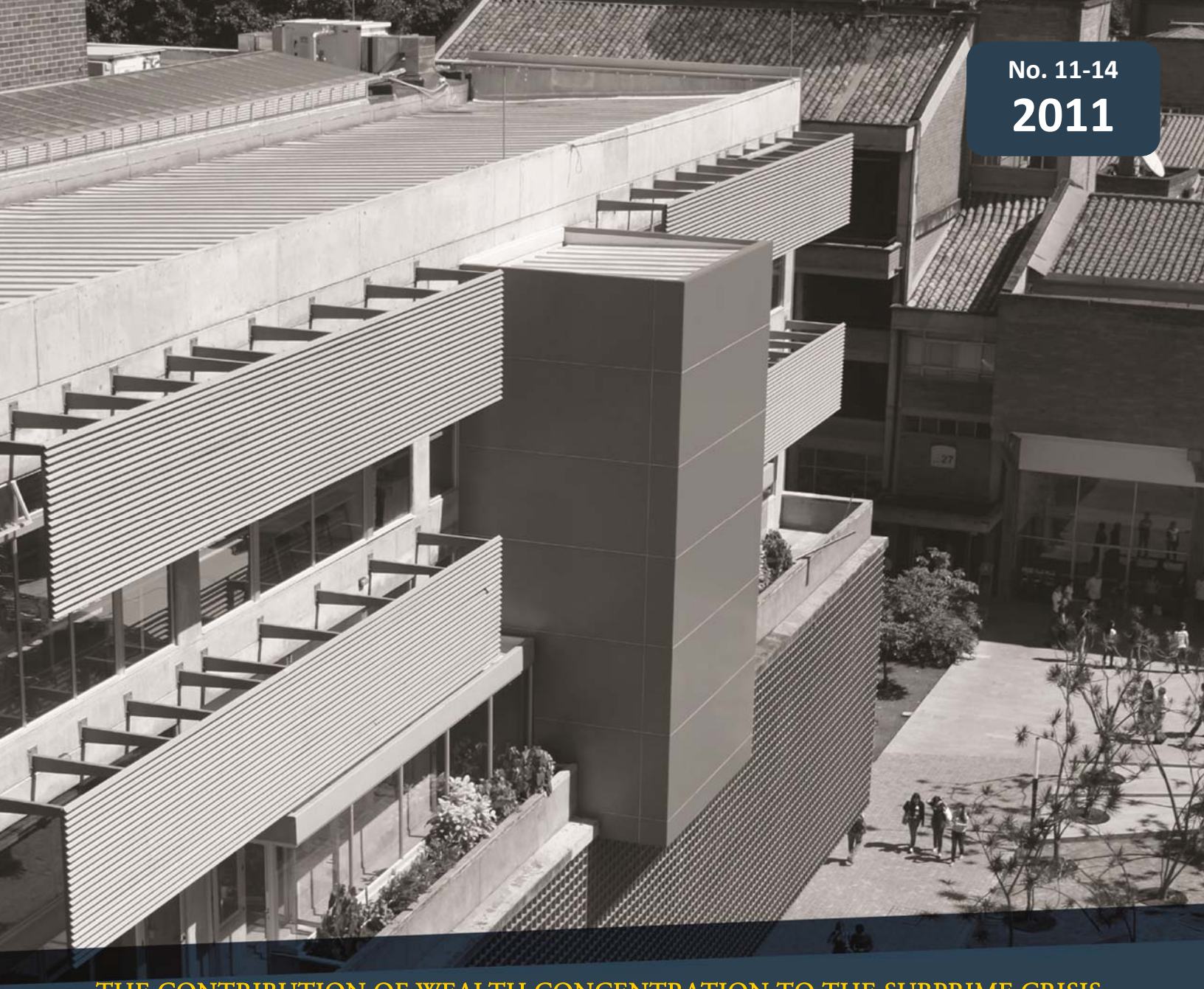

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THE CONTRIBUTION OF WEALTH CONCENTRATION TO THE SUBPRIME CRISIS: A QUANTITATIVE ESTIMATION

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

Thomas Goda and Photis Lysandrou[•]

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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 caused 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

One of the unresolved questions arising out of the subprime crisis of 2007 concerns the precise role played by income and wealth inequality. That this issue had to figure somewhere in the crisis is not in doubt considering that many of those who took out the subprime loans belonged to the poorest sections of the American population (see e.g. Fernandez *et al.*, 2008; Wade, 2009; Palma, 2009; Stockhammer, 2009). What is in doubt is whether economic inequality had a more centrally causal role, for although poverty can explain the demand for mortgage loans it cannot explain why these loans were securitised and then re-securitised into the collateralised debt obligations (CDOs) that were sold to investors. This shortfall in explanatory power helps to explain the observed asymmetry in the discussions of the subprime crisis: while those seeking to give importance to the role of inequality feel bound to also give prominence to the failures in the banking sector, the reverse is not true in that those

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who prioritise the part played by these institutional failures do not also feel bound to include the part played by inequality (see e.g. Brummer (2009) who emphasises the importance of greed on the part of the banks; Davies (2010) who highlights the lack of regulation; Trichet (2008) and IMF (2008) who blame the widespread undervaluation of risk, and Obstfeld and Rogoff (2009) who identify global imbalances and low short-term interest rates as important codeterminants).

It has been argued (Lysandrou, 2011a) that the only way to redress this imbalance is to bring both ends of the wealth distribution spectrum into the story behind the growth of CDOs: just as low incomes and poverty in the US were among the 'supply-push' factors in this growth inasmuch as mortgage loans constituted the raw material for CDOs, so was wealth concentration one of the 'demand-pull' factors inasmuch as it was a major source of the pressure on the banks to satisfy investors' reach for yield. We agree fully with this argument but also point out that more work needs to be done to give it weight. Three hurdles in particular need to be overcome. 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 chiefly in order to absorb the overspill of demand for yield flowing from the other US debt markets it has to be shown 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 hurdle concerns the contribution of rich individuals to the downward pressure on 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 hurdle concerns the unusual structure of the CDO market: as rich individuals along with certain other types of customer would have been excluded from this market due to the highly complex nature of CDOs the claim that the banks were under pressure to create these products can only hold up if there is a clear explanation as to exactly how that pressure was transmitted. Some progress appears to have been made with regard to overcoming the first and third of these hurdles and we shall review this progress below. As far as we are aware, however, no attempt has yet been made to overcome the middle hurdle. The chief contribution of this paper is to take up this task.

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 estimated amount of CDOs in 2002 was about US$0.25 trillion and yet by the time these products triggered the financial crisis in mid-2007 that figure had multiplied twelvefold to about US$3 trillion (Blundell-Wignall, 2007). This rapid growth 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 as long term yields continued to remain low even as the Federal Funds rate began to rise sharply from this date (see Figure 1)[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 now appearing 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 oil or non-oil export surpluses were the major source of funds (Bernanke *et al.*, 2011)).

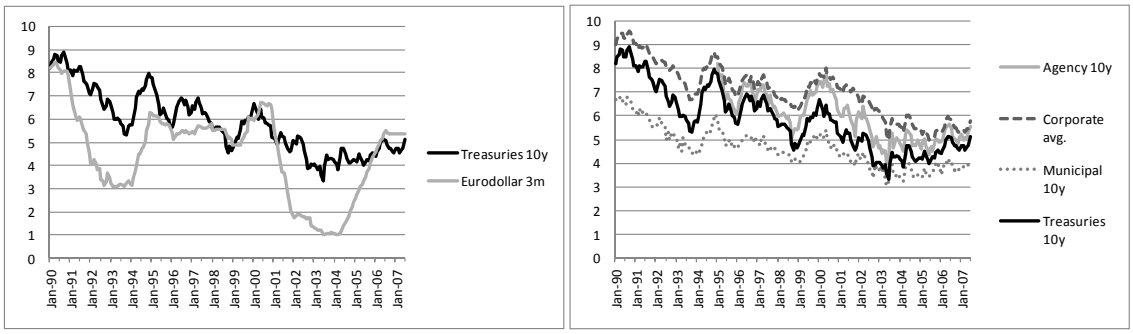

Figure 1. *Long and short-term interest rates in the US*

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).

[1] As Alan Greenspan, the then Chairman of the Federal Reserve, stated before Congress in June 2005: "Among the biggest surprises of the past year has been the pronounced decline in long-term interest rates on U.S. Treasury securities despite a 2-percentage-point increase in the federal funds rate. This is clearly without recent precedent. … Moreover, even after the recent backup in credit risk spreads, yields for … corporate bonds have declined even more than Treasuries over the same period." (Greenspan, 2005, p.1).

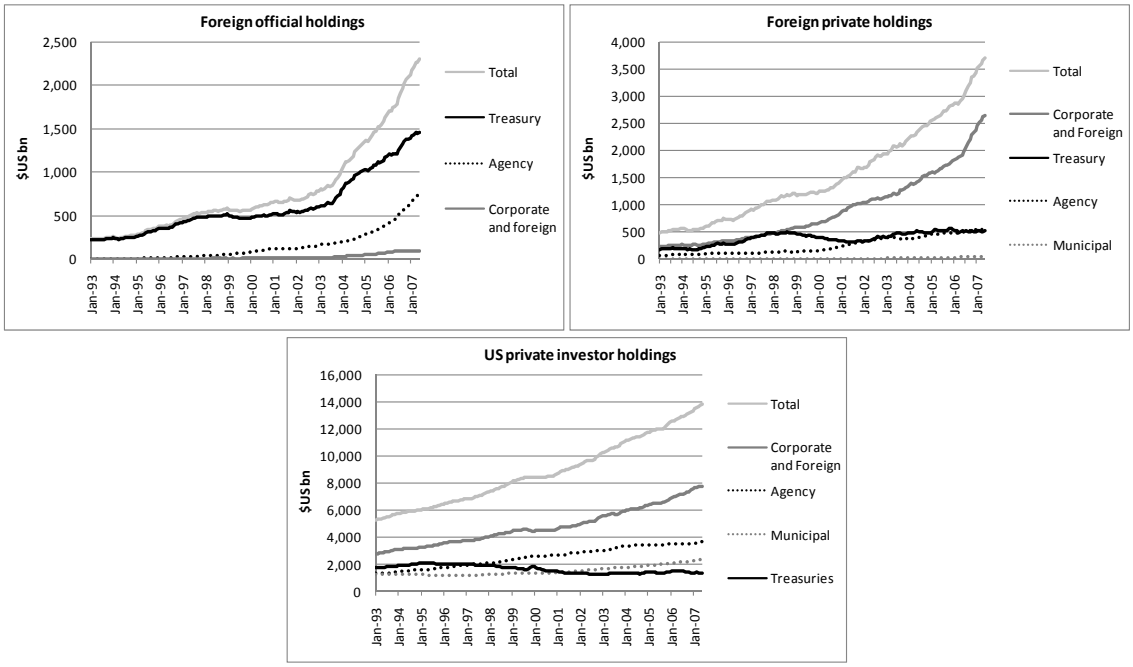

Figure 2. *US bond holdings from foreign and private domestic investors*

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).

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 and other failings on the part of the banks and their associates were the more important motivating forces behind the rapid acceleration in CDO production prior to mid-2007. A number of authors (see e.g. Caballero and Krishnamurthy, 2009; Gros, 2009; Lysandrou, 2009; Caballero, 2010; Bernanke *et al.* 2011) have advanced the contrary 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-

[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."

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). However, while these results represent a necessary first step towards vindicating 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 chiefly in order to take the overspill of demand for yield flowing from the other US debt markets it has to be shown 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. Some details regarding their choice of modelling procedure and the data that were used are given in 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).

[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).

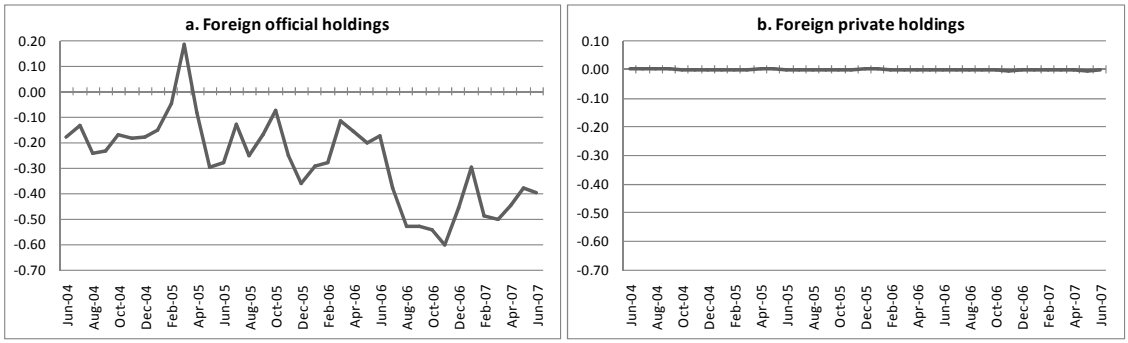

Figure 3. *Variables' MCIs for the nominal 10-year Treasury yield (in % points)*

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).

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.

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.

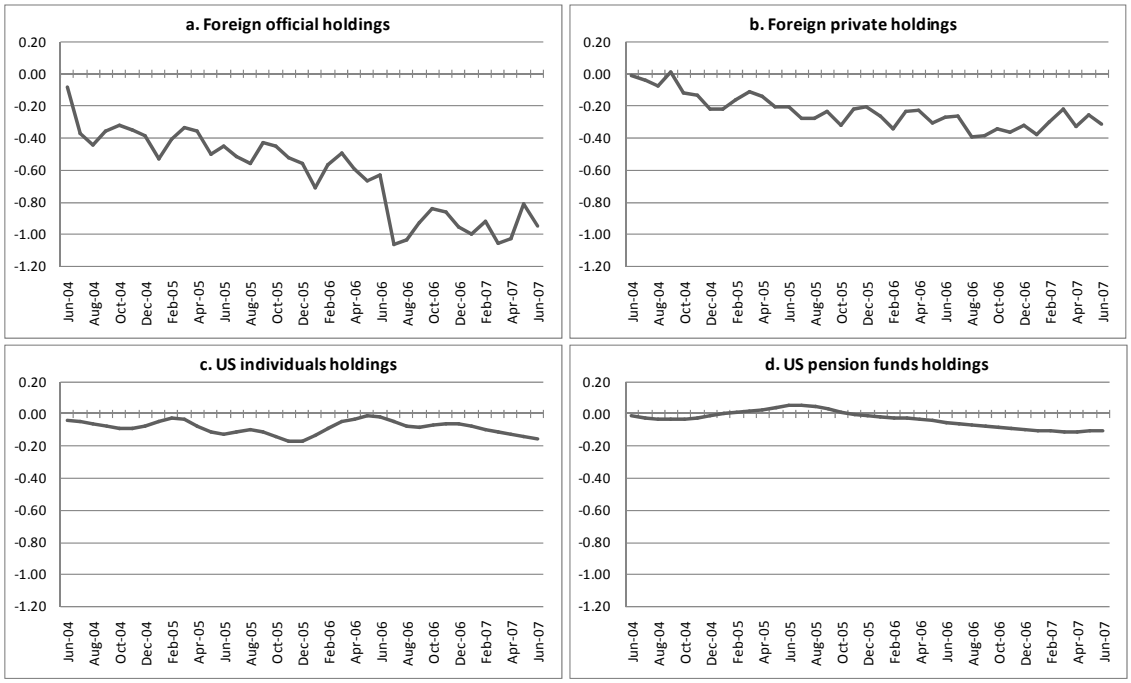

Figure 4. *Variables' MCIs for the nominal 10-year agency bond yield (in % points)*

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).

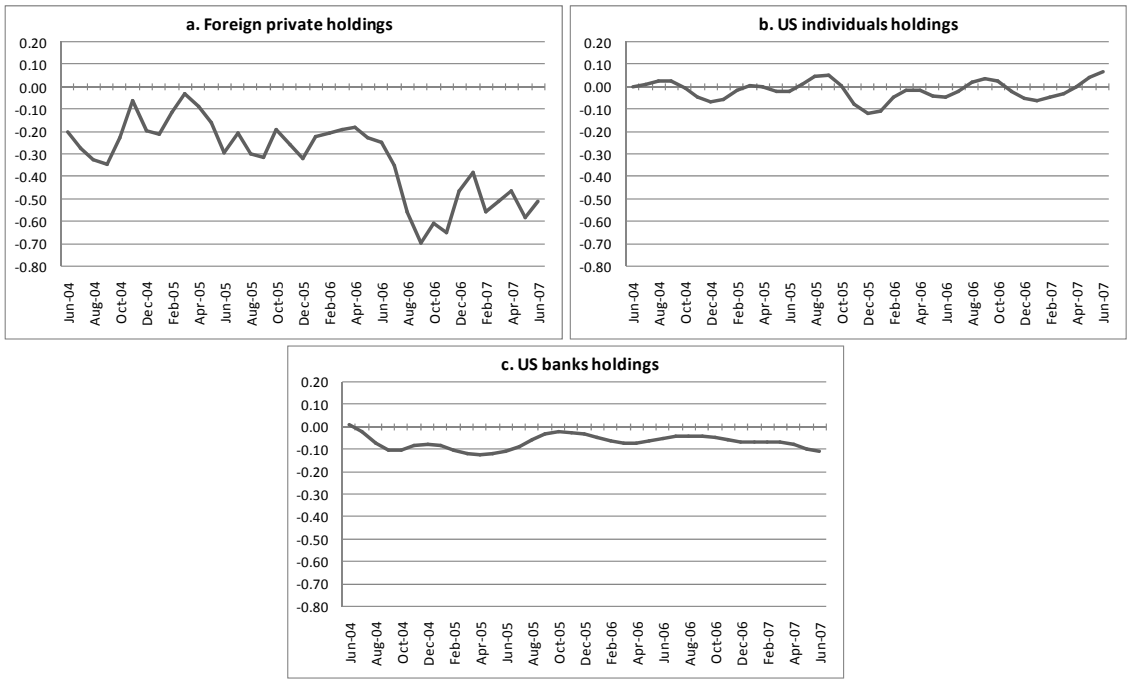

Figure 5. *Variables' MCIs for the nominal AAA-rated corporate bond yield (in % points)*

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).

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.

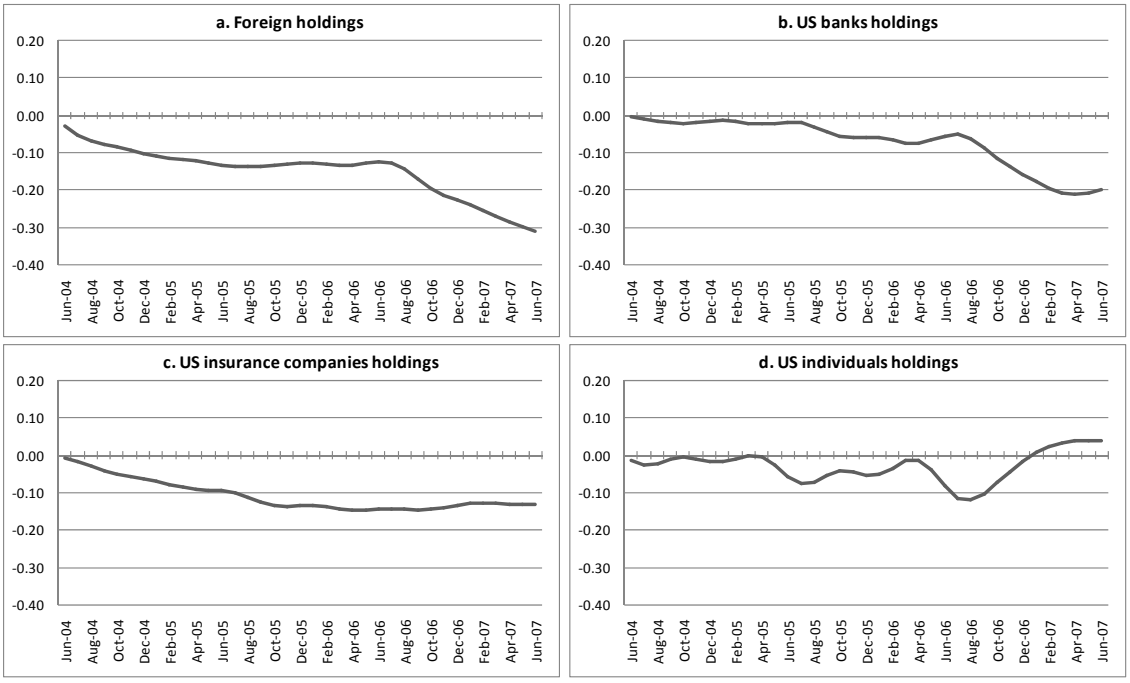

Figure 6. *Variables' MCIs for the nominal AAA-rated municipal bond yield (in % points)*

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).

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$1 million (excluding primary residences) – was around 10 million in 2007, a figure that represented just 0.15% of the world's population of 6.6 billion. The supposition that these individuals could have had any significant impact in the US bond markets in the pre-subprime crisis era may seem incredible when one considers how vanishingly small in number they were but not when one considers the amounts of wealth they concentrated in their hands and the forms in which this wealth was stored. As shown in Figure 7a, in 2007 the world's HNWIs had approximately US$ 41 trillion in assets (world GDP in that year was US$55 trillion) as compared with approximately US$25 trillion in 2000[5], which is to say that prior to the crisis HNWIs were the biggest global investor group with more assets under management than global pension funds (US$ 28 trillion), mutual funds (US$ 26 trillion) and insurance companies (US$ 20 trillion) (IFSL, 2008a)[6]. 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.

[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 four fold increase in world GDP over the same period (WDI, 2011).

[6] It should be noted that even these figures understate the degree of wealth concentration as exemplified by the fact that of the US$ 41 trillion figure for 2007 US$ 15 trillion worth of assets, or 37% of the total, was held by 100,000 'ultra-HNWIs' with net assets in excess of US$ 30 million (Capgemini and Merrill Lynch, 2008), while a sizeable proportion of this amount, US$ 2.6 trillion, was held by an even smaller group of 793 billionaires, half of whose number were US citizens (IFSL, 2007).

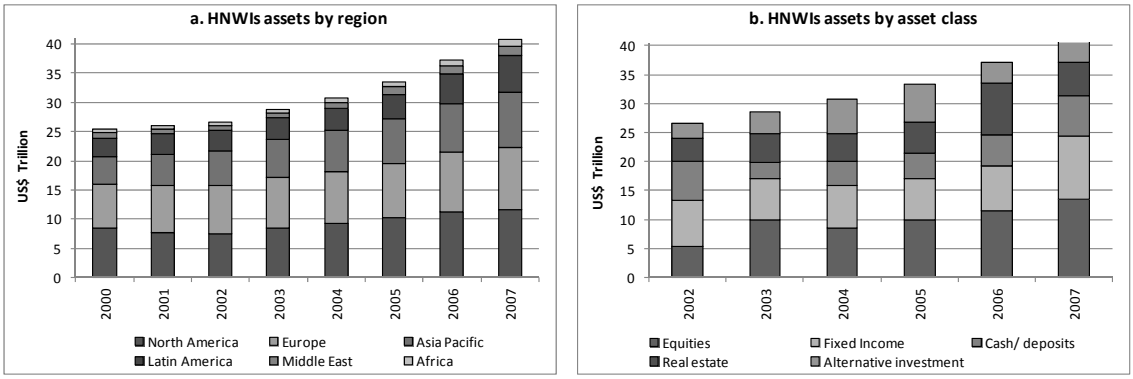

Figure 7. *HNWIs assets under management, by region and by asset class (in US$ tr)*

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

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 is clear that HNWIs had to have had an impact on AAA-rated US bond yields. Although there is no precise information about the degree of HNWI involvement in the US bond markets in the immediate pre-2007 period, some approximate estimates of that involvement 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[7]. 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.

[7] 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)

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

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. *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)

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[8]. 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[9]. The resulting estimates of ROW HNWIs US bond holdings according to bond type are given in Table 5.

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

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

[8] 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).
[9] 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.

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. *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

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).

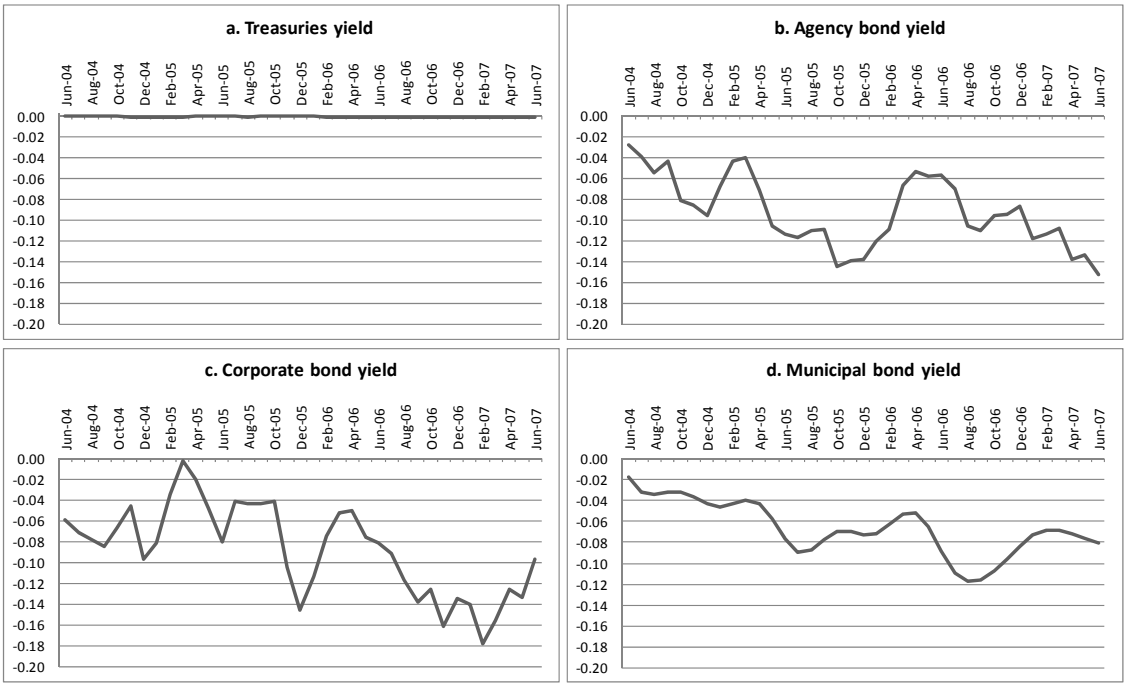

Figure 8. Estimated impact of HNWIs demand on AAA-rated long-term yields (in % points)

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).

To summarise, 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: namely, that 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 meant that 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 mass production of CDOs

CDOs had been in existence for about two decades prior to 2002 but it was only from about this time that these products began to be produced on a mass scale[10]. This development had to have had some connection with the increase in US income inequality for obvious reasons. As most CDOs were comprised of securitised conforming and nonconforming (including subprime) household loans there had to be a rise in overall US household debt levels and this criterion was certainly met in the pre-2007 era. 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). Although the rapid expansion of loans to the US household sector was certainly facilitated by the use of various enticements and by the progressive reduction in lending standards, the deeper material precondition for this rapid expansion had to be a steep rise in inequality and this criterion was also met. While the richest 1% of the US population increased their income share from roughly 9% in 1980 to 23% in 2006 (Palma, 2009) the bottom 40% of the population lost around 4% of their income share in the same period, ending up with approximately 14% in 2007 (Palma, 2011)[11].

The catch, as previously noted, is that while it is easy to bring inequality into the CDO growth story in an enabling role it is far more difficult to give it a more centrally causal role: an increase in income inequality can explain the demand for loans (see e.g. Horn *et al.*, 2009; UN, 2009; Ezuho, 2011; Onaran *et al.*, 2011) but not the reasons why these loans were securitised and then resecuritised to form CDOs. To make good this explanatory shortfall it is necessary to direct attention as much to those at the rich end of the distribution spectrum as to those at the poor end: just as individuals on low incomes face the problem of how to make ends meet and have to rely on credit to help alleviate this problem so the very rich individuals face the opposite of problem of how to store their vast sums of wealth and have to rely on

[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] 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).

financial securities, including corporate and government bonds, to help resolve this problem. The key point here is to view debt securities not merely as forms of debt but as commodities whose use value to investors, including HNWIs, is to serve as stores of value. This point is missing in Kumhof and Ranciere (2010) and Milanovic (2011, pp. 193-197) who have observed that a further reason why the rising polarisation lead to an increase in bank lending to poor households is that rich households needed to recycle their surplus income. While we accept this observation, it leaves out the possibility that HNWIs, after having exerted a negative impact on yields in the traditional US bond markets, were then involved in some way in the promotion of CDOs as the means of resolving the low yield problem.

However, even this line of argument comes up against a major difficulty in that HNWIs simply did not have the requisite expertise or knowledge to be directly involved in the CDO market. Indeed, the complexity and opacity of these structured credit products was such as to prevent the development of a broad customer base similar to that in other financial markets, a fact which helps to explain why so many commentators on the subprime crisis believe that the rapid growth in CDO issuance before 2007 could not have been due to the pull of investor demand but that, on the contrary, it must have been powered by the issuing banks themselves. Of course, the inevitable corollary of giving supply push factors primacy in the CDO growth story is that economic inequality either drops out of this story altogether or only enters it merely as something that the banks were able to exploit in the course of advancing their own material interests. It has been argued that the only way to set the record straight regarding the role of investor demand in the CDO production system prior to the crisis is to direct attention to the hedge funds (Lysandrou, 2011b).

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. Although CDOs offered what seemed a good and direct solution to the yield problem that was becoming increasingly acute due to the low long-term yields in the traditional US

bond markets, the high risk and difficult to trade nature of these structured credit products meant that the pension and mutual funds and various other institutional investors had to limit their direct involvement with them and look for additional solutions to the yield problem. This included the placement of large sums with the hedge funds, which, not being subject to the same regulatory and prudential constraints that were binding on the public investment funds used a substantial proportion of these sums to buy vast amounts of CDOs. Just how vast is shown in Table 7 that gives the June 2007 breakdown of CDO holdings by type of institution: hedge funds were by the far the biggest single group of investors in CDOs, holding nearly a half of all these products (around US$ 1.4 trillion), a figure that appears all the more striking considering that at that same time hedge funds' holdings of ordinary financial securities amounted to no more than 1-2% of the world's total.

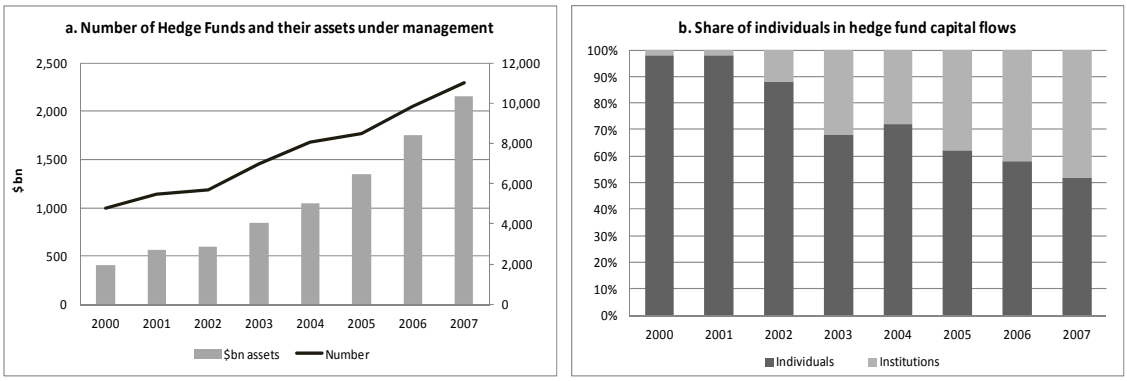

Figure 9. *Hedge Funds: number, assets under management, and source of capital*

Source: IFSL (2008a)

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 (2007)

In view of the opaque and highly illiquid nature of CDOs the question arises as to why hedge funds, which were well known for being short term 'buy and sell' traders rather than long term 'buy and hold' investors, would choose to invest heavily in these products. The answer is to be found in the composition of their CDO holdings. On the one hand, hedge funds held significantly higher proportions of the unrated and high risk equity tranches than did the insurance companies and asset managers (the latter had to restrict their holdings of these tranches on account of prudential considerations and regulatory constraints). On the other hand, the hedge funds held substantial amounts of the senior tranches in large part because these could be used as collateral in borrowing arrangements. In common with other financial institutions, such as the bank operated conduits and special purpose vehicles, hedge funds leveraged up their exposure to CDOs, but unlike these other institutions who principally relied on the issuance of asset-backed commercial paper for their borrowing needs (see Acharya and Schnabel, 2010), the hedge funds did most of their borrowing via their prime brokers and used the investment grade rated CDO tranches as collateral to reduce the costs of this borrowing. If it is asked why the investment banks, the primary lenders of money to the hedge funds, were willing to accept these securities as collateral, the simple answer is that it was these very same banks that helped to create the CDOs in the first place.

Once it is made clear why the hedge funds were attracted by the special properties of CDOs and why these properties in turn depended to a large extent on the hedge fund-investment bank relation, the barriers to the demand-pull version of the CDO growth story begin to collapse. 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). Nor has there been any shortage of anecdotal evidence attesting to that pressure[12]. If, however, all of this has yet to undermine the

[12] For example, 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

widespread support for the supply-push version of the CDO growth this is because there has been until now no clear specification of the demand pressure transmission mechanism. The reality is that such a mechanism did exist between 2002 and 2007, albeit that it was based not so much on a system of arms length and impersonal exchanges as on a dense network of personal relations between pairs of agents at the very heart of which was the relation between the hedge funds and the investment banks (see Figure 10). This relation has always been a particularly close one: hedge funds could not carry out their function to the extent that they do without the range of prime brokerage and other support services provided by the investment banks, while the latter could not maintain profit margins at the level that they do without the interests, fees and commissions that they charge the hedge funds (according to Mustier and Dubois (2007) about a quarter of all investment banks' income comes from the hedge funds). When the problem of yield started to becomes serious from about 2002, the close-knit and mutually advantageous nature of the relation between the hedge funds and the investment banks made that relation the perfect conduit through which the demand pressure for yield was passed on to the creators of CDOs. 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 and commissions earned directly from the sale of these products they could also expect the extra income from the extra business with hedge funds much of which would have been generated with the help of CDOs..

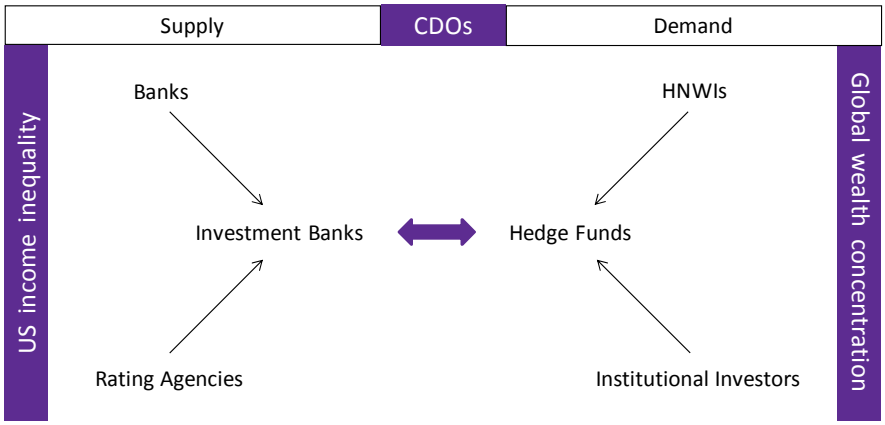

Figure 10. *Outline of the main forces in the CDO market*

approvals, [this] was fuelled with faxes and emails from lenders to brokers touting easier qualification for borrowers and attractive payouts" (Brooks and Simon, 2007).

To understand the pivotal role of the investment bank-hedge fund relationship in the mass production of CDOs is not just to understand the importance of the demand pressure for yield in that mass production; it is also to understand the importance of income inequality and wealth concentration in providing the all-encompassing framework for the CDO production system, a point also illustrated in Figure 10. Consider again 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 consider 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 the worlds' HNWIs (see Figure 9b). Although their percentage share of the total assets placed with hedge funds fell in the years preceding the financial crisis, as money flowed in from institutional investors, HNWIs still remained by far the largest single group of investors, accounting for around two thirds of hedge fund assets during the 2002 to 2007 period. Thus, the irony is that having helped to create the US bond yield problem by virtue of channelling sizeable proportions of their wealth into the US bond markets, the HNWIs then continued to be at the forefront of the demands made upon 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 wrong organisation of finance rather than by a wrong distribution of income and wealth for which 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 this order of priorities needs to be reversed. The subprime 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 at this point in time. Economic inequality was absolutely central to the growth of that market. Absent the large numbers of American people who were on or below the official poverty line 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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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:

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

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[13].

[13] See Goda et al. (2011) for a detailed discussion of the model specification, model selection, and for 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		(ii) equilibrium long-run effects		
			before the break		
Δ(FOROFFICIAL)	-0.2155***	(-6.81)	FOROFFICIAL	-0.0944***	(-7.14)
Δ(FOROFFICIAL(-1))	-0.1325***	(-4.11)	FORPRIVATE	-0.2396***	(-5.82
Δ(EUR_DOL)	0.7202***	(4.38)	EURDOL	0.4478***	(4.50)
$\Delta(EURDOL)^{s11/98}$	-0.5256***	(-2.98)	LOGISM	3.3286***	(5.52)
Δ(EURDOL(-1))	-0.1630*	(-1.78)	PCE	0.9426***	(3.72)
Δ(LOGISM)	1.0200***	(2.65)	DOW	0.0005***	(5.56)
Δ(LOGISM(-1))	1.6376***	(2.86)	MOVE	0.0070***	(2.88)
$\Delta(LOGISM(-1))^{s11/98}$	-1.2539*	(-1.80)	**after the break**		
Δ(LOGISM(-4))	0.8844***	(2.66)	FOROFFICIAL	-0.0944***	(-7.14)
Δ(PCE)	0.5403***	(2.90)	FORPRIVATE	0.0038	(0.07)
Δ(PCE(-9))	-0.6432***	(-3.12)	EURDOL	0.1113***	(2.85)
Δ(DOW)	0.0001**	(3.14)	LOGISM	2.5283***	(3.61)
YIELD(-1)	-0.3795***	(-6.63)	PCE	0.9426***	(3.72)
FOROFFICIAL(-1)	-0.0358***	(-4.67)	DOW	0.0005***	(5.56)
FORPRIVATE(-1)	-0.0909***	(-6.50)	MOVE	0.0070***	(2.88)
$FORPRIVATE(-1)^{s11/98}$	0.0924***	(3.62)			
EURDOL(-1)	0.1700***	(3.45)			
$EURDOL(-1)^{s11/98}$	-0.1277***	(-2.73)	**misspecification/cointegration tests**		
LOGISM(-1)	1.2634***	(4.69)	BG(2) prob.	0.24	
$LOGISM(-1)^{s11/98}$	0.3038**	(-2.29)	BG(12) prob.	0.36	
PCE(-1)	0.3578***	(3.28)	Jarque-Bera prob.	0.26	
DOW(-1)	0.0002***	(5.88)	Arch(1) prob.	0.56	
MOVE(-1)	0.0027***	(2.78)	Arch(12) prob.	0.49	
adj. R-squared	0.64		White prob.	0.61	
Schwarz criterion	-0.54		Ramsey LR prob.	0.15	
Sample: 1994:02 to 2007:06 (161 observations)			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)] – see Pesaran *et al.* (2001). 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)] – see Pesaran *et al.* (2001) (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).