure 9a, hedge fund assets more than tripled between 2002 and 2007, rising from US$ 600 billion to about US$ 2.2 trillion, while the number of firms operating within the industry nearly doubled in this period. The two drivers behind the growth of the hedge fund industry were the increasing amounts of wealth of HNWIs, which was partly channelled into hedge funds, and the 'institutionalisation' of the hedge funds' client base. Institutional investments in hedge funds remained comparatively modest up to 2002 but after that date these investments rose rapidly (see Figure 9b) – a likely motivating factor being their search for yield[13].

< Figure 9 >

Faced with these large inflows of client funds demanding yield, the hedge funds found that one of the most effective ways of meeting this demand was through investments in CDOs (see Lysandrou, 2011-12). By June 2007 hedge funds were the largest group of investors in CDOs, holding nearly a half of all these products (around US$ 1.4 trillion). In contrast to institutional asset managers, which had to severely restrict the amounts of the high risk and unrated CDO equity tranches that they bought on account of prudential and regulatory constraints, hedge funds faced no such constraints in their involvement in the CDO market. This meant that they could go long on the risky equity tranches thus enabling them to take advantage of their high yields while at the same time controlling for risk through the use of credit default swaps and put options. At the same time, however, they also held substantial amounts of the senior tranches (see Table 7) that were used as collateral to leverage their client's capital by a factor of around four[14]. Both of

these strategies allowed them to generate the 11% average returns that were given back to investors in 2006 (Blundell-Wignall, 2007a; Farrel *et al.*, 2007). To maximize gross returns on assets the hedge funds had to spend far more money than was given to them by clients, and to maximize the net returns that had to be given back to these clients, the hedge funds had to keep the costs of borrowing the extra sums of money to a minimum[15]. CDOs fitted into this equation supremely well. There were other securities such as emerging market bonds that gave high returns but could not be used as collateral in borrowing arrangements and there were other securities such as US Treasuries that could be used as collateral but gave poor returns. Only CDOs combined these two distinct advantages together because only they comprised triple-A rated securities at one end of the scale with unrated equity securities at the other end.

< Table 7 >

In view of the increasing reliance on CDOs as a means by which hedge funds could generate yield for clients, it follows that HNWIs had to have been heavily, if unconsciously, implicated in CDO growth by virtue of having continued to increase their investments in hedge funds after 2002[16]. However, it is here that we come to another complication that marks off the role played by HNWIs in CDOs from that played by them in the ABS and other US debt securities markets. This concerns the distribution of wealth holdings amongst HNWIs. Far from being an even distribution, it on the contrary describes a reverse pyramid that is the inverse mirror image of the HNWI population ranked in terms of net wealth. Thus while the majority of relatively less wealthy HNWIs hold a minority of HNWI assets, at the other end of the scale a minority of HNWIs hold the majority of assets. In 2007, for example, 'ultra' HNWIs – individuals with net assets of over US$ 30 million of whom there were then about 100,000 – held approximately 37% of the US$ 41 trillion global HNWI assets (Capgemini and Merrill Lynch, 2008). Despite this highly skewed distribution of HNWI wealth it is permissible to include all 10 million or so HNWIs in calculating their impact in the other US debt securities markets because these allowed for a 'democratic' HNWI participation not only on account of the transparency of the products but also on account of the low entry barriers to these markets. By contrast, the situation with CDOs is very different. While the opacity of these structured credit products barred all HNWIs from having any direct contact with them, the relative high entry barriers into hedge funds[17] effectively prevented a significant proportion of 'low wealth' HNWIs from having even an indirect effect on CDO growth via this intermediary channel.

Our response to the above observations is to again evoke the 'blocking' hypothesis. Just as HNWIs taken as a whole occupied sufficient space in the traditional US debt securities markets as to add to the downward pressure on yields and hence to the ensuing search for yield, so also did a proportion of these same individuals occupy sufficient space in the hedge fund client base as to force hedge funds to resort to CDOs as a supplementary means of boosting yield. Two arguments can be advanced in support of this hypothesis. The first is that despite the increasing 'institutionalization' of the hedge fund client base between 2002 and 2007, HNWIs remained, as already noted, the largest source of hedge fund capital. The second argument concerns the skewed structure of the hedge fund industry. Although the number of hedge funds rose from about 5,000 to about 10,000 over the 2002-7 period, this rise did nothing to alter the hugely uneven distribution of capital amongst these funds. If anything, the steep rise in capital inflows served to further accentuate the concentration of capital investments amongst the largest hedge funds as evidenced by the fact that in 2007 around 80% of all hedge funds' assets were managed by the top 300 firms (IFSL, 2008b). It appears that HNWIs and institutional investors alike preferred to direct the bulk of their investments towards the large well-established hedge funds with a proven track record. The latter in turn, mindful of the increasing competition from other hedge funds, appeared to be reluctant to turn away new clients or to decline increased investments from established clients. Given the competitive pressure on the top hedge fund firms to find yield for their clients, and given the limits to how much yield could be generated from traditional investments products and strategies, it is understandable why these firms would increasingly turn to CDOs for a solution to the yield problem.

In sum, hedge funds and wealth concentration were two of the key elements behind the importance of demand-pull factors in CDO growth after 2002. In light of the close correlation between low US bond yields and CDO growth in the 2002-2007 period, there has been no shortage of claims or suspicions on the part of academic economists and policy makers alike that the search for yield was a major source of pressure on the US banks to create CDOs (see King, 2007; Gros 2009; Lysandrou 2009; Caballero 2010; Bernanke *et al.* 2011). If, however, all of this has yet to win more support for a demand-pull explanation of CDO growth this is because there has been until now no clear specification of the demand pressure transmission mechanism. Our view is that such a mechanism did exist, albeit that it was based not on a system of arm's length and impersonal exchanges so much as on a dense network of personal relations between pairs of agents at the hub of which was the relation between the hedge funds and the investment banks (see Figure 10). Just as the hedge funds needed to plough substantial amounts of their

clients' money into CDOs, because these helped to enhance returns while also helping to reduce leverage costs, so were the investment banks pressing the commercial banks and others into helping them to supply the hedge funds with CDOs because in addition to the fees earned from the sale of these products they could also make extra income from the extra business that was generated with the help of CDOs.

< Figure 10>

To understand the pivotal role of the investment bank-hedge fund relationship in the production of CDOs is also to understand the importance of income inequality and wealth concentration in providing the all-encompassing framework for the CDO production process, a point also illustrated in Figure 10. Take the role of US income inequality on the supply side of the production process. To create CDOs in abundance you need an abundant US demand for loans for which in turn you need an increasing polarisation of US incomes and, as we have seen, both of these preconditions were met in full. Now take the role of global wealth concentration on the demand side of the CDO production process. Hedge funds may have been the conduit through which the demand pressure for yield was transmitted through to the CDO creators but the ultimate source of that pressure were the clients of the hedge funds, and chief amongst these clients were HNWIs**.** The irony is that while the world's HNWIs helped to create the US bond yield problem by virtue of channelling sizeable proportions of their wealth into the US bond markets, a proportion of these HNWIs then continued to be an important source of the pressure on the hedge funds to find ways of resolving that yield problem.

5. Conclusion

The majority of mainstream economists and government policy makers continue to believe that the financial crisis was caused by a mixture of de-regulation, wrong incentives, and a lax monetary policy rather than by an increasing unequal distribution of income and wealth. For that reason they continue to prioritise structural changes in the financial system rather than structural changes to the current system of inequality. The conclusion that falls out of the above analysis is that as much priority needs to be given to income and wealth redistribution as to financial regulation because economic inequality had co-primacy with regulatory failure as a root cause of the financial crisis. That crisis broke out in mid-2007 because the CDO market had grown to a size sufficient to cause havoc when it collapsed at this point in time. Absent the large numbers of

American people who had low and stagnant incomes and you deprive the American banks of the raw material they needed in abundance to create CDOs on a mass scale**.** On the other side of the equation, absent the huge concentration of personal wealth amongst a very few individuals and you remove a vital source of the pressure on the American banks to create the CDOs on that mass scale. The first half of this story has been well told by others. This paper has sought to fill in some of the gaps in the second half of the story.

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Figures / Tables

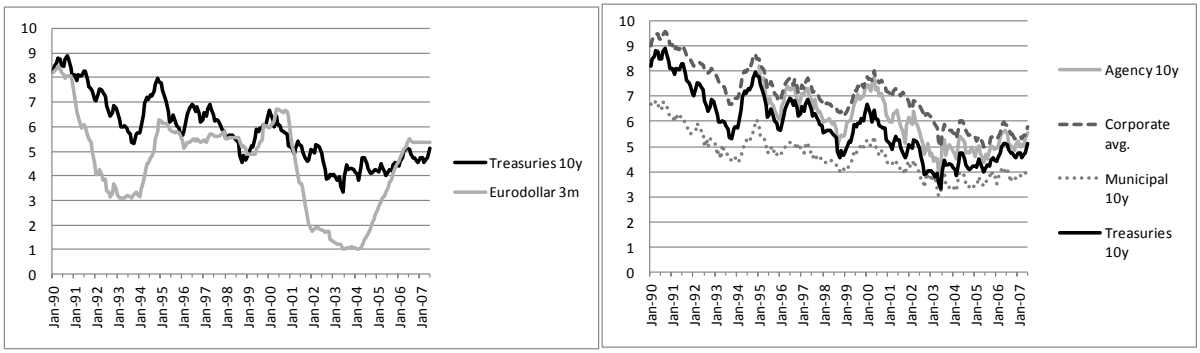

Figure 1. *Long and short-term interest rates in the US*

Note: The left plot compares the 3-month Eurodollar rate with the nominal 10-year Treasury yield. The right plot demonstrates the downward movement of traditional long-term bond yields in the US (Sources: Bloomberg, 2010; FR Statistical Release H.15, 2010).

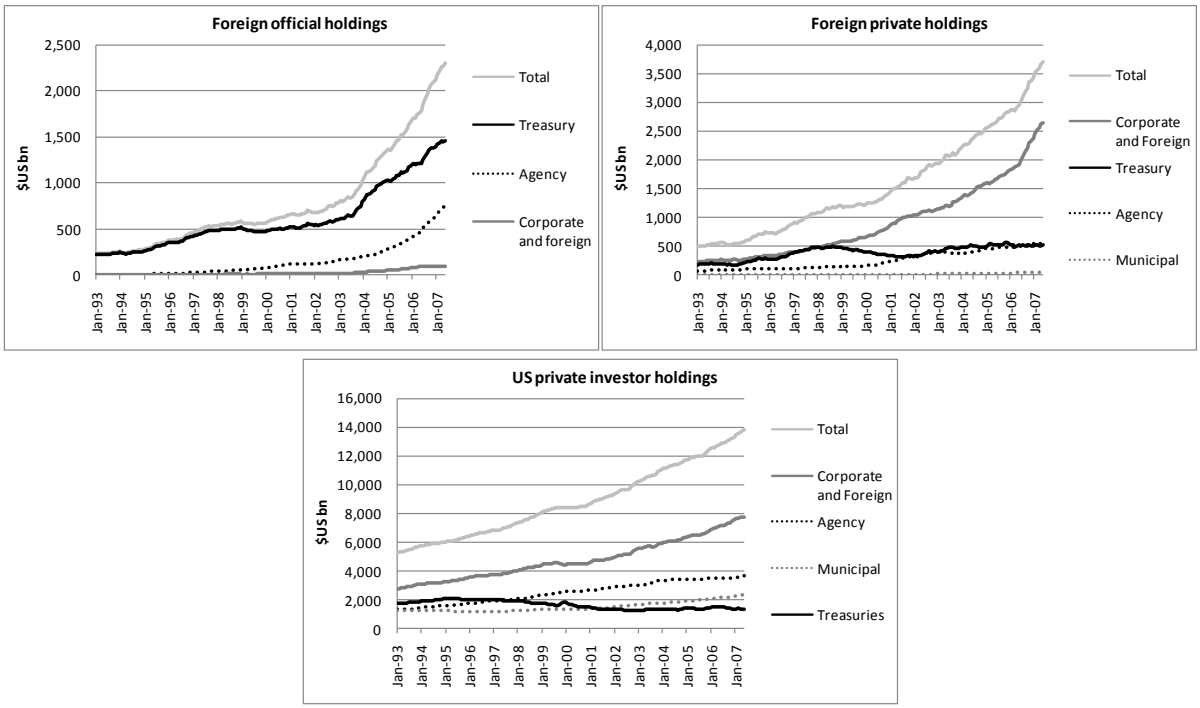

Figure 2. *US bond holdings from foreign and private domestic investors*

Note: The plots respectively show the US bond holdings of foreign governments (top left), foreign private investors (top right) and domestic private investors (bottom) (Sources: FR Statistical Release Z.1, 2010;TIC, 2010).

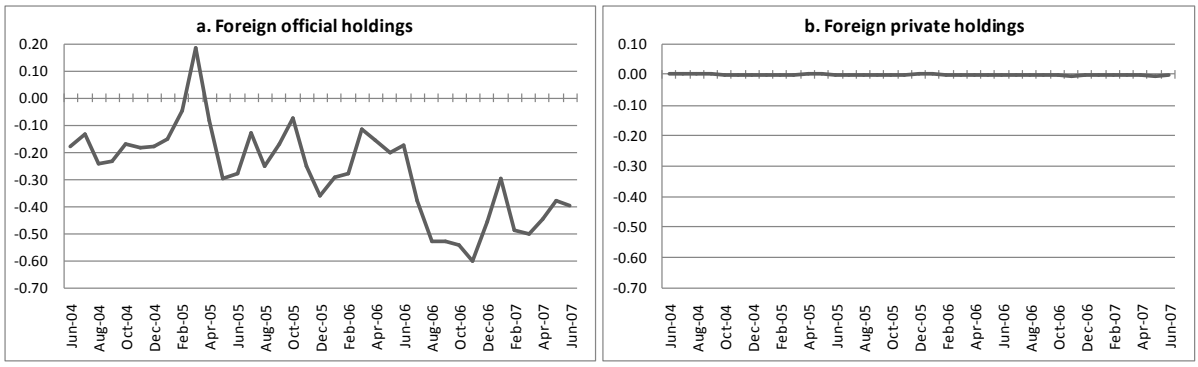

Figure 3. *Variables' MCIs for the nominal 10-year Treasury yield (in % points)*

Note: These plots show the marginal cumulative impact of the demand variables on the nominal 10-year Treasury yield for each month during the 'conundrum' period according to the results of the Treasury yield model (see Appendix, Table A1).

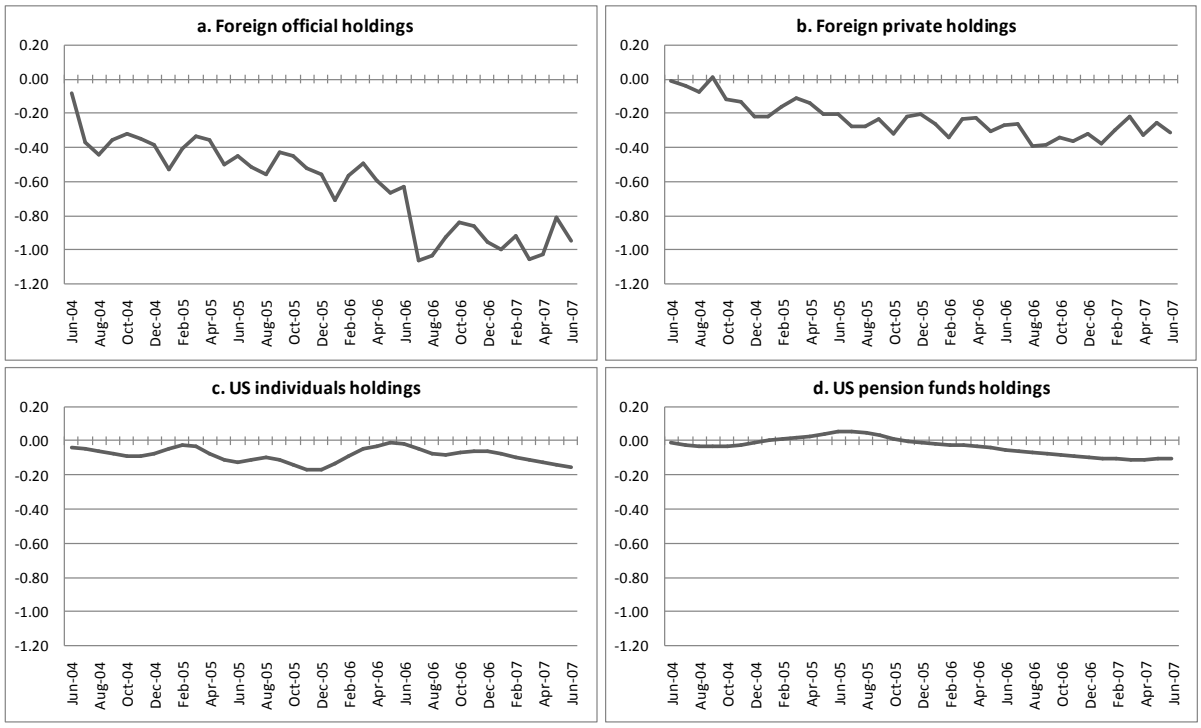

Figure 4. *Variables' MCIs for the nominal 10-year agency bond yield (in % points)*

Note: These plots show the marginal cumulative impact of the demand variables on the nominal 10-year agency bond yield for each month during the 'conundrum' period according to the results of the agency yield model (see Appendix, Table A2).

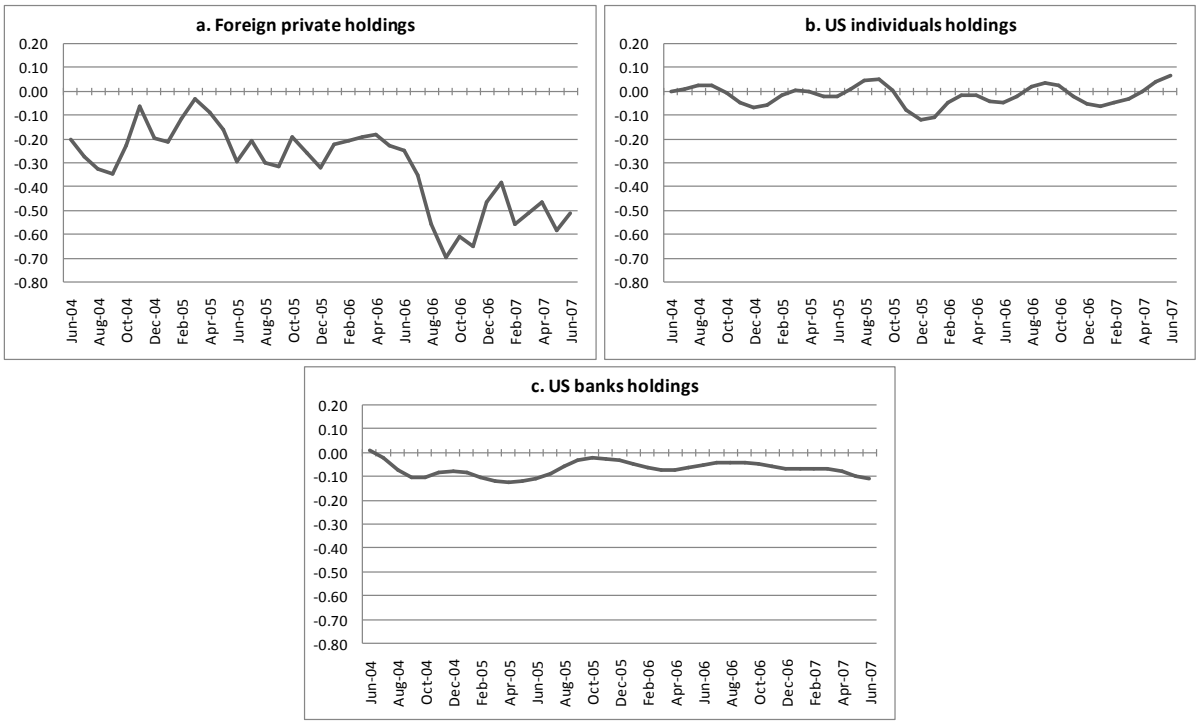

Figure 5. *Variables' MCIs for the nominal AAA-rated corporate bond yield (in % points)*

Note: These plots show the marginal cumulative impact of the demand variables on the nominal AAA-rated corporate bond yield for each month during the 'conundrum' period according to the results of the corporate yield model (see Appendix, Table A2).

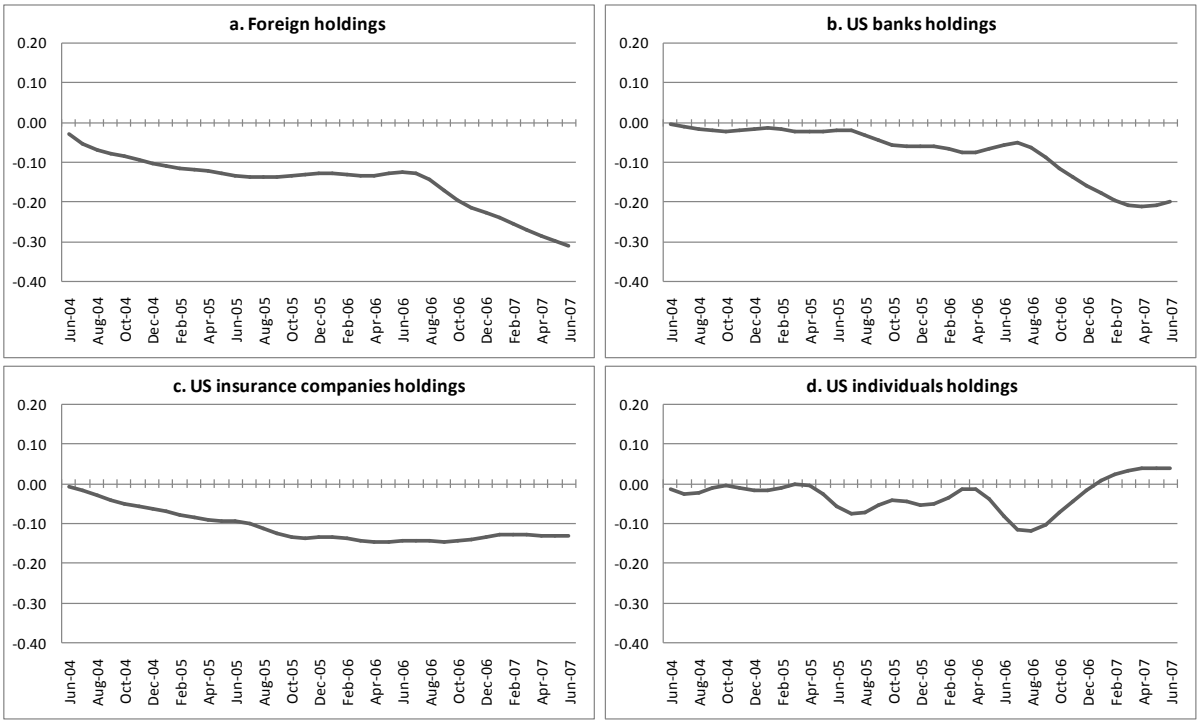

Figure 6. *Variables' MCIs for the nominal AAA-rated municipal bond yield (in % points)*

Note: These plots show the marginal cumulative impact of the demand variables on the nominal10-year AAA-rated municipal bond yield for each month during the 'conundrum' period according to the results of the municipal yield model (see Appendix, Table A2).

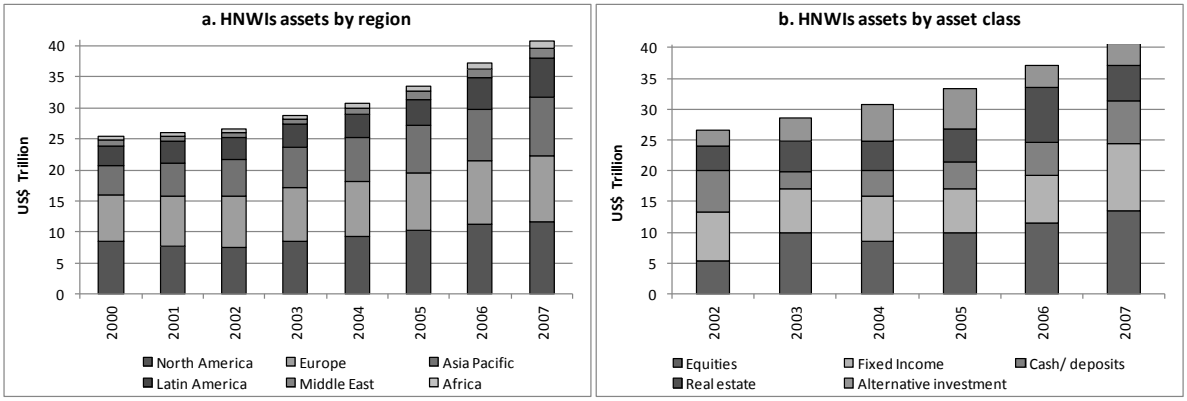

Figure 7. *HNWIs assets under management, by region and by asset class (in US$ tr)*

Source: Capgemini and Merrill Lynch World Wealth Reports (2003-2008)

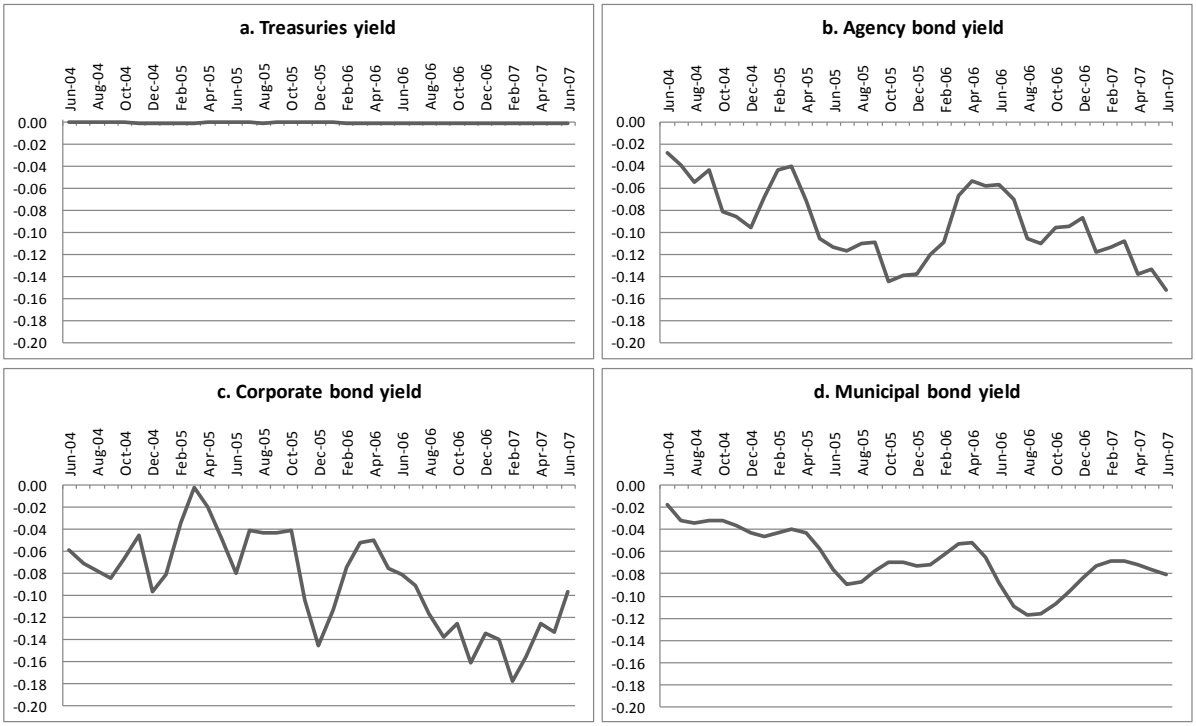

Figure 8. Estimated impact of HNWIs demand on AAA-rated long-term yields (in % points)

Note: These plots show the marginal cumulative impact of HNWIs according to the sum of the shares of US HNWIS in US individual holdings and ROW HNWIs in foreign private holdings and the MCIs of US individual investors and foreign private investors (see Figures 3-6).

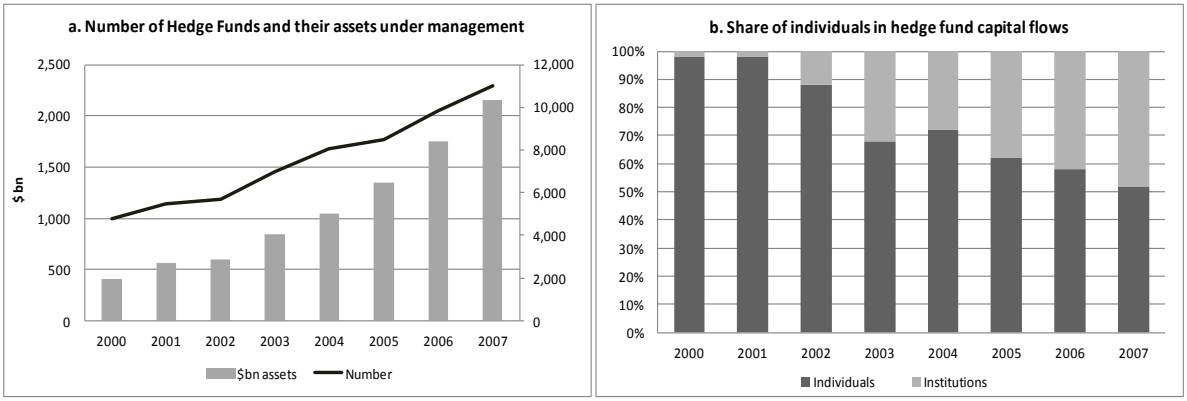

Figure 9. *Hedge Funds:number, assets under management, and source of capital*

Source: IFSL (2008b)

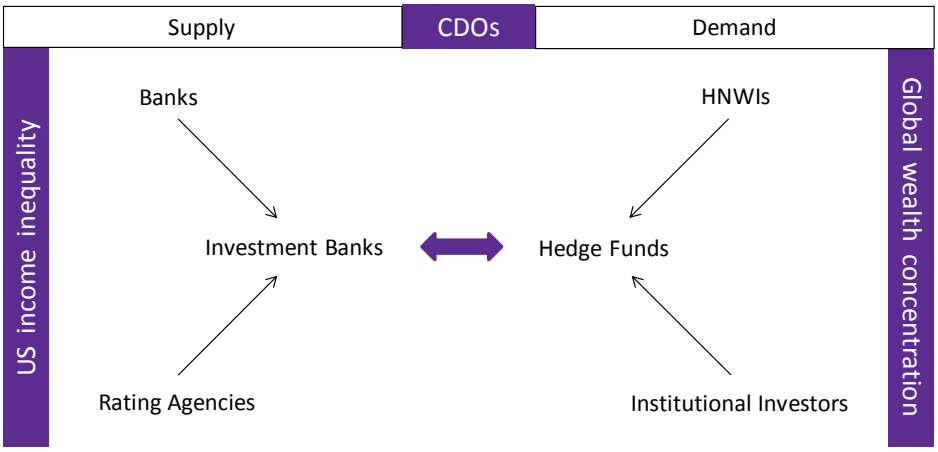

Figure 10. *Outline of the main forces in the CDO market*

Table 1. *Estimated bond holdings of US HNWIs (in US$tr)*

	US HNWIs global bond investment	US HNWIs investment in US bonds	US individual investment in US bonds
Jun-04	1.93	1.50	2.48
Jun-05	2.11	1.65	2.82
Jun-06	2.34	1.82	3.24
Jun-07	2.42	1.89	3.35

Source: own estimates; column 3 Federal Reserve Statistical Release Z.1. (2010) data

Table 2. *Estimated US bond holdings of US HNWIs sub-divided by bond type (in US$bn)*

	US Treasuries	US agency bonds	US corporate and foreign bonds	US municipal bonds
Jun-04	238	176	604	420
Jun-05	238	247	691	460
Jun-06	316	215	844	502
Jun-07	202	305	908	530

Source: own estimates derived from Federal Reserve Statistical Release Z.1.(2010) data

Table 3. *Estimated global bond holdings of ROW HNWIs (in US$ tr)*

	HNWIs investment in fixed income	US HNWIs global bond investment	Investment of ROW HNWIs in bonds
Jun-04	7.37	1.93	5.44
Jun-05	7.01	2.11	4.90
Jun-06	7.81	2.34	5.47
Jun-07	10.99	2.42	8.57

Source: own estimates derived from Capgemini and Merrill Lynch (2006, 2008) data

Table 4. *Estimated US bond holdings of ROW HNWIs (in US$ tr)*

	ROW HNWIs investment in foreign bonds	US debt securities / world total	ROW HNWIs investment in US bonds
Jun-04	1.63	39%	0.63
Jun-05	1.47	40%	0.59
Jun-06	1.64	39%	0.64
Jun-07	2.57	37%	0.96

Source: own estimates; column 2 data are derived from IMF Global Financial Stability Reports (2004-2008)

Table 5. *Estimated US bond holdings of ROW HNWIs sub-divided by bond type(in US$ bn)*

	US Treasuries	US agency bonds	US corporate and foreign bonds	US municipal bonds
Jun-04	124	96	407	8
Jun-05	97	87	402	9
Jun-06	106	84	439	10
Jun-07	123	105	721	13

Source: own estimates derived from Global Financial Stability Report (2004-2008) data

Table 6. *Estimated holdings of all HNWIs in the US bond market*

	total HNWIs investment in US bonds	US Treasuries	US agency bonds	US corporate and foreign bonds	US municipal bonds
Jun-04	2,073	362	272	1,011	428
Jun-05	2,231	335	334	1,093	469
Jun-06	2,516	423	299	1,283	512
Jun-07	2,907	325	411	1,629	542

Table 7. *Holdings of CDO buyers by June 2007*

CDO Tranche	Hedge Funds	Banks	Asset Managers	Insurance Companies
AAA	12%	15%	6%	7%
AA	4%	4%	4%	1%
A	5%	1%	3%	0%
BBB	4%	0%	4%	1%
BB	2%	0%	0%	0%
Equity	19%	5%	2%	1%
Total %	47%	25%	19%	10%
Total US$ bn	1,396	746	564	295

Source: Blundell-Wignall (2007b)

Footnotes

[1] The term wealth refers most of the times to the amount of material assets that a person or household possesses minus the liabilities of that person or household (i.e. the net worth of a person or household). However, definitions and concepts that are used by wealth reports differ to some degree. The total absolute figures are taken from the World Wealth Reports of Capgemini and Merrill Lynch (CML), while the share of total wealth comes from the Boston Consulting Group´s (BCG) Global Wealth Report. CML include in their definition all equities, fixed income securities, cash and deposit holdings, real estate holdings (excluding primary residences), and alternative forms of investment, while consumables and consumer durables and collectibles are excluded. BCG's Wealth Report is less inclusive and estimates the assets under management (AuM) from global private households on the basis of "cash deposits, money market funds, listed securities … and onshore and offshore assets [while] wealth attributed to investor's own businesses, residences, or luxury goods" are excluded (2008, p.7).

[2] As Coval *et al.* (2009, p.4) state, by "offering AAA-ratings along with attractive yields during a period of relatively low interest rates, these products were eagerly bought up by investors around the world."

[3] The MCI is the variable's contribution to the yield relative to a chosen reference point, in this case May 2004. The MCI depends on the changes in the holdings ratios and on the respective coefficients of the differenced and lagged level demand variables. The formula for calculating each month's MCI is:

$$Impact_{\gamma t} = \beta_{\gamma 1}\Delta\gamma_t + \beta_{\gamma 1}^{shift}\Delta\gamma_t + \cdots + \beta_{\gamma 12}\Delta\gamma_{t-12} + \beta_{\gamma 12}^{shift}\Delta\gamma_{t-12} + \beta_{\gamma 13}\gamma_{t-1} + \beta_{\gamma 13}^{shift}\gamma_{t-1} \quad (1)$$

$$MCI_{\gamma t} = Impact_{\gamma t} - Impact_{\gamma 2004:05} \quad (2)$$

[4] The holdings ratio (i.e. the amount of holdings divided by the outstanding amount of bonds) "is preferable to mere flow or stock figures because demand pressure can be expected to take place only when investors increase their holdings disproportionally to newly available bonds (i.e. if their holdings ratio increases)." (Goda *et al.*, 2011, p. 11).

[5] In the two decades prior to the subprime crisis there was a six fold increase in HNWI wealth – from US$ 7 trillion in 1986 (Haseler, 2000) to US$ 41 trillion in 2007 – while there was only a fourfold increase in world GDP over the same period (World Development Indicators, 2011).

[6] This percentage seems very reasonable given that in the US the "ownership of any type of bond is concentrated among the highest tiers of the income and wealth distributions" (Bucks *et al.*, 2009, p. A22).

[7] Data regarding foreign private investors' use of tax havens and financial centres to invest in US Treasuries and in agency and corporate bonds are available from the Treasury International Capital System (TIC). Municipal bonds are not included in the TIC data (probably because only a relatively small amount is held by foreigners).

[8] The interest income of most municipal bonds is exempted from state and local taxes. Thus, the share of US individuals in total municipal bond holdings (around 36% in the conundrum period) was higher than in other bond classes.

[9] Although this polarisation gathered momentum during Clinton's presidency as "the top 1% of income earners captured 45% of the total growth in (pre-tax) income" it accelerated even more rapidly during Bush's first term of office as during this period "no less than 73% of total income growth accrued to the top 1%" (Palma, 2009, p. 842).

[10] In his testimony to the Financial Crisis Inquiry Commission (2011), Charles Prince (ex Citigroup CEO) stated that "Securitization could be seen as a factory line … As more and more and more of these subprime mortgages were created as raw material for the securitization process" (2011, p.102); while David Sambol, the President and CEO of Countrywide (the largest mortgage originator in the US) admitted that in the run up to the subprime crisis the chief business purpose of his company was to be a "seller of securities to Wall Street … originating what was salable in the secondary market.", a point exemplified by the fact that it "sold or securitized 87% of the $1.5 trillion in mortgages it originated between 2002 and 2005" (p.105).

[11] Mike Francis, executive director at Morgan Stanley on the residential mortgage trading desk, stated in an interview: "We almost couldn't produce enough to keep the appetite of our investors happy. More people wanted bonds than we could actually produce. That was our difficult task, was trying to produce enough. They would call and say, we're looking for more fixed rate. What have you got? Do you have anything coming? What's going on? Tell us what you're trying to do. From our standpoint it's like, there's a guy out there with a lot of money. And we have got to find a way to become his sole provider of bonds, of mortgage bonds, to fill his appetite. And his appetite's massive." (This American Life, 2008). To be able to produce the huge quantities that were needed standards were lowered not only to bring more numbers of subprime borrowers into the mortgage market but also to speed up the whole mortgage origination process. Furthermore, it was not only poor households that were supplied with subprime loans; households with good credit scores were also "pushed into risky subprime loans [because] lenders or brokers aggressively marketed the loans, offering easier and faster approvals, [this] was fuelled with faxes and emails from lenders to brokers touting easier qualification for borrowers and attractive payouts" (Brooks and Simon, 2007).

[12] For example, "Pension funds … face ratings-based regulations. A recent survey of two hundred pension plan sponsors and investment managers in the US and Europe (Cantor et al., 2007) found that 75% have minimum rating requirements for bond purchases and 50% set limits on portfolio distribution by rating class." (Benmelech and Dlugosz, 2009, p. 20). According to estimates provided by Blundell-Wignall (2007b) 29% of the US$ 3 trillion worth of CDOs outstanding at mid-2007 were held by institutional investors, but most of these holdings (around 90%) fell into the A- and B-rated categories. This contrasts sharply with the hedge funds who held 40% of their CDOs in equity tranches.

[13] The large institutional investors typically assign the majority of their assets to core portfolios that match expected returns with acceptable levels of risk (partly due to regulatory reasons). Having safely covered most assets under their management, these investors then typically assign a small proportion to the much riskier, but reputedly much higher yielding, 'alternative' investment classes such as private equity, hedge funds and CDOs. What appears to have happened from 2002 onwards is that the problem of yield on traditional assets became so acute that institutional investors were motivated to increase their exposure to the alternative investment classes by more than what was usual before.

[14] Leverage also is the explanation why hedge funds could hold so many CDOs although their assets under management were 'only' US$ 2.2 trillion. The downside to the hedge fund's heavy use of leverage to increase their CDO holdings was that it exposed to them to the risk of liquidity withdrawal, as actually happened in 2007. However, while excessive leverage was instrumental to the collapse of many hedge funds during the financial crisis, and to the collapse of an even greater proportion of the bank-sponsored conduits and SIVs, it was not what triggered the collapse. That trigger was to be found in the opacity and complexity of the CDOs. After all, as was made very clear in Brunnermeier's (2009) event logbook of the crisis, it was the BNP Paribas announcement on August 9th of 2007 to the effect that it could not value

the CDOs held by three of its hedge funds that spread widespread panic in the financial markets, which in turn led to the complete withdrawal of liquidity.

[15] In 2001 and 2002 hedge funds returns were relatively low compared with other investment opportunities (6.3% and 0.1% respectively). Between 2003 and 2007 the return of hedge funds increased to an average of 11.6% (with some funds having much higher returns, which together with portfolio reasons explains the increasing amount of investment in hedge funds). Nevertheless, hedge funds were under constant pressure to increase these returns as the average S&P 500 return was 13.2% during the same period (IFSL, 2009).

[16] Due to the existing regulations, individual investment in hedge funds came almost to 100% from HNWIs. This means that hedge fund assets from HNWIs were increasing from around US$ 0.5 trillion in 2002 to around US$ 1.1 trillion in 2007.

[17] According to SEC regulation only individuals with a minimum net worth of US$ 5 million or in special cases with a net worth of US$ 1 million and at least US$ 200,000 in income in the last two years are allowed to invest in hedge funds. For funds of hedge funds the regulations are similar.

Appendix

When quantifying the impact of demand on bond yields all major determinants of yields have to be taken into account. These determinants broadly divide into three groups: those relating to macroeconomic essentials, those relating to financial risk (see Rudebusch *et al.*, 2006; Wu, 2008) and those relating to investor demand (see Bandholz *et al.* 2009; Craine and Martin 2009; Warnock and Cacdac Warnock, 2009). Accordingly, the long-term yields are influenced by the following factors:

$$y^l = f(i^s, \pi, \pi^e, y^e, rp, d) \tag{A1}$$

Where y^l denotes the long term interest rate, i^s the short-term interest rate, π current inflation, π^e inflation expectations, y^e growth expectations and *rp* is a risk premium for the expected default risk and macroeconomic and financial volatility, while *d* denotes investor demand for bonds.

Based on (A1) Goda *et al.* (2011) develop four Autoregressive Distributed Lags (ARDL) models, to test which of these factors depressed the long-term yields of AAA-rated bonds in the bond yield 'conundrum' period. The general form of these models is:

$$\Delta y_t^l = \beta_0 + \sum_{i=0}^{p} \gamma_{1i} \Delta X_{1t-i} + \cdots + \sum_{i=0}^{p} \gamma_{Ki} \Delta X_{Kt-i} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-i}^l + \alpha_0 y_{t-1}^l + \sum_{k=1}^{K} \beta_k X_{kt-1} + u_t \tag{A2}$$

The main reasons for choosing the ARDL modelling technique were that, firstly, it was infeasible for their purpose to use stationary vector autoregression (VAR) and vector error correction models (VECM) because of the large number of variables involved and the incorporation of lags and, secondly, most of the variables are non-stationary but some are stationary. It should be further noted that Goda *et al.* report that in each bond class a structural change took place during the sample period, the dates of these changes apparently being November 1998 in the Treasury market, February 1999 in the AAA-rated corporate bond market, and April 2004 in the agency and municipal bond markets. What follows are the models that account for these structural breaks as these are Goda *et al.*'s favoured models for inference due to their superior fit[1].

[1] See Goda et al. (2011) for a detailed discussion of the model specification, model selection, andfor possible reasons for the structural breaks and their influence on the variables.

Table A1. *Parsimonious model of the nominal 10-year Treasury yield*

	(i) model	
Δ(FOROFFICIAL)	-0.2155***	(-6.81)
Δ(FOROFFICIAL(-1))	-0.1325***	(-4.11)
Δ(EUR_DOL)	0.7202***	(4.38)
$\Delta(EURDOL)^{s11/98}$	-0.5256***	(-2.98)
Δ(EURDOL(-1))	-0.1630*	(-1.78)
Δ(LOGISM)	1.0200***	(2.65)
Δ(LOGISM(-1))	1.6376***	(2.86)
$\Delta(LOGISM(-1))^{s11/98}$	-1.2539*	(-1.80)
Δ(LOGISM(-4))	0.8844***	(2.66)
Δ(PCE)	0.5403***	(2.90)
Δ(PCE(-9))	-0.6432***	(-3.12)
Δ(DOW)	0.0001**	(3.14)
YIELD(-1)	-0.3795***	(-6.63)
FOROFFICIAL(-1)	-0.0358***	(-4.67)
FORPRIVATE(-1)	-0.0909***	(-6.50)
$FORPRIVATE(-1)^{s11/98}$	0.0924***	(3.62)
EURDOL(-1)	0.1700***	(3.45)
$EURDOL(-1)^{s11/98}$	-0.1277***	(-2.73)
LOGISM(-1)	1.2634***	(4.69)
$LOGISM(-1)^{s11/98}$	0.3038**	(-2.29)
PCE(-1)	0.3578***	(3.28)
DOW(-1)	0.0002***	(5.88)
MOVE(-1)	0.0027***	(2.78)
adj. R-squared	0.64	
Schwarz criterion	-0.54	
Sample: 1994:02 to 2007:06 (161 observations)		

(ii) equilibrium long-run effects		
before the break		
FOROFFICIAL	-0.0944***	(-7.14)
FORPRIVATE	-0.2396***	(-5.82
EURDOL	0.4478***	(4.50)
LOGISM	3.3286***	(5.52)
PCE	0.9426***	(3.72)
DOW	0.0005***	(5.56)
MOVE	0.0070***	(2.88)
after the break		
FOROFFICIAL	-0.0944***	(-7.14)
FORPRIVATE	0.0038	(0.07)
EURDOL	0.1113***	(2.85)
LOGISM	2.5283***	(3.61)
PCE	0.9426***	(3.72)
DOW	0.0005***	(5.56)
MOVE	0.0070***	(2.88)

misspecification/cointegration tests	
BG(2) prob.	0.24
BG(12) prob.	0.36
Jarque-Bera prob.	0.26
Arch(1) prob.	0.56
Arch(12) prob.	0.49
White prob.	0.61
Ramsey LR prob.	0.15
Wu-Hausm. prob.	0.58
Bounds test F-stat.	8.20***
Bounds test t-stat.	-6.63***

Note: This table summarizes the results of our ARDL-model for the nominal 10-year Treasury yield. Where Δ is the difference operator, the number of lags are indicated in parentheses as a suffix to a variable's name, $s^{11/98}$ indicates the shift component of a variable and the date of the structural break (i.e. after November 1998), *YIELD* is the 10-year nominal Treasury yield, *FOROFFICIAL* are foreign official holdings as a ratio of total outstanding long-term Treasuries, *FORPRIVATE* are foreign private holdings as a ratio of total outstanding long-term Treasuries, *EURDOL* is the 3-month Eurodollar rate, *LOGISM* is the log of the ISM-Index, *PCE* is the actual PCE inflation rate, *DOW* is the value of the Dow Jones Index, and *MOVE* is the Merrill Lynch Option Volatility Estimate Index. Intercepts are not reported but are included in the models. In each column coefficients and t-statistics (in parenthesis) are reported. Probability values for all misspecification tests are reported in the section headed misspecification/cointegration tests, where BG(x) denotes the probability value of the Breusch-Godfrey test for x order correlation and Arch(x) the probability value of the ARCH heteroskedasticity test with x lags. The 5% critical values for the bounds cointegration test with unrestricted intercept and no trend are (i) F=3.39, t=-4.72, (ii) F=3.50, t=-5.03 [(i) k=8, (ii) k=10 (t), k=7 (F)]. The significance of a coefficient or test statistic at the 1%, 5% and 10% level of significance is indicated by ***, ** and *, respectively (Source: Goda *et al.*, 2011).

Table A2. *Parsimonious model of the nominal long term yields of AAA-rated non-Treasury US securities*

(i) Agency			(ii) Corporate			(iii) Municipal		
Δ(FOROFFICIAL)	-1.7414***	(-5.68)	Δ(YIELD(-1))	0.0956	(1.61)	$\Delta(YIELD(-1))^{s04/01}$	0.4644***	(4.57)
Δ(FORPRIVATE)	-0.4600***	(-3.45)	Δ(FORPRIVATE)	-0.3983***	(-9.59)	$\Delta(YIELD(-1))^{s04/01}$	0.3334***	(3.59)
Δ(USINDIVIDUALS)	-0.1321***	(-2.98)	Δ(FORPRIVATE(-1))	-0.2464***	(-5.10)	$\Delta(YIELD(-3))^{s04/01}$	0.2833***	(3.22)
Δ(EURDOL)	0.4803***	(3.80)	Δ(US INDIVIDUAL(-1))	-0.1792***	(-5.90)	Δ(YIELD(-4))	0.2293***	(3.70)
Δ(LOGISM)	1.4678***	(3.11)	Δ(USBANK(-1))	-0.3478***	(-4.28)	Δ(YIELD(-5))	0.2166***	(3.62)
Δ(PCE)	0.6020**	(2.50)	Δ(EURDOL(-1))	-0.1658***	(-2.59)	Δ(EURDOL)	0.7231***	(8.42)
$\Delta(PCE(-2))^{s04/01}$	-0.8739***	(-2.82)	$\Delta(EURDOL(-8))^{s02/99}$	-0.3045***	(-4.24)	$\Delta(EURDOL(-2))^{s04/01}$	-0.3469**	(-2.34)
$\Delta(DOW)^{s04/01}$	0.0003***	(4.95)	Δ(EURDOL(-11))	0.1275**	(2.24)	$\Delta(EURDOL(-8))^{s04/01}$	-0.3734***	(-2.87)
$\Delta(MOVE)^{s04/01}$	0.0094***	(4.95)	Δ(LOGISM)	0.6734**	(2.39)	Δ(PCE)	0.9009***	(5.03)
YIELD(-1)	-0.4101***	(-7.87)	Δ(LOGISM(-1))	1.5553***	(3.82)	Δ(DOW)s04/01	0.0002***	(3.85)
FOROFFICIAL(-1)	-0.4626***	(-3.27)	$\Delta(LOGISM(-1))^{s02/99}$	-1.4720***	(-3.03)	Δ(DOW(-5))	0.0001***	(2.61)
$FOROFFICIAL(-1)^{s04/01}$	0.4027***	(3.32)	Δ(PCE)	0.4381***	(3.29)	Δ(MOVE)	0.0033***	(3.19)
FORPRIVATE(-1)	-0.2168***	(-3.11)	Δ(PCE(-9))	-0.4191***	(-2.91)	Δ(MOVE(-2))	-0.0027***	(-2.96)
USINDIVIDUAL(-1)	-0.0514***	(-3.54)	Δ(DOW)	0.0001***	(3.21)	YIELD10(-1)	-0.5913***	(-8.75)
$USPENSION(-1)^{s04/01}$	-0.1441***	(-3.07)	YIELD(-1)	-0.2273***	(-6.56)	$YIELD(-1)^{s04/01}$	-0.4765***	(-6.14)
EURDOL(-1)	0.2218***	(5.02)	FORPRIVATE(-1)	-0.2113***	(-5.37)	FOREIGN(-1)	-4.9958***	(-6.30)
LOGISM(-1)	1.3153***	(4.34)	$FORPRIVATE(-1)^{s02/99}$	0.1615***	(4.50)	$FOREIGN(-1)^{s04/01}$	4.1318***	(6.05)
PCE(-1)	0.8260***	(6.30)	EURDOL(-1)	0.0664***	(4.83)	USINDIVIDUAL(-1)	-0.1010***	(-4.27)
DOW(-1)	0.0002***	(4.53)	LOGISM(-1)	0.6125***	(3.51)	USINSURANCE(-1)	-0.0747***	(-2.60)
MOVE(-1)	0.0036**	(2.24)	$LOGISM(-1)^{s02/99}$	-0.5380***	(-4.33)	USBANK(-1)	-0.2470**	(-2.07)
$MOVE(-1)^{s04/01}$	0.0061***	(2.80)	PCE(-1)	0.1906***	(2.88)	EURDOL(-1)	0.2054***	(6.09)
adj. R-squared	0.63		CPI10Y(-1)	0.3002**	(2.29)	LOGISM(-1)	0.6388***	(2.73)
Schwarz criterion	-0.09		DOW(-1)	0.0001***	(5.61)	PCE(-1)	0.3050***	(3.66)
Sample: 1995:01 to 2007:06 (150 obs.)			MOVE(-1)	0.0016**	(2.34)	DOW(-1)	0.0001***	(3.71)
			EDFAAA(-1)	3.0898***	(5.60)	MOVE(-1)	0.0055***	(4.82)
			adj. R-squared	0.71		adj. R-squared	0.57	
			Schwarz criterion	-1.19		Schwarz criterion	-0.61	
			Sample: 1994:02 to 2007:06 (161 obs.)			Sample: 1994:02 to 2007:06 (161 obs.)		

Results misspecification/cointegration tests

BG(2) prob.: (i) 0.89, (ii) 0.65, (iii) 0.23 BG(12) prob.: (i) 0.26, (ii) 0.15, (iii) 0.10 Jarque-Bera prob.: (i) 0.44, (ii) 0.99, (iii) 0.54

Arch(1) prob.: (i) 0.61, (ii) 0.86, (iii) 0.41 Arch(12) prob.: (i) 0.56, (ii) 0.15, (iii) 0.87 White prob.: (i) 0.47, (ii) 0.31, (iii) 0.06

Ramsey LR prob.: (i) 0.16, (ii) 0.26, (iii) 0.23 Wu-Hausman Prob.: F-stat. (i) 0.46, (ii) 0.55, (iii) 0.86

Bounds test: F-stat. (i) 8.68***, (ii) 10.41***, (iii) 10.39***; t-stat. (i) -7.87***, (ii) -6.56***, (iii) -9.85***

Note: This table summarizes the results of our ARDL-models for the nominal 10-year US agency, and AAA-rated corporate and municipal bond yields, respectively. The table notes are the same as in Table A1, with the following exceptions: $s^{x/x}$ indicates the shift component of a variable with the date of the structural break indicated by *x/x* (i.e. after February 1999 and after April 2001), *YIELD* is the 10-year nominal yield of the respective bond class, *FOROFFICIAL* are foreign official holdings as a ratio of total outstanding bonds (i.e. the holdings ratio) of the respective bond class, *FORPRIVATE* is the foreign private holdings ratio of the respective bond class, *FOREIGN* is the foreign holdings ratio of municipal bonds, *USBANK* is the US banking institutions holdings ratio of the respective bond class, *USINDIVIDUAL* is the US individual holdings ratio of the respective bond class, *USINSURANCE* is the US insurance companies holdings ratio of the respective bond class, *USPENSION* is the US pension funds holdings ratio of the respective bond class, and *EDFAAA* is Moody's expected default frequency for AAA-rated corporate bonds. The 5% critical values for a Bounds cointegration test with unrestricted intercept and no trend are (i) F=3.30, t≈-5.20 , (ii) F=3.39, t=-5.03, (iii) F=3.24, t≈-5.20 [(i) k=11 (t), k=9 (F) (ii) k=10 (t), k=8 (F) (iii) k=10 (F), k=11 (t)] (Source: Goda *et al.*, 2011).

Table A3. *Equilibrium long-run impacts on the nominal long term yields of AAA-rated non-Treasury US securities*

(i) Agency bond yield			(ii) Corporate bond yield			(iii) Municipal bond yield		
before the break			**before the break**			**before the break**		
FOROFFICIAL	-1.1282***	(-3.82)	FORPRIVATE	-0.9298***	(-5.39)	FOREIGN	-8.4493***	(-5.64)
FORPRIVATE	-0.5286***	(-3.43)	EURDOL	0.2923***	(5.18)	USINDIVIDUAL	-0.1709***	(-4.33)
USINDIVIDUAL	-0.1253***	(-3.93)	LOGISM	2.6953***	(3.24)	USINSURANCE	-0.1263***	(-2.83)
USPENSION			PCE	0.8387***	(3.15)	USBANK	-0.4178**	(-2.08)
EURDOL	0.5410***	(6.83)	CPI10Y	1.3207**	(2.42)	EURDOL	0.3473***	(8.47)
LOGISM	3.2074***	(4.80)	DOW	0.0005***	(5.56)	LOGISM	1.0805***	(3.17)
PCE	2.0143***	(7.82)	MOVE	0.0071**	(2.51)	PCE	0.5159***	(3.74)
DOW	0.0004***	(4.53)	EDFAAA	13.5957***	(6.33)	DOW	0.0002***	(3.36)
MOVE	0.0088**	(2.20)				MOVE	0.0093***	(4.63)
after the break			**after the break**			**after the break**		
FOROFFICIAL	-0.1462*	(-1.73)	FORPRIVATE	-0.2193***	(-5.63)	FOREIGN	-0.8091***	(-7.00)
FORPRIVATE	-0.5286***	(-3.43)	EURDOL	0.2923***	(5.18)	USINDIVIDUAL	-0.0946***	(-5.45)
USINDIVIDUAL	-0.1253***	(-3.93)	LOGISM	0.3282	(0.43)	USINSURANCE	-0.0699***	(-2.92)
USPENSION	-0.3514***	(-3.10)	PCE	0.8387***	(3.15)	USBANK	-0.2314**	(-2.18)
EURDOL	0.5410***	(6.83)	CPI10Y	1.3207**	(2.42)	EURDOL	0.1923***	(7.97)
LOGISM	3.2074***	(4.80)	DOW	0.0005***	(5.56)	LOGISM	0.5983***	(2.88)
PCE	2.0143***	(7.82)	MOVE	0.0071**	(2.51)	PCE	0.2857***	(3.94)
DOW	0.0004***	(4.53)	EDFAAA	13.5957***	(6.33)	DOW	0.0001***	(4.07)
MOVE	0.0237***	(5.91)				MOVE	0.0051***	(4.58)

Note: This table summarizes the equilibrium results of our ARDL-models for the nominal 10-year US agency, and AAA-rated corporate and municipal bond yields, respectively. The table notes are the same as in Table A1 and Table A2 (Source: Goda *et al.*, 2011).