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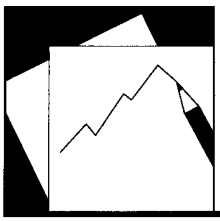

IMF Working Paper

The (Other) Deleveraging

Manmohan Singh

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 WP/12/179

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Research Department

The (Other) Deleveraging

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Authorized for distribution by Stijn Claessens

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Abstract

Deleveraging has two components--shrinking of balance sheets due to increased haircuts/shedding of assets, *and* the reduction in the interconnectedness of the financial system. We focus on the second aspect and show that post-Lehman there has been a significant decline in the interconnectedness in the pledged collateral market between banks and nonbanks. We find that both the collateral and its associated velocity are not rebounding as of end-2011 and still about $4-5 trillion lower than the peak of $10 trillion as of end-2007. This paper updates Singh (2011) and we use this data to compare with the monetary aggregates (largely due to QE efforts in US, Euro area and UK), and discuss the overall financial lubrication that likely impacts the conduct of global monetary policy.

JEL Classification Numbers: G21; G28; F33; K22; G18; G15

Keywords: pledged collateral, velocity of collateral, rehypothecation, monetary policy, deleveraging, hedge funds, securities lending, Taylor rule

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Contents Page

I. INTRODUCTION

The past decade's build up of debt capacity in the global financial system needs to unwind. Bloated banks, especially in Europe, are desperate to shed assets but there are very few buyers; so, for now, the official sector is keeping afloat their balance sheets. Thus there is transfer from official sector to private sector (i.e., banks) balance sheet. Deleveraging from shrinking of bank balance sheets is not (yet) taking place; however, we still find the financial system imploding.

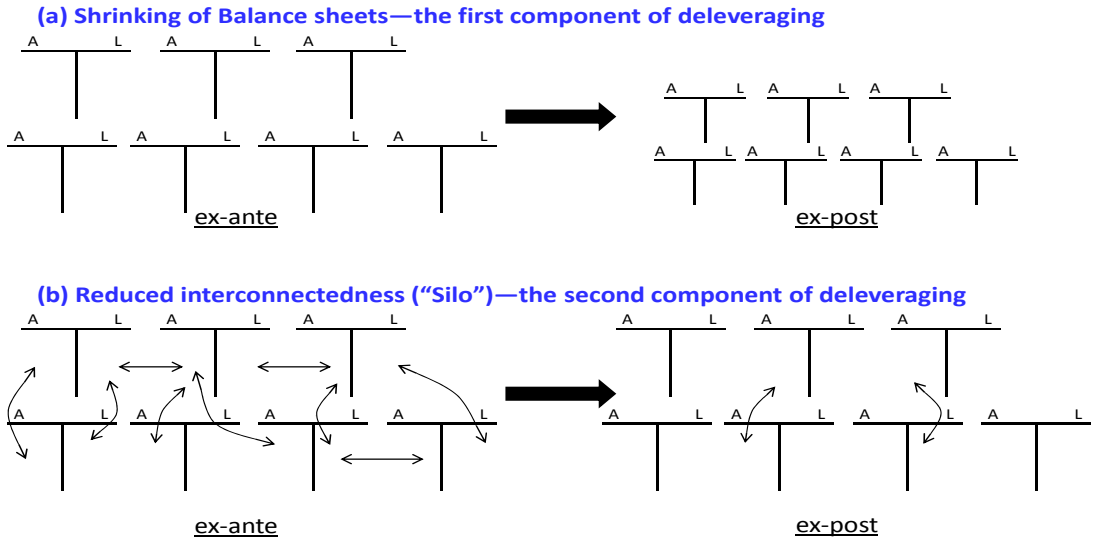
The reduction in debt (or deleveraging) has two components. The first (and more familiar) involves the shrinking of balance sheets. The other is a reduction in the interconnectedness of the financial system (Figure 1). Most recent researchers have focused on the impact of smaller balance sheets, overlooking this 'other' deleveraging resulting from reduced interconnectedness. Yet, as the current crisis unfolds, key actors in the global financial system seem to be "ring fencing" themselves owing to heightened counterparty risk. While "rational" from an individual perspective, this behavior may have unintended consequences for the financial markets.

The interconnections nexus has become considerably more complex over the past two decades. The interconnectedness of the financial system aspect may be viewed from the lens of collateral chains. Typically, collateral from hedge funds, pension, insurers, central banks etc., is intermediated by the large global banks. For example, a Hong Kong hedge fund may get financing from UBS secured by its collateral. This collateral may include, say, Indonesian bonds which will be pledged to UBS, (U.K.) for re-use. There may be demand for such bonds from, for instance, a pension fund in Chile who may have Santander as its global bank. However, due to heightened counterparty risk, UBS may not want to onward pledge to Santander, despite demand for the collateral with UBS. Fewer trusted counterparties in the market owing to elevated counterparty risk leads to stranded liquidity pools, incomplete markets, idle collateral and shorter collateral chains, missed trades and deleveraging. In volume terms, over the past decade this collateral use has become on par with monetary aggregates like M2.

The balance sheet shrinking due to 'price decline' (i.e., increased haircuts) has been studied extensively—including the recent April 2012 *Global Financial Stability Report* of the IMF and the European Banking Association recapitalization study (2011). Some of the academic literature on this issue spans the work of Geanakoplos, 2003; Brunnermeier and Pedersen, 2009; Gorton and Metrick, 2009; Krishnamurthy, Nagel, Orlov, 2010; and Shleifer and Vishny, 2011. But the balance sheet shrinkage is being postponed—Euro area bank balance sheets may have increased up to €500bn since the end of November, 2011 helped by the liquidity injection from ECB's 3-year Long Term Repo Operations or LTROs (net of reduced Monthly Repurchase Operations, MROs).[2]

[2] The two Long Term Repo Operations of the ECB were around €1 trillion. However, since Monthly Repo Operations gave way to the LTROs (and were approximately €500 billion), the net liquidity impact from the LTROs was up to €500 billion, assuming some leakage for other non balance sheet activity. (JPMorgan,Flows and Liquidity, June 8th,2012)

Figure 1: Deleveraging Components—Balance Sheet and Interconnectedness



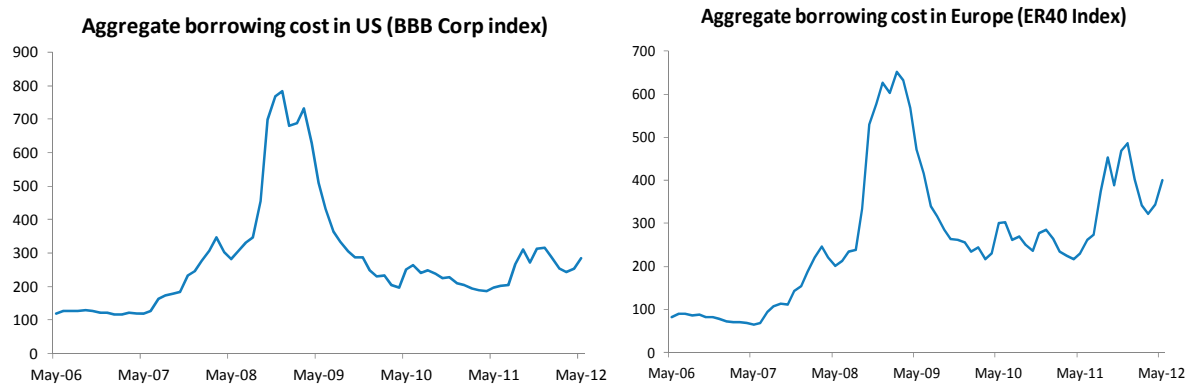
However, de-leveraging of the financial system due to the shortening of 're-pledging chains' has not (yet) received attention. *This deleveraging is taking place despite the recent official sector support*.[3] This second component of deleveraging is contributing towards the higher credit cost to the real economy. In fact, relative to 2006, the primary indices that measure aggregate borrowing cost are well over 2.5 times in the U.S. and 4 times in the Eurozone (see Figure 2). This is after adjusting for the central bank rate cuts which have lowered the total cost of borrowing for similar corporates (e.g., in the U.S., from about 6% in 2006 to about 4% at present). Figure 3 shows that for the past three decades, the cost of borrowing for financials has been below non-financials; however this has changed post-Lehman. Since much of the real economy resorts to banks to borrow (aside from the large industrials), the higher borrowing cost for banks is then passed on the real economy.[4]

Empirically, this paper provides evidence and attempts to quantify the extent of this deleveraging using the analytical framework developed by Shin (2009) and applied by Singh (2011); this analytics are shown again as Annex 1 of this paper.

[3] Intraday bank liquidity has also dried up and contributes towards decline in interconnectedness.

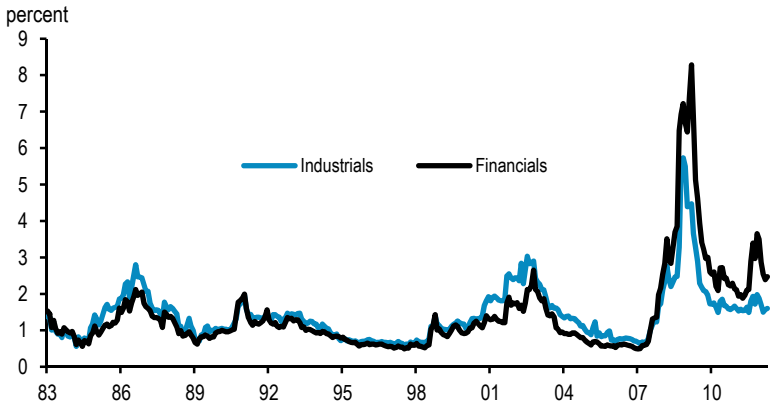
[4] Recall the GDP identity Y = C + I + G + X – M (where, Y is GDP, which is equal to consumption + domestic investment + government spending exports - imports). Investment (I) can be written as Y-C-G+M-X. Or, I = (Y-C-T) + (T-G) + (M-X), where on the right hand side, the first parenthesis is private savings and second parenthesis is government savings. From a closed economy perspective, higher cost of credit to the real economy may explain the lower levels of Y. If we view this from an open economy perspective, then lower cross-border flows (e.g., from collateral) may also contribute to lower Y since much of these flows are not picked up in the statistics/metrics that capture the external sector.

Figure 2: Average cost of borrowing for the real economy (relevant US and Europe indices)



Source BoA-ML indices

Figure 3: Post-Lehman, Borrowing Cost For Financials Are Higher than Non-Financials



Source: Barclays Intermediate, investment grade spreads (1983-2012)

The paper is laid out as follows. Section II focuses on the deleveraging, as defined above, that has taken place from 2007-2011. Section III discusses the monetary aggregates (largely due to QE efforts in US, Euro area and UK), in the context of the overall financial lubrication that likely impacts the conduct of global monetary policy. Section IV concludes with some policy suggestions and open questions.

II. DELEVERAGING FROM 2007-2011

In the global financial system, the nonbanks generally allow re-use of their collateral in lieu of other considerations. The key providers of (primary) collateral to the 'street' (or large banks/dealers) are: (a) hedge funds; (b) custodians on behalf of pension, insurers, official sector accounts etc.; and (c) commercial banks that liaise with dealers. Typically, hedge funds are suppliers of collateral while money market funds are users, in that they supply funds to the market in exchange for collateral. Hedge funds via their prime-brokers allow for collateral reuse as a quid pro quo for the leverage/funding they receive from dealers. The other nonbank providers of collateral generally loan collateral for various tenors to optimize their asset management mandates.

The 'supply' of pledged collateral is typically received by the central collateral desk of dealers that re-use the collateral to meet the 'demand' from the financial system. Such securities serve as collateral against margin loans, securities borrowing, reverse repo transactions and OTC derivatives. This collateral is secured funding for the dealers and is received in lieu of borrowing and/or other securities given to a client. Major dealers active in the collateral industry include Goldman Sachs, Morgan Stanley, JP Morgan, BoA/Merrill and Citibank in the U.S. In Europe and elsewhere, important collateral dealers are Deutsche Bank, UBS, Barclays, Credit Suisse, Societe General, BNP Paribas, HSBC, Royal Bank of Scotland and Nomura. Major dealers active in the collateral are shown in Figure 2.

(i) Hedge Funds:

Hedge Funds (HFs) largely finance their positions in two ways— (i) loans made under prime broker agreements with their prime brokers (PBs) and (ii) repurchase agreements (repos), generally with other banks that are not their PBs.

Pledged collateral via Prime Brokerage Agreements

HFs usually pledge their securities as collateral for re-use to their prime broker (PB) in exchange for cash borrowing from the PB (a process also known as rehypothecation).[5] There are limits to the degree of reuse, however. In the U.S., for example, Regulation T and SEC's Rule 15c3 limits PBs' use of rehypothecated collateral from a client (for details see Box 1 and Box 2, Singh 2011).[6] This means that any excess collateral of a HF cannot be used by the PB in the U.S.—unless explicitly agreed to— and thus remains "locked". Regulation T limits debt to 50 percent, or a leverage factor of 2. With portfolio margining (i.e., after netting positions), HFs can increase leverage beyond the factor of 2. However, to have more unconstrained leverage, aggressive strategies are booked offshore (e.g., U.K.). Typically equity-related strategies like *equity long/short, quant-driven, event driven* etc, are funded via PBs.

HFs also fund their positions by repo-ing out their collateral with another bank/dealer in the market who may not be their PB. Typically, *fixed income arbitrage, global macro* strategies that seek higher leverage, is done via repo financing.

[5] The re-use pledged collateral discussed in this paper includes title transfer and thus akin to rehypothecation. Legally, under a title transfer arrangement the collateral provider transfers ownership of collateral to the collateral taker. The latter acquires full title to the collateral received and, as the new owner of this property, is completely free to deal with it as he sees fit. If rehypothecation has occurred, the collateral taker is expected to return *equivalent* securities and not *exactly* the same property initially received as collateral. It is standard practice to use title transfer in repo and securities lending activities. Also the OTC derivatives contracts under English Law form of ISDA also uses title transfer in collateral support agreements (CSA). The prevalence of rehypothecation outside the U.S. allows for a market clearing price for financial collateral in Europe (i.e., U.K. and continental Europe), in which rights of re-use have a strong legal underpinning.

[6] SEC Rule 15c3-3 also prohibits prime brokers from re-hypothecating more than 140% of a client's debit balance or more than 100% of overall client debits.

How much collateral was sourced from HFs (end-2011)?

First, we calculate the mark-to-market value of collateral with the HF industry (source HFR or CS Hedge Index, or other market sources), or an average when all sources are available. Based on available data, the HF industry's estimates assets under management (AUM) to be at $2.0 trillion for end-2011. The consensus estimates for global HF gross leverage for end-2011 was about 1.5 as of end-2011.[7] Thus mark-to-market collateral (i.e., AUM x gross leverage) was about $3.0 trillion as of end-2011.

With mark-to-market value of HF collateral at $3 trillion and a 40% share of relevant strategies that fund via PBs, and adjusting for long/short ratio, the borrowing from PB was about 3 trillion x 0.40 x 4/7 or about **$700 billion** (see Annex 2 for details) .[8] [9]

Non-PB funding was about $650 billion and calculated as follows: 30% relevant strategies (usually fixed income related executed via repos) x $3 trillion or roughly $900 billion. Since leverage was about 3.75 (lower than in 2010) and adjusting for the AUM imbedded within 30% of the non-PB related strategies, we get 0.3 x $3 trillion minus 250 billion, or approx **$650 billion** via non-PB sources. [10]

Note, *managed futures* strategy is via cash that goes to an exchange like CME (Chicago Mercantile Exchange), and thus is not a collateral/leverage based strategy; also *emerging markets or distressed strategies* do not generally require leverage via PB or non-PB. Some hedge funds hold AUM in cash. Thus the total PB and non-PB strategies (with leverage) do not entail that all the total AUM x gross leverage of mark-to-market value of securities (i.e., in our case $3 trillion) will hit the street.

Thus, the total collateral from HFs that came to the large dealers (and "hit the street") is estimated to have been about $1.35 trillion as of end-2011, with $700 billion to have come via PB funding and $650 billion from repo funding outside the PBs.

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[7] We use gross leverage since we want to estimate the total amount of mark-to-market collateral with HFs. See "Hedge Fund Leverage", Ang, Gorovvy and van Inwegan, 2010. We also acknowledge the limitations of calculating global leverage for this industry as reflected in the BIS working paper # 260, "Estimating the Leverage for Hedge Funds".

[8] The basic arithmetic for our estimate is as follows: for U.K., via FSA HF surveys, $250 billion base margin + $250 billion excess margin. (see Charts 13 and 14 of FSA survey www.fsa.gov.uk/static/pubs/other/hedge-fund-report-feb2012.pdf.—see Annex 2 for more details.

[9] Since we show separately the securities that come from custodians –as per Table 1–we need to be careful about client's "shorts". So if a PB exchanges client's "shorts" with custodians for securities, we avoid the double counting. (i.e., the PBs total pool of collateral maybe higher than $700 billion estimated here since we will show the shorts via the custodian's pool of collateral that comes to the street).

[10] We assume fixed income arbitrage, convertible arbitrage and global macro to be the most aggressive and have a weighted average leverage of about 4:1 in recent year.

(ii) Securities Lending—another primary source of collateral:

Securities lending provides collateralized short term funding, just like repo.[11] Furthermore, with respect to legal rights, securities lending is effectively identical to repo; for example both transactions include full transfer of title. The asset management complex that includes pension, insurers, official sector accounts such as sovereign wealth funds, central banks, is a rich "source" for collateral deposits. The securities they hold are continuously re-invested to maximize returns over their maturity tenor.

We use Risk Management Association (RMA) as the main data source (see Table 1), which includes only primary sources of securities lending from clients such as pension funds, insurers, official sector accounts and some corporate/money funds. RMA's data includes the largest custodians such as BoNY, State Street, JPMorgan etc.[12] As noted in Table 1, the risk aversion due to counterparty risk since Lehman has led many of the pension and insurance funds, official accounts *not* to let go their collateral for incremental returns. These figures are not rebounding as per end-2011 financial statements of banks (and anecdotal evidence suggests even more collateral constraints recently).

Table 1: Securities Lending, 2007-2011

Collateral Received from Pension Funds, Insurers, Official Accounts etc. (US dollar, billions)					
	2007	**2008**	**2009**	**2010**	**2011**
Securities Lending vs. Cash Collateral [13]	1,209	935	875	818	687
Securities Lending vs. Non-Cash Collateral	486	251	270	301	370
Total Securities Lending	**1,695**	**1,187**	**1,146**	**1,119**	**1,058**

source: RMA

[11] In a repo there is an outright sale of the securities accompanied by a specific price and date at which the securities will be bought back. On the other hand, securities lending transactions generally have no set end date and no set price. The beneficial owner can recall the shares on loan at any time and the borrower can return the shares at any time. Thus, securities lending transactions are much more flexible than repos and thus are better conducive in covering shorts where the position's profitability relies on exact timing/tenor matching.

[12] Data Explorers shows larger numbers as they include a significant part of the secondary market activity also. A recent paper by *Bank of England's Quarterly* (September, 2011) states that about $ 2 trillion of securities were on loan but includes secondary holdings also (i.e., also counts the bank to bank holdings of primary sources)

[13] The decline in the first row of Table 1 needs some explanation. As background, the US, regulatory rules that guide the borrowers only permit cash, and certain government securities (US). Hence, the US developed as a cash collateral business where the lending agent lends client assets versus cash and then reinvests the cash according to the client's direction in very short term reinvestments. Outside the US (e.g., UK) regulatory rules permit certain types of non-cash collateral that are readily available (such as FTSE equities). In the aftermath of Lehman and the liquidity crisis, borrowers in the US were/are borrowing more hard to borrow stocks (specials), and less general collateral; this explains the decline in the Table. Non-cash collateral deals (i.e., collateral for collateral) effectively provide the lenders with a hard fee for the deal, and it does not give temporary cash to generate excess returns by creating a short term money market book.

(iii) Bank-Dealer Collateral:

Dealers occasionally receive requests from commercial banks, like Rabobank, for collateral swaps. In such a transaction, typically the collateral posted by the commercial bank may need an 'upgrade'. Discussions with dealers suggest that such requests are generally minimal and thus insignificant relative to the collateral flows from the key clients (hedge funds, pension funds, insurers, official accounts etc.). We acknowledge such flows in Figures 4 and 6 with a *de minimis*, but do not consider these flows to impact the arithmetic of the results of our paper (i.e., the velocity of pledged collateral).

We also considered other sources of collateral. Box 1 explains why there are not material since we only considered collateral that has no legal constraints on re-use.

Box 1. Are There Any Other Buckets That Are Sources Of Pledged Collateral?

Dealer to Dealer Collateral

Dealers would generally prefer not to use their balance sheet when moving collateral for their clients. Typically, collateral coming in via reverse repos (i.e., lending to clients) exceeds the collateral leaving the dealers via repos (i.e., borrowing from clients). Discussions with the funding/collateral desk of the large dealers suggest that there may be times when such dealers may want to use their own balance sheet and diversify their sources of funding (i.e., the cost of repo may be less than another type of funding). [1/] The repo business straddles two aspects: (i) a matched book (i.e., via reverse repo) to provide funding to clients, and (ii) financing of the bank. We focus on the client aspect and the associated churning of this primary source of collateral. Although the collateral desk is supposed to be 'self funding', dealers may have to 'dip' into their balance sheet when collateral going out exceeds collateral coming in; but such requests are scrutinized by the dealer's Treasury and generally do not exceed $5-10 billion per large dealer. Thus, if there are 10 dealers active in the collateral space, they may have $50-$100 billion of balance sheet funding that does not really leave the rectangle in Figure 1, but this provides the lubrication to iron out any asymmetries between clients' collateral flows to the dealers (in a theoretical sense, one can assume the dealers' own collateral funded by their balance sheet to have an infinite churning factor, as it does not leave the rectangle). However, to put this in perspective, the figure of $50-100 billion is only ½-1% of the total collateral that churns between the dealers (about $10 trillion).

Tri-party Repo Collateral Market and Rehypothecation

The tri-party repo market is a primary source of funding for banks in the U.S., standing at $1.6 trillion (July, 2011), according to statistics New York Fed. [2/] It provides banks with cash on a secured basis, with the collateral being posted to lenders – like money-market funds – through one of two clearing banks, BNY Mellon and JP Morgan. The collateral pledged by dealers towards the repo is discounted by the lender, and protects the lender against a change in its value. However, such pledged collateral sits with custodians and is not rehypothecable to the street. The collateral is segregated and identifiable in case of default of the collateral provider. This reduces the risk of the cash investor (Copeland, Martin and Walker, 2009). This also explains that haircuts during the 2008 crisis were minimal when dealing within the tri-party system, relative to the 'street' where clients were re-negotiating collateral terms with their dealers. Dealers in collateral management generally differentiate between the tri-party type of collateral and client collateral which has unlimited re-pledging rights. Aside from tri-party repo, there are open market operations trades involving collateral between dealers and NY Fed; we do not consider these 'restricted' collateral trades. Also, the European triparty repo market has recently seen sizable growth and stands at € 1.1 trillion between the four tri-party agents Euroclear, Clearstream, BNY Mellon and JP Morgan, largely due to recent credit concerns and U.S. multinationals keeping money oversees.

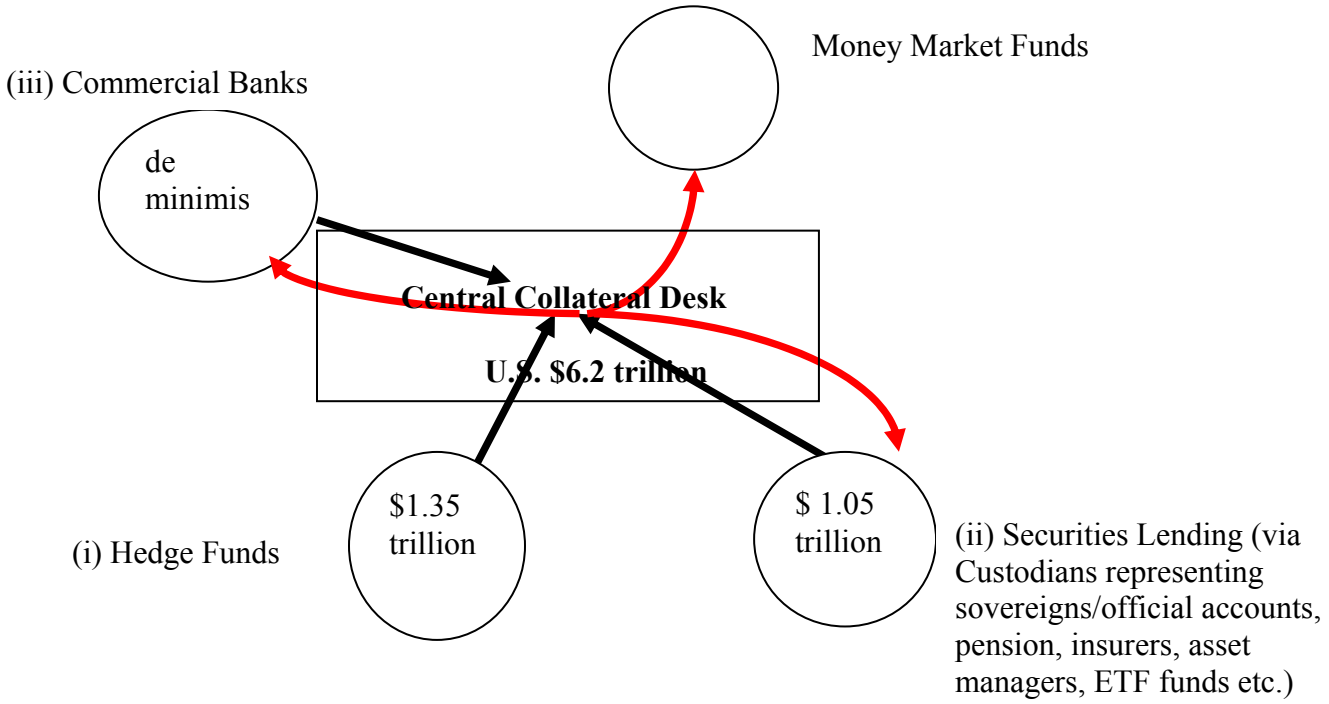
Securitization Vehicles

ABCP-funded vehicles (such as SIVs and conduits) did not rely on dealers for funding. Since these structures were securitization-based and against specific pieces of collateral, it was difficult to raise funds by pledging collateral from such vehicles. Unlike hedge funds, the above vehicles sourced their funding directly, by issuing liabilities to institutional cash pools such as corporate treasurers, securities lenders or money funds. Some SIVs for example had dedicated treasury functions that were responsible to raise funds from cash investors. Also those that relied on intermediaries for treasury functions did not get their funding from intermediaries, but from cash investors. Thus, we do not consider collateral related to such flows to be 'source' collateral that is churned by the dealers.

1/ Recent signs in European banks show that proprietary collateral is being used to lend to clients (UBS Investment Research, "A deep dive into the funding mix," Sept 6, 2011).

2/ Lenders and dealers agree bilaterally on what baskets of securities they will trade. This collateral cannot be re-pledged to the 'street'. However, it is not frozen in place, in that substitutions of collateral are possible during the repo. For example, a dealer can pull some agencies out of a "live" repo, pledge or sell them, after substituting in some treasuries. So, churning due to re-pledging is restricted to the rectangle shown in Figure 1.

Figure 4: Pledged Collateral, 2011—Typical Sources and Uses

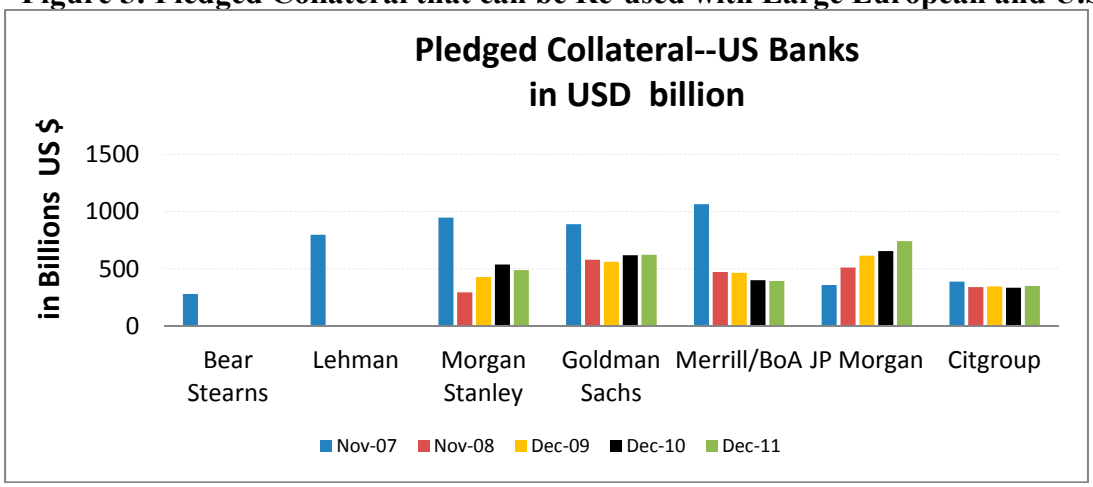


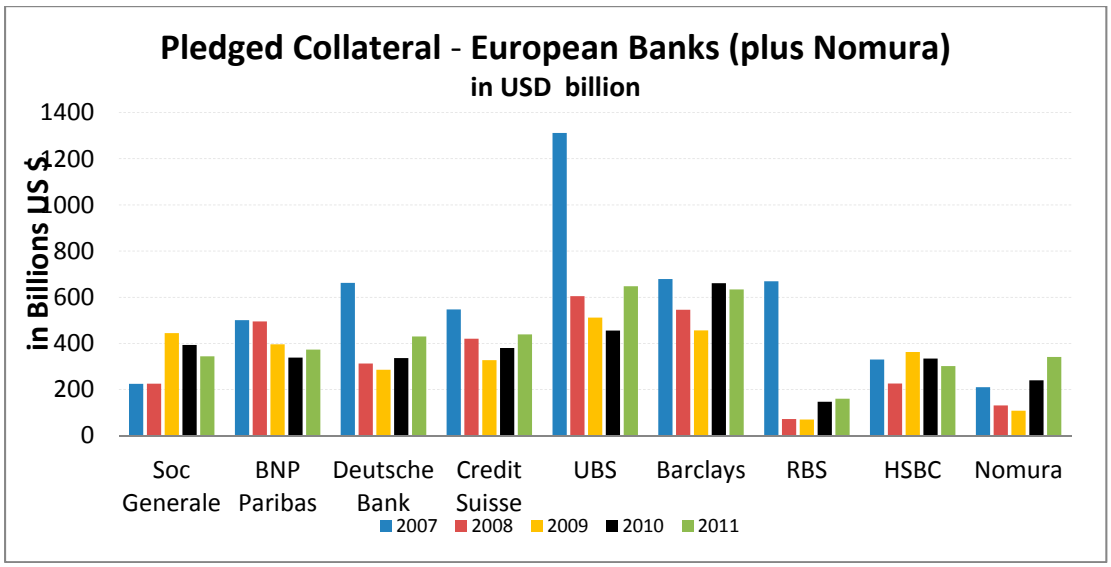
Red curve lines = "users" of collateral
Black straight lines = "suppliers" of collateral

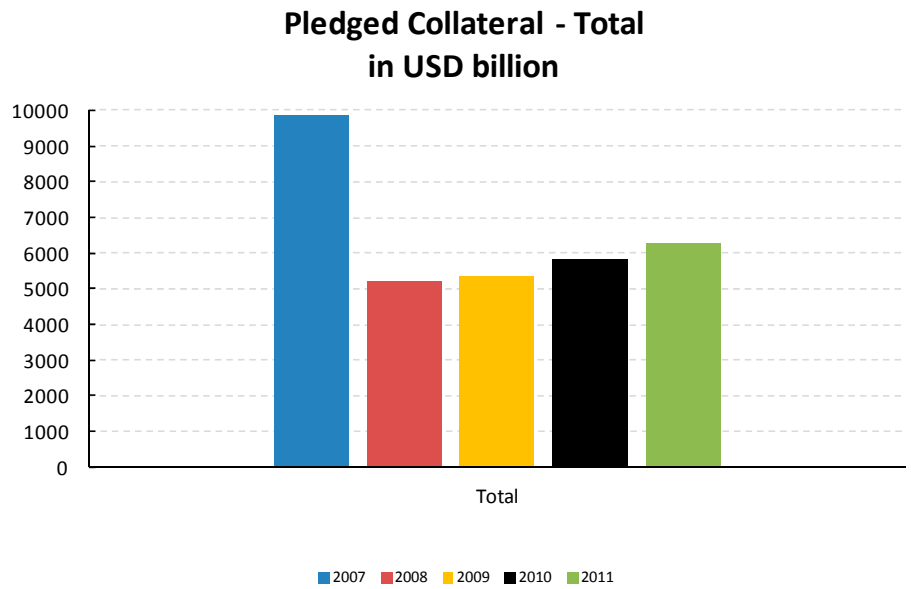
We then take the total collateral received as of end-2011 (almost $6.2 trillion) and compare it to the primary sources of collateral of $2.4 trillion (i.e., the two primary source buckets identified in Figure 3, namely HFs and Security lenders on behalf of pension, insurers, official accounts etc.). The ratio of the total collateral received/primary sources of collateral, is the velocity of collateral due to the intermediation by the dealers. The last column (i.e., green columns) in the first two panels of Figure 5 shows the contributions towards the total collateral received in 2011, or the numerator of $6.2 trillion for 2011.

$$\text{Velocity of collateral for end-2011} = \frac{\$\ 6.2 \text{ trillion}}{\$\ 2.4 \text{ trillion}} \text{ or about } 2.5$$

Figure 5: Pledged Collateral that can be Re-used with Large European and U.S. Banks







Source: Singh (2011) updated; 10K reports and equivalent financial statements of the banks listed.

Figure 6 shows the sources of collateral (in the circles), overall collateral received by the banks (in the rectangle) for 2007, 2010 and 2011. Table 2 provides a summary statistics on how the sources and the associated chain result in calculating the overall collateral.

Figure 6: The Sources and Uses of Collateral—Summary (2007, 2010 and 2011)

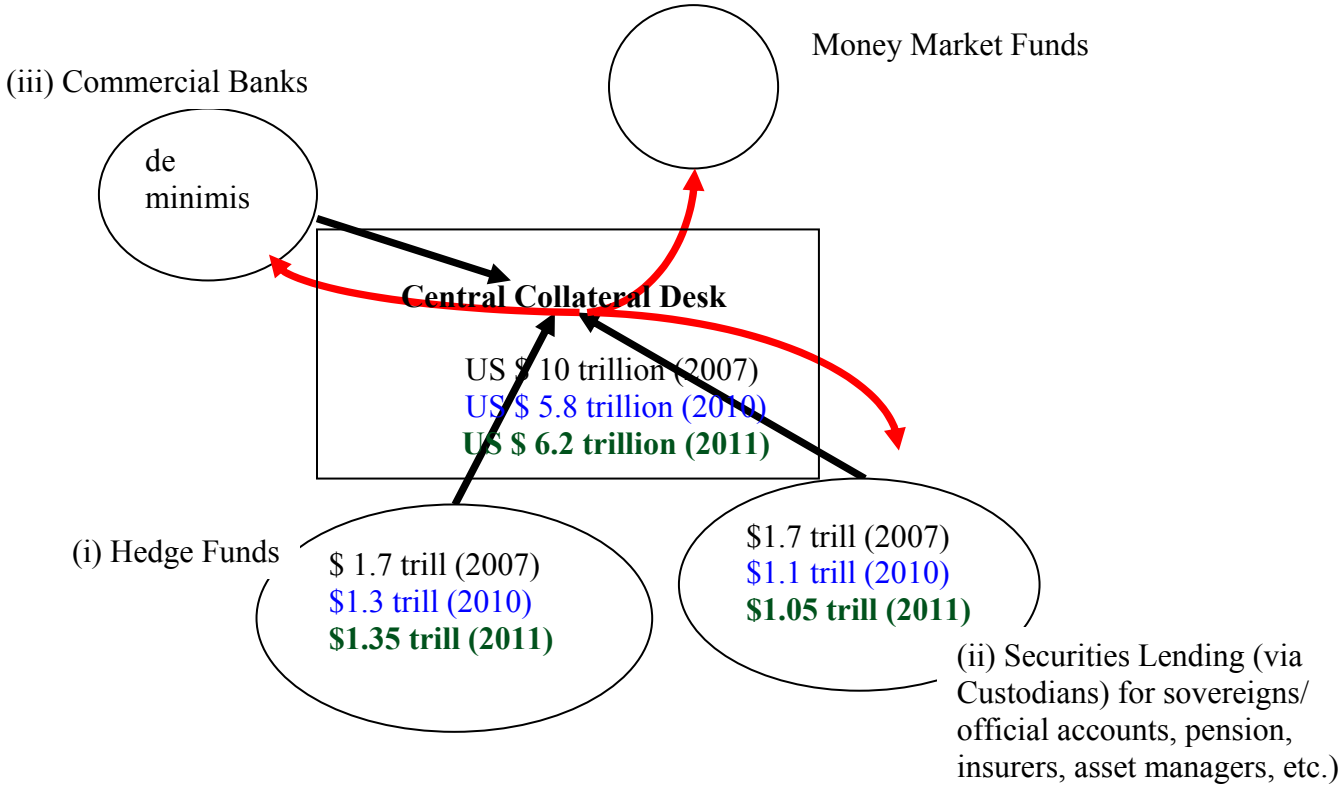


Table 2: Sources of Pledged Collateral, Velocity and Overall Collateral

Year	Sources		Total Source	"Chain" (velocity)	Overall collateral <"total source" times "chain"> (in trillions USD)
	Hedge Funds (in trillions USD)	Others (in trillions USD)			
2007	1.7	1.7	3.4	3	10
2010	1.3	1.1	2.4	2.4	5.8
2011	1.3	1.05	2.4	2.5	6.2

Source: Velocity of Pledged Collateral—Update, Singh (2012)

III. COLLATERAL AND MONETARY POLICY

Large dealers are incredibly adept at moving collateral they receive that is pledged for re-use. The re-use rate of collateral"—analogous to the concept of the "velocity of money"—indicates the liquidity impact of collateral.[14] A security that is owned by an economic agent and can be pledged as re-usable collateral leads to chains. Thus, a shortage of acceptable collateral would have a negative cascading impact on lending similar to the impact on the money supply of a reduction in the monetary base. Thus the first round impact on the real economy would be from the reduction in the "primary source" collateral pools in the asset management complex (hedge funds, pension and insurers etc), due to averseness from counterparty risk etc; such collateral remains idle and does not contribute in completing markets. The second round impact is from shorter "chains"—from constraining the collateral moves, and higher cost of capital resulting from decrease in global financial lubrication.

In the U.S. and Europe, both the Fed and ECB consider many information variables when determining monetary policy. The monetary base or M2 is an integral part of the "orthodox" monetary tool-kit where the velocity of money is considered as either constant or stable.[15] The ECB still uses this metric and both the U.K. and ECB also publish the M3 measure.[16] After Lehman, since there has been a move away from the strict Taylor rule, we look at alternatives to augment the traditional metrics. We suggest that the traditional monetary indicators be augmented by including collateral that large banks in the U.S. and Europe pledged for reuse with each other. There are links between pledged collateral that is intermediated by large banks and "quantitative" monetary policy instruments. We find that post-Lehman counterparty risk and related issues led to a significant drop in pledged collateral among the major U.S. and European globally active banks and this market is not rebounding (Figure 6). [17] This stems from a decline in both the collateral that is pledged for re-use and the associated churning factor. [18] Data on pledged collateral that may be repledged and the associated velocity factor

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[14] Generally, short term credit is extended by private agents against collateral. The collateral necessary to make such a deal can be borrowed against assets that are less liquid, and these less liquid assets in turn can also be borrowed. This is the collateral chain. By analogy with traditional banking, the stock of high quality assets is 'high powered' money, the haircut is the reserve ratio, and the number of times collateral gets re-pledged is the equivalent of money velocity.

[15] Ricks (2011) makes a legal distinction between fiat money and money-like other instruments that function like money.

[16] Others such as Gorton and Metrick (2010) have said that "repos are considered part of the money supply." When M3 was published (prior to March 2006), only repos transactions between the primary dealers and the Fed were included in this metric.[16] Thus the extent of repo involved in M3 would have been on the lines of the above discussion in box 1 on tri-party repo where collateral cannot be re-pledged beyond the privileged club of members.

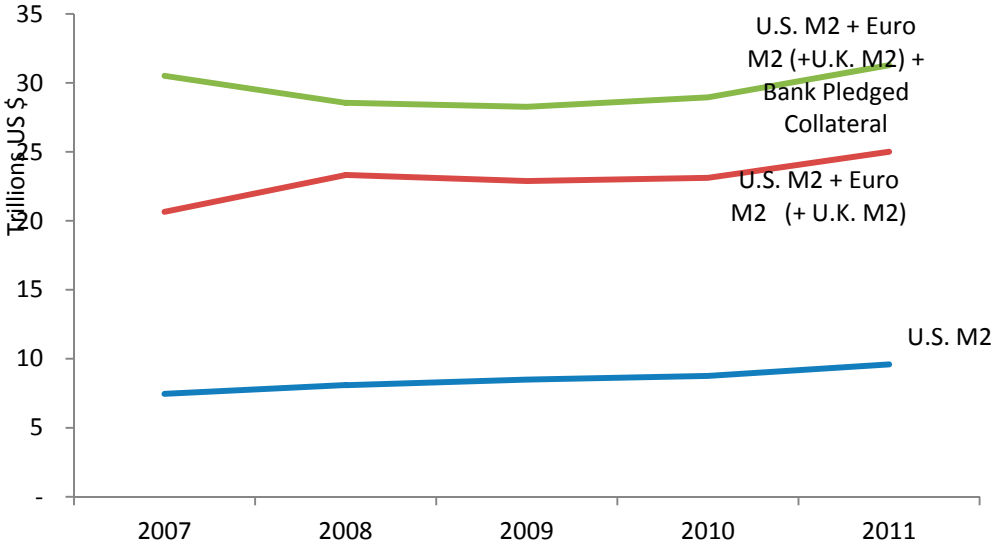
[17] We do not conclude if the pre-Lehman level of global liquidity was optimal or not.

[18] The Fed has discontinued publishing the M3 metric since 2006. We understand that M3 consisted of M2, institutional money market mutual funds, time deposits in amounts of $100,000 or more, repurchase agreement liabilities of depository institutions (in denominations of $100,000 or more) on U.S. government and federal agency securities, and Eurodollars. See "Discontinuation of M3," federalreserve.gov/releases/h6/discm3.htm

should be considered by the major central banks within the global financial system. Since cross-border funding is important for large banks, allowing for the efficient arbitrage of their European banks), the state of the pledged collateral market needs to be considered when setting monetary policy (Debelle, 2012).

The effective global liquidity remains below pre-Lehman level primarily because that velocity (or re-use) of collateral is higher than velocity of money. A rebound in the pledged collateral market would be more effective in easing liquidity constraints than a further round of QE which merely substitutes bank reserves for highly desirable pledgeable collateral.[19] For example, Fed's balance sheet has over $1.5 trillion in excess reserves of large banks that do not contribute towards financial lubrication.

Figure 7: Overall Financial Lubrication—M2 and Pledged Collateral



IV. POLICY ISSUES

When we consider collateral use/reuse in addition to M2 or the monetary base in U.S., U.K. and Eurozone, financial lubrication was over $30 trillion before Lehman (and one-third came via pledged collateral). This decline in leverage and re-use of collateral may be viewed positively from a financial stability perspective. The amount is large—an estimated $4-5 trillion (difference between the green and the red line in Figure 7 from 2007-20011). Increase in M2 due to quantitative easing (QE) does not substitute for loss in financial collateral, especially if QE is in exchange of good collateral (e.g., buying US Treasury—see Singh and Stella 2012). The 'kinks' in the red line in Figure 7 show M2 expansion due to QE. As of end-2011, the overall financial lubrication is back over $30 trillion but the "mix" is in favor of

[19] Singh and Stella (2012) argue that QE that leads to swapping of only good collateral by central bank does nothing for global liquidity.

money which not only has lower velocity than pledged collateral but much of it "sits" in central banks.

Due to the LTROs, European banks have been given some breathing room and thus are likely not to shrink their balance sheet (i.e., the "T" accounts) rapidly through higher haircuts, fire-sale of assets, or mark-to-marking of assets (e.g., from the "hold to maturity" book where assets are often booked at par or purchase price, to the trading book where assets reflect market price). So we can envisage—except in some obvious cases—that the deleveraging from the shrinking of balance sheets may not be sizable in the very near future, and yet the financial system may shrink as the financial intermediaries, due to counterparty risk and "silo" mentality, reduce their interconnectedness.

As the "other" deleveraging continues, the financial system remains short of high-grade collateral that can be re-pledged. Recent official sector efforts such as ECB's "flexibility" (and the ELA programs of national central banks in the Eurozone) in accepting "bad" collateral attempts to keep the good/bad collateral ratio in the market *higher* than otherwise. ECB's acceptance of good and bad collateral at non market price brings Gresham's law into play. But, if such moves become part of the central banker's standard toolkit, the fiscal aspects and risks associated with such policies cannot be ignored. By so doing, the central banks have interposed themselves as risk-taking intermediaries with the potential to bring significant unintended consequences.

Annex 1. Deleveraging Components—Balance Sheet and Interconnectedness

The purpose of this annex is to provide a mathematical framework to discuss the buildup of leverage on the balance sheet of financial institutions. The mathematical model described below was developed by Shin (unpublished technical note, 2009) and shows how the unwinding of systemic leverage can be separated into two components, i.e. balance sheet shrinking (due to haircuts/shedding of assets) *and* reduced interconnectedness within the financial system (due to shorter collateral chains). *This paper use the model to empirically show that post-Lehman the second component is sizable.*

x_i = market value of bank i's total liabilities

y_i = market value of bank i's assets that can be pledged as collateral

e_i = market value of bank i's equity

a_i = market value of bank i's assets

π_{ji} = proportion of j's liabilities held by i

$d_i = 1 - \left(\frac{e_i}{a_i} \right)$ is the ratio of debt to total assets

Noting that the total assets of bank i are given by $a_i = y_i + \sum_j x_j \pi_{ji}$ and from a simple accounting identity, it follows that the total debt can be computed by multiplying the totals assets with the leverage ratio:

$$x_i = d_i \left(y_i + \sum_j x_j \pi_{ji} \right)$$

Let $x = [x_1 \cdots x_n]$, $y = [y_1 \cdots y_n]$, and $\Delta = diag[d_1 \cdots, d_n]$ and rewriting the previous equation in vector form:

$$x = y\Delta + x\Pi\Delta$$

Solving for x and using Taylor series expansion,

$$\begin{aligned} x &= y\Delta(I - \Pi\Delta)^{-1} \\ &= y\Delta\left(I + \Pi\Delta + (\Pi\Delta)^2 + (\Pi\Delta)^3 + \ldots\right)^{20} \end{aligned}$$

The matrix $\Pi\Delta$ is given by

[20] Note that the sum of the elements of the rows of $\Pi\Delta$ is always strictly less than 1. This means that the infinite Taylor series converges and hence, $I - \Pi\Delta$ has a well-defined inverse.

$$\Pi\Delta = \begin{bmatrix} 0 & d_2\pi_{12} & \cdots & d_n\pi_{1n} \\ d_1\pi_{21} & 0 & \cdots & d_n\pi_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ d_1\pi_{n1} & d_2\pi_{n2} & \cdots & 0 \end{bmatrix}$$

The interaction between institutions and the system is elegantly captured by the above matrix notation. While we often talk about systemic leverage and systemic risks, the above matrix notation captures a very subtle issue, i.e*., it makes a distinction between impact of systemic leverage on an institution and impact of the institution on the remaining system.* This distinction between the two concepts is essential to breaking down endogenous systemic leverage into two exogenous variables, which provide additional insight into the economics of building leverage through collateral. The sum of the elements of the *i-th* row of $\Pi\Delta$ represents the net impact of bank i's leverage of the remaining system. The sum of the elements of the *i-th* column represents the net impact of systemic leverage on bank i. Note that the powered matrices $(\Pi\Delta)^t$ indicate the collateral value of the asset in the *t-th* link of the re-pledging chain.

Using the matrix $\Pi\Delta$, the change in deleveraging can be decomposed into two effects: price decline on balance sheet assets, and the decline in the interconnectedness factor, independent of price decline of assets. Assume there is a parameter σ that captures measured risks which affects both the price of marketable assets (y) as well the haircuts (which determines the debt ratios and consequently Δ). Denote $\Delta(\sigma)$ as the diagonal debt ratio matrix, and $y(\sigma)$ as the market value of marketable securities as function(s) of σ. <note (y) is defined here as price of marketable assets on the balance sheet and off balance sheet (i.e., pledged assets)> Define:

$$M(\sigma) \equiv \Delta(\sigma)\ (I - \Pi\Delta(\sigma))^{-1}$$

Suppose $\sigma < \sigma'$, then the decline in debt is given by:

$$x(\sigma) - x(\sigma') = y(\sigma)M(\sigma) - y(\sigma')M(\sigma')$$

Rewrite this as follows:

$$\begin{aligned} x(\sigma) - x(\sigma') &= y(\sigma)M(\sigma) - y(\sigma')M(\sigma) + y(\sigma')M(\sigma) - y(\sigma')M(\sigma') \\ &= \underbrace{(y(\sigma) - y(\sigma'))\ M(\sigma)}_{\text{Balance sheet shrinking (price decline)}} + \underbrace{y(\sigma')\ (M(\sigma) - M(\sigma'))}_{\text{Reduced interconnectedness (chain shortening)}} \end{aligned}$$

This identifies two parts: the balance sheet shrinking (via price declines/haircuts on the balance sheet) and the reduced interconnectedness (due to shorter collateral chains). The first has been studied extensively. The second term represents the de-leveraging in the financial system and could be significantly larger than the collateral squeeze term.

Annex 2. Hedge Fund Borrowing from Prime Brokers

Hedge Funds (HF) largely finance their positions by either (i) pledging collateral to the prime brokers (PB) to borrow money, and/or (ii) repurchase agreements with either their PB or another dealer where the repo their collateral for funding. This Annex looks at the first type of financing and estimates the HF borrowings from PBs as of end-2011 (for details of similar calculations for end-2007 and end-2010, see Annex 2 of Singh 2011).

HFs generally borrows from PBs for *equity long/short*, *event driven* strategies and equity biased strategies. The share of these 2 strategies in the mark-to-market value of collateral was about 35% as of end-2011. Mark-to-mark value of collateral has been defined in the paper to equate AUM times gross leverage (approximates NAV or net asset value of a HF). This is the sum of LMV (long market value) positions and the absolute value of SMV (short market value) positions. The figure below gives the *delta bias* on the left axis. Delta bias captures the ratio of LMV/SMV. Arithmetically, delta bias equals (total LMV/total SMV) minus 1. This ratio is a very useful indicator to gauge PB borrowing for HF's equity long/short strategies. At end-2011, the delta bias—see figure below-- was about 30% which means LMV/SMV ratio of 130/100 or approximately 4:3.

With mark-to-market value of HF collateral at $3 trillion and a 40% share of relevant strategies (as per market sources; also see Singh 2011 Table 1) that fund via PBs, and adjusting for long/short ratio, the borrowing from PB was about 3 trillion x 0.40 x 4/7 or about $700 billion.[21] Since we show separately the securities that come from custodians –as per Table 1–we need to be careful about client's "shorts". So if a PB exchanges client's "shorts" with custodians for securities, we avoid the double counting. (i.e., the PBs total pool of collateral maybe higher than $700 billion estimated here since we will show the shorts via the custodians pool of collateral that comes to the street)

[21] However, rehypothecation is limited in the U.S. due to Reg T and SEC's 15c3. The basic arithmetic for our estimate is as follows: for U.K., via FSA HF surveys, $250 billion base margin + $250 billion excess margin. (see Charts 3, 13 and 14 of FSA survey www.fsa.gov.uk/static/pubs/other/hedge-fund-report-feb2012.pdf Rest is from the U.S.

Source: Credit Suisse

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