

# Controlling global leverage: a new challenge for regulatory authorities

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## Abstract

The current crisis has underlined the failure of the credit economy based on the investment banking model which has promoted the extension of market participants and therefore to the increasing role of the so-called “shadow banking system” and, an increased use of leverage. Despite their banking structure, these institutions are not considered to be banks and consequently are not regulated by banking regulators. So in reality, the agents responsible for the excessive leverage are out of the scope of supervisors. The aim of this paper is to put forward a relevant indicator which will enable supervisors to control the excessive use of leverage which gives rise to systemic risk. This paper attempts to propose a leading macro prudential indicator (MPI) for monitoring vulnerability of financial markets. There is a consensus on the need to devise an appropriate early warning system for early detection of vulnerability of the financial system of a country. The new macro-prudential tool we estimate may allow supervisors to better monitor the evolution of excessive behaviour in the economy.

In the first part of the paper we will emphasize the strong rise of the credit derivatives and securitization markets. In the second part, we show how leverage is generated by financial institutions and how procyclical leverage can lead to systemic risk as shown in the vicious circle of leverage. And in the third part, we suggest the aggregated leverage ratio as a new macro-prudential tool for regulatory authorities. To achieve this goal, we perform a logit regression which allows us to compare the ability of the existing regulatory capital ratios to detect the evolution of banks’ risk-taking level in line with EWS’ one main approach, the discrete dependent variable.

An important result of our econometrical study is that the Aggregated Leverage Ratio (ALR) we estimate seems to be the best expression of banking excessive credit supply in comparison with credit growth and risk based capital ratio. Another main result is that leverage is a better indicator when it takes into account the more financial institutions as possible like investment banks (SIVs and hedge funds when it is possible). Lastly, ALR seems to predict correctly stress periods over one year and two year horizons. This result confirms our intuition that is to say ALR may be a useful complementary indicator to signal the need for supervisory action despite it is a simple ratio. In addition of its simplicity, it is costless to compute and consequently easy to implement.

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## **Introduction**

The 2007 summer crisis has showed the failure of credit economy based on investments bank “originate and distribute” business model. This crisis revealed the use of an excessive leverage on behalf of some financial institutions like investments bank, SIV and hedge funds. The continuing process of financial innovations led to an array of new structured products, to the securitization of many loans and to the extension of market participants and therefore to the emergence of the shadow banking system. This shadow system is compounded of leveraged financial firms without any deposit base, hence whose funding stems entirely from wholesale money markets.

Given that, leverage can lead to systemic risk mainly because it is pro cyclical as shown in the vicious circle of leverage, it seems to us crucial for the supervisory authorities to find a way to limit this excessive use of leverage and consequently to control it. In reality, the total leverage responsible for the crisis no more corresponds to the monetary aggregates and therefore no more allows supervisors to observe the evolution of the economy indebtedness. To observe the total indebtedness of the economy it seems to us necessary to add the leverage of investment banks, SIVs and hedge funds onto commercial banks’ leverage. These last one can benefit from a huge leverage and can use it excessively to maximize their yield and incited by an inflated optimism. So in reality, the agents responsible for the excessive leverage are out of the scope of supervisors (Hellwig, 2008). That is why we focus on the leverage of the extended banking system (the so-called shadow banking system) and to demonstrate that it can be a good indicator of excessive credits in the economy. Supervisory authorities have realized with the crisis the need for controlling financial institutions aggregated leverage (Hildebrand, 2008). While most of researches focus on the aggregated leverage of each financial institution, our paper points out a calculation of an aggregated leverage.

We think that the US leverage ratio and risk based capital ratio don’t give significant information and therefore supervisors should use an aggregated leverage ratio in order to reinforce it. Our paper contribution is to integrate investment bank leverage and to set up a macro prudential tool for supervisors to monitor liquidity and systemic risk which are risks that only supervisors can see because they are at an aggregated level.

After the reminder of the current regulation framework on commercial banks and highly leveraged institutions which give rise to regulatory by-pass, we will test the validity of the Aggregated Leverage Ratio as a macro-prudential tool.

After a graphic analysis of the aggregate leverage ratio, we observe the deviations of credit series from their long-term trend in order to identify boom credit periods. The statistical analysis reveals that the ALR and the credit/GDP ratio are good indicators to detect boom credit periods.

In order to demonstrate that this Ratio is a good leading indicator for supervisors to detect excessive credit in the economy, we perform a logit regression over the 1994-2008 periods. This allows us to compare the ability of the existing regulatory capital ratios to detect the evolution of banks' risk-taking level in line with one of the main approaches of "Early Warning Systems", the discrete dependent variable one (logit/probit models).

An important result of our econometrical study is that the ALR seems to be the best expression of banking excessive credit supply in comparison with credit growth and risk based capital ratio. Another main result is that leverage is a better indicator when it takes into account the more financial institutions as possible like investment banks (SIVs and hedge funds when it is possible). Lastly, ALR seems to predict correctly stress periods over one year and two year horizons. This result confirms our intuition that is to say ALR may be a useful complementary indicator to signal the need for supervisory action despite it is a simple ratio. In addition of its simplicity, it is costless to compute and consequently easy to implement.

Our paper is organised as followed. First, we ring a bell on the rise of credit derivatives markets and securitization. Second, we emphasize the extension of the counterparty network and the amplification of systemic risk it leads to. And third, we suggest a leverage measurement tool for regulatory authorities.

## **Part I: The rise of credit derivatives markets and securitization**

Since the 80's a boom in credit risk transfer markets can be observed. Credit derivatives and securitization are two main financial innovations. However this trend accelerated from the beginning of years 2000's until the upsurge of the financial crisis. The most outstanding growth among

securitised products concerns MBS (Mortgage-backed securities), ABS (Asset-backed securities) and CDO (Collateralised debt obligation). Single name credit derivatives, e.g. CDS (Credit default swaps) waxed tremendously. ABS issuance grew from around \$1071 billion in 2000 to \$2472.4 billion in 2007 (i.e. an increase around 130%). MBS issuance followed the same trend, growing from \$684.4 billion in 2000 to \$2050.1 billion in 2007 (i.e. an increase around 200% see table 1). From 2004 to 2007 CDO issuance spiked from \$157418.5 billion to \$502978.8 billion, that is to say an increase of around 219% (SIFMA, 2008). According to Fitch, the notional amount of credit derivatives increased from \$3 trillion in 2003 to \$12 trillion in 2005 (Rey, 2007). The notional amount of CDS increased exponentially from 1000 billion of dollars to 26 000 billions of dollars from 2001 to 2006 (FSF, 2006).

Table 1: Issuance of ABS and MBS in 2000 and 2007 (\$ billions/ %)

Issuance (\$ billions/ %)	2000	2007	Growth interest
MBS	1071	2472.4	130
ABS	684.4	2050.1	200

Source: SIFMA, 2008

The current financial crisis which broke up in July 2007 has revealed weaknesses in securitization. It has led to a drop in CDO markets. CDOs issuance decreased from \$186467.6 billions in the first quarter of 2007 to \$93063.6 billions in the third quarter of 2007. CDOs issuance slumped to \$17336.7 billions in the second quarter of 2008 (SIFMA, 2008). Despite the fall in CDO markets we presume that securitization will carry on, albeit with much stricter regulatory requirements. Indeed the MBS and ABS issuances are either still growing or remain stable. MBS issuances rose from \$5747.9 billions in 2007 Q3 to \$6228.8 billions in 2008 Q2. As well as MBS issuances, ABS issuance grew modestly from \$2477.3 billion in 2007 Q3 to \$2498.9 billions in 2008 Q2. Furthermore, securitization and credit derivatives are from now on a core tool of the banking system. Banks use securitization to reduce funding costs, to diversify their portfolios and revenue sources and to hedge risks. In general rule financial innovation never completely disappears.

The general idea behind a typical securitized issue is as follows. First, a bank originates credit market assets of some sort. The objective is to pool and transfer credits to an *ad hoc* entity, the Special Investment Vehicle (SIV) which issues securities bought by institutional investors (pension funds, insurance companies) and hedge funds (Davis N., 2008, Clerc L., 2002))

Why speaking about the rise of securitization? Because the growth of securitization and the licence to transfer risks OTC have hugely changed banks behaviour. Beyond favourable macroeconomic conditions, as well as low interest rates and abundant liquidity in those years, this highest increase can be explained on the one hand by mutation of the economy toward a more market-based activity and on the other hand by changes in regulatory rules (Brunnermeier M. K., 2008, Estrella A. 2000)

The key changes in regulatory rules are the implementation of the Basel I legislation and the repeal of the Glass Steagall Act. Basel I have offered a framework which makes banks' capital requirements stricter. In order to reduce their capital costs banks learnt the way to take advantage of this large and complex structure. There is a consensus in research on the fact that banks respond to capital pressure by the less expensive way (Calomiris C. Mason J., 2004).. As raising equity can be very expensive according to market environment, financial institutions prefer to decrease their exposition to risks. Securitization allows banks to modify the risk profile of their balance sheet and finally to achieve capital adequacy targets (Davis N., 2008). The upcoming implementation of the Basel II legislation will emphasize this trend (Minton and al, 2004).

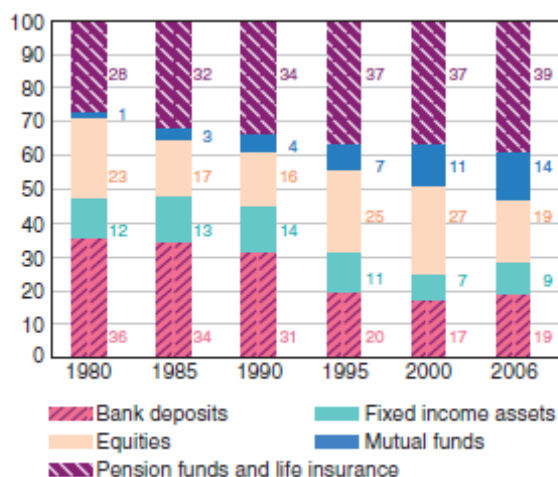
They manage to achieve capital adequacy targets because securitization allows them to get the good assets off their balance sheet. The securitization practice allows reducing considerably the amount of loans on banks' balance sheets (De Young and Rice, 2004). Moving loans into off-balance-sheet vehicles and granting an AAA rating for securitised assets permit banks to save on regulatory capital and release capital for further loans, entailing a higher leverage. Securitised assets require less regulatory capital than the initial assets, reducing the capital cost. It has been a strong incentive for the rise of securitization (Duffie and Garleanu 2001).

The repeal of the Glass Steagall Act in 1999 which abolished the split between commercial banks and investment banks induced the creation of new financial holding companies. These bank holding companies perform all types of financial activities. This induced the switch-from the "*originate and hold*" business model to the "*originate to distribute*" one. The "*originate to distribute*" business model is associated to new practices in banking. Securitization is the linchpin in those practices. Banks seek to maximise their fees and commissions in buying pools of credits, offloading and tranching them into structured credits, in underwriting the primary distribution of securities collateralized with those assets and in servicing them.

The end of the Glass Steagall Act also improved financial services technology, favouring the creation of large credit data bases, thanks to innovations in information technologies. Progress in financial engineering has allowed banks to disentangle complex risks into elementary risk factors and to create derivatives to market separately the different components of risk or to bundle them again into synthetic derivatives contracts. Banks, using the new technology of securitization, have thought that they could benefit from the huge yields without bearing an increase of risks. They have systematically underplayed the increase in counterparty and liquidity risks due to the opaque sale of complex products in over-the-counter (OTC) markets (Crouhy and al, 2001). Therefore derivative and complex securities were very attractive. It led to an increase of their demand and consequently to a boost of securitization.

For thirty years, fundamental economic forces have transformed the main traditional feature of banks, commonly described as “*borrowing short and lending long.*” In their traditional business banks lend long and fund their loans in issuing short-dated deposits (Mishkin & Edwards, 1995). Deregulation has opened a wide array of new financial instruments to the public leading to disintermediation. Financial innovation and deregulation have created attractive alternatives for both depositors and borrowers. Commercial banks are losing their monopoly power over depositors' funding. Deposit share in banks funding has been divided by two between 1980 and 2006 (figure 1). Consequently, traditional banking has lost profitability insofar as business lending has diminished.

Figure 1: Financial assets of financial households (in % of total<sup>3</sup>)



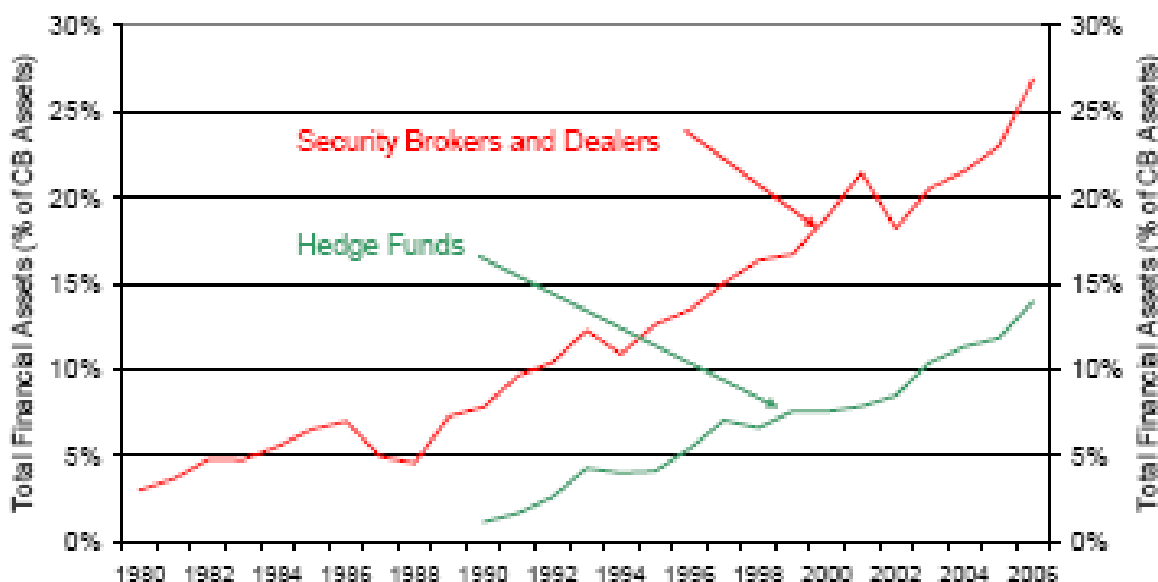
Sources: US federal reserve, see ECB 2007:”Euro money market survey 2006”, February, Financial Stability Review, 2008 February.

<sup>3</sup> Excluded miscellaneous items.

To survive and maintain sufficient profit levels, banks are facing two alternatives. First, they can attempt to maintain their traditional lending activity by expanding into new riskier areas of len (Crouhy and al, 2001). ding . There is evidence that banks have in fact increased their lending to less creditworthy borrowers The second way is to pursue new off-balance-sheet activities that are more profitable. Commercial banks have increased fee-based activities since the early 1980's (Mishkin & Edwards, 1995, De Young, 2007). For example, they have increased their participation in derivatives markets dramatically in the last few years. This trend resulted in a change of the Net banking Product's structure. Banks moved from interest based revenues to fee based revenues. Until this crisis, banks which have used these securitization techniques thought that they could benefit substantial profits without bearing an increasing risk in counterparty. Crisis has revealed that banks have under estimated the increase of counterparty risk and liquidity risk owed to complex and opaque products sale in OTC markets.

This “originate to distribute model” promoted an increased use of leverage. The continuing process of financial innovation led to an array of new structured products, to the securitization of many loans and to the extension of market participants and therefore to the emergence of the shadow banking system (Crockett, 2007).

Graph 1: Total financial assets of financial intermediaries (as % of commercial banks total assets)



Source: Total financial assets of Security Brokers and Dealers are from table L.129 of the flow of funds, Board of governors of the Federal Reserve. Total financial assets of Bank Holding Companies are from table L.112 of the flow of

funds, Board of governors of the Federal Reserve. Total assets under management of hedge funds are from HFR. Tobias and Shin, 2008, "Liquidity and leverage".

It is compounded of leveraged financial firms without any deposit base, hence whose funding stems entirely from wholesale money markets; they are the broker dealer firms: investment banks, SIVs/ conduits and hedge funds.

## **Part II: The extension of counterparty network: an amplification factor of systemic risk**

We will focus on hedge funds, investment banks and SIVS because of their increasing role in credit market. Moreover, they are high leveraged financial institutions without deposits and which funding stems from wholesale market. These three institutions use excessive leverage in order to maximise their return because they plan very optimistic anticipations. First we will define them and second we will explain the way they generate leverage.

There is no legal definition of hedge funds. They are generally defined according to their characteristics. Hedge funds have three main structural features: they are private pools of capital, they pursue multiple and complex strategies and their returns are boosted by leverage. A hedge fund is managed by a general partner who combines various long-short strategies<sup>4</sup>, very active trading and leverage via derivatives markets<sup>5</sup> in order to obtain an absolute return. Hedge fund manager extract a double structure of very high fees from the investors (management and performance fees) (Lubochinsky C., 2007).

Investment banks profit from companies and governments by raising money through issuing and selling securities in the capital markets as well as providing advices on transactions such as mergers and acquisitions. The main characteristic of investment banks is that by contrast with commercial banks they have no deposits. They find their funding in financial markets. They are generally included in the broader category of broker-dealers.

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<sup>4</sup> Long short strategies allow to make return on arbitrage bets.

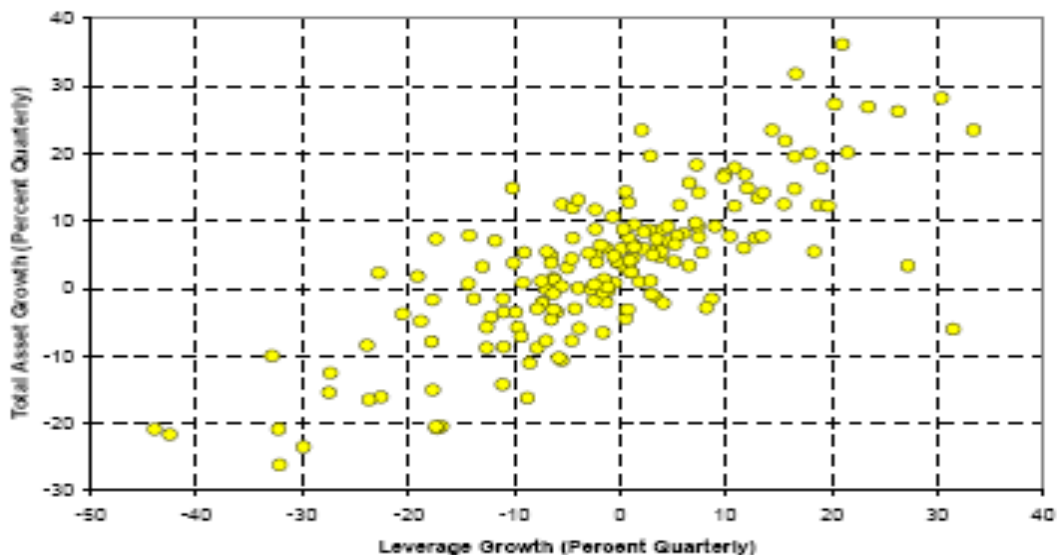
<sup>5</sup> The number of hedge fund strategies has increased. About twenty strategies can be identified; they can be categorized into the three following subsets: arbitrage, event-driven and directional strategies. The most recurring strategies are: multi-strategy (30.6%), long-short equity (23.2%) and event-driven (13.3%)( Mac Kinsey, 2007).



The third leveraged institutions we consider are SIVs. They appeared in 1990's when investment banks realized they could exploit capital requirement rules via off balance sheet vehicles. We do not have much information about them. SIVs are run separately with no shared management and no legal ties between them and the sponsoring institution. SIVs pay to the originator bank fees and commission which come from originating asset, from managing those assets in off-balance sheet structures, from underwriting the primary distribution of securities collateralized with those assets and from servicing them. Conducts and SIVs need funding because they are by nature very little capitalised.

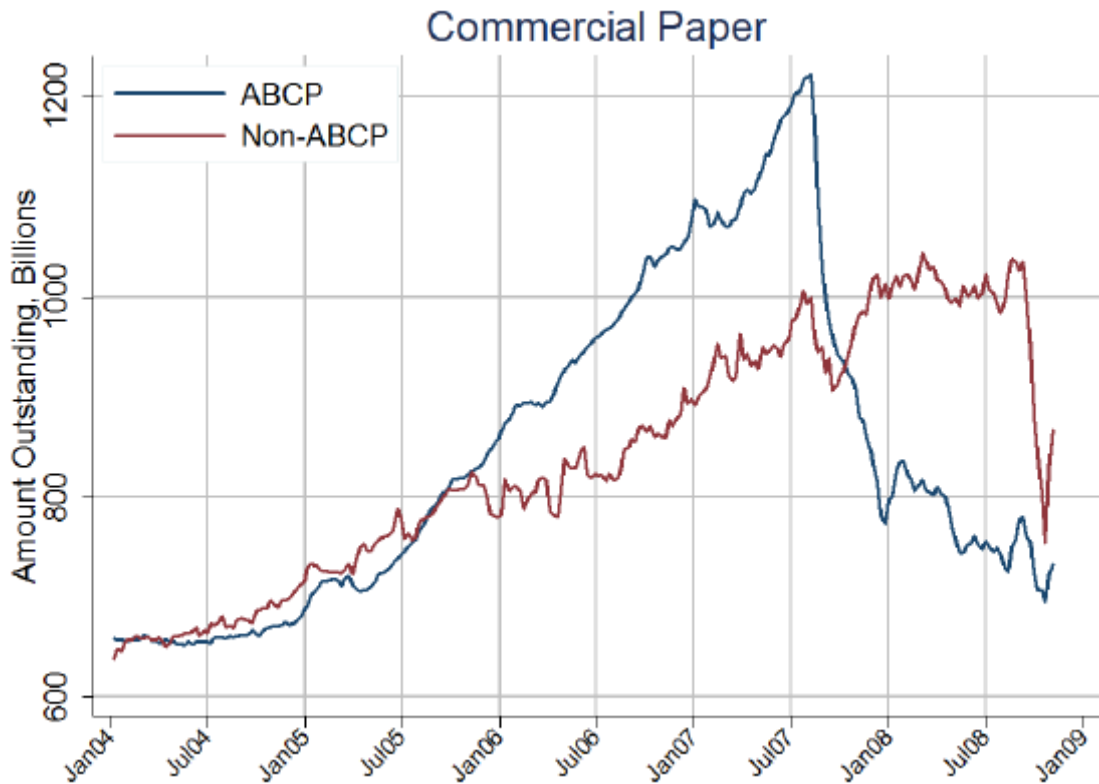
These intermediaries have two main common features: an excessive leverage and a light regulation or a lack of regulation. They belong to the so-called “shadow banking system” which has two main characteristics: First, a banking structure with illiquid, long term asset and liquid, short term liabilities and second, a light touch regulation. Despite their similar structure with banks, these institutions are not considered to be banks and consequently are not regulated by banking regulators. After a brief recall on how leverage is generated by these three institutions, we will examine the consequences of the use of an excessive leverage on systemic risk.

Graph 2: Total assets growth and leverage growth of security brokers and dealers



Source : Tobias and Shin, 2008, “Liquidity and leverage”.

Graph 3: Outstanding asset-backed commercial paper and unsecured commercial paper



Source : Federal reserve Board, Brunnermeier, “Deciphering the liquidity and credit crunch 2007-08”.

Investment bank leverage comes from the increasing issuance of ABCP to purchase long term debt securities. SIVs benefit from an important leverage thanks to their balance sheet structure. Their leverage comes from the issuance of ABS, MBS and CDO in order to fund ABCP issued by sponsoring banks (see table 2). Hedge funds leverage stems from derivatives and subordinated tranches of CDO. Hence they benefit from an unlimited leverage which is without risk given the double effect<sup>6</sup> of leverage because of the lack of transparency.

<sup>6</sup> Leverage allows financial institutions to maximise profitability of invested capital. However, while leverage can play a positive role in our financial system, problems can arise when financial institutions go too far in extending credit to their customers and counterparties.

Table 2: CDO buyers

CDO tranches	Insurance cies	Hedge Funds	Banks	Asset Managers
AAA	6.9	12.1	14.5	5.8
AA	1.2	4.0	3.5	4.0
A	0.3	4.6	1.4	2.9
BBB	0.6	4.3	0.3	4.0
BB	0.0	2.3	0.3	0.3
Equity	0.9	19.1	4.9	1.7
Total %	9.8	46.5	24.9	18.8
Total \$b	295	1396	746	564

Source: Adrian Blundell Wignall, « Structured Products: implications for financial markets », OECD, December 2007, p45.

What makes leverage excessive and potentially systemic is the fact that these institutions manage their leverage in an active way. That is to say leverage is procyclical. When balance sheet' size changes due to a market price variation, or to the decision of one institution to limit lending/borrowing, banks will adjust their leverage. Leverage amplifies in the same time gains and losses depending on the position in the financial cycle. It is a first source of fragility. The second characteristic which makes leverage potentially systemic is related to the fact that each of them rely on short term borrowing. This reliance on short term borrowing makes these institutions more vulnerable to disruption on market liquidity.

Beyond the extension of counterparty network, the growth of securitization and credit derivatives markets allowed financial intermediaries and particularly investment banks and shadow banks (like SIV, conduits and hedge funds) to obtain almost an unlimited leverage. This huge leverage through these financial innovations fuelled the cumulative process between credit expansion and the increase of asset prices which leads to financial instability and then to a higher systemic risk. This dynamics of financial instability is exacerbated by excessive and procyclical leverage (Borio and Al, 2001; Goodhart, 2004).

The new finance model has increased the potential for contagion that raises systemic risk. We can distinguish two types of systemic risk (De Bandt and Hartmann, 2000). The first refers to “domino

effect” that is to say a detrimental choc related to one or several institutions or markets and is reflected in other institutions or markets (Hellwig, 1998, Schnabel and Shin, 2004 and, Allen and Carletti, 2006, 2008). The second one stems from a macro-economic shock which affects in the same time a lot of institutions and markets and induces a common negative response. In both cases contagion is the mechanism by which an event may cause a financial crisis as well as a bank run, a credit crunch, a general fall in financial assets prices and the freezing of payment systems (Kashyap and Stein, 2000 and Van den Heuvel, 2002).

To explain that securitization and credit derivatives raise systemic risk we will rely on the first part of the systemic risk definition. Indeed the growth of these credit risk transfer markets has led to a bigger leverage. Moreover the adoption of the “originate and distribute” business model has amplified this trend.

In booming periods, collateralized asset price increases. The more collateralized asset price increases, the more banks have incentives to grant new loans, and the more investors are keen to hold these assets. This process tends to boost the size of these financial institutions’ balance sheet and to decrease mechanically their leverage (Kashyap and Stein, 2003, Adrian and Shin 2008). Financial institutions will buy more assets to reach their target leverage. This will generate an increase of asset prices which will create an additional increase of balance sheet like (positive feed back) (see figure 2).

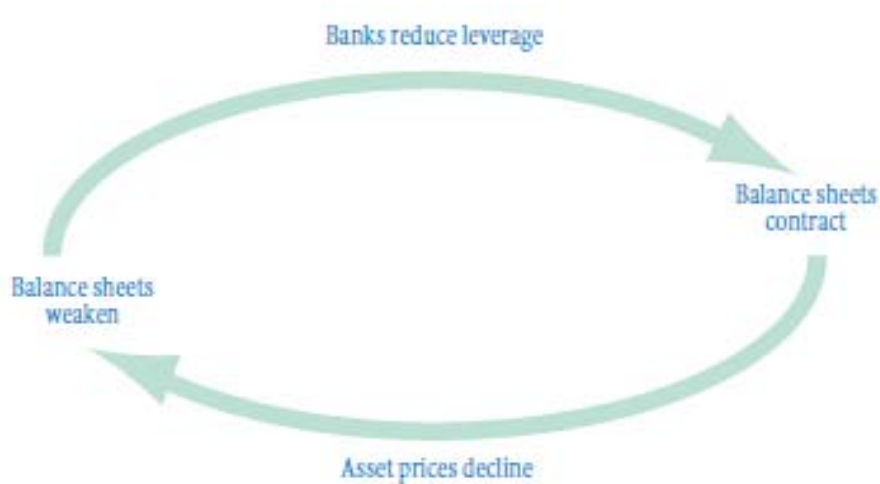
Figure 2: Leverage management during an asset price boom



Source : Adrian and Shin 2008

At the contrary, in downturn periods collateralized asset price falls and financial institutions' balance sheet size plummets. This makes their leverage mechanically higher. To restore the target leverage, banks are bound to sell assets to payback their debt. This additional supply of assets provokes a decrease of their price. This process will generate distressed sales which will fuel the crisis (see figure 3) (Fisher 1933, Bernanke, Gertler and Gilchrist 1999).

Figure 3: Leverage management during an asset price decline



Source : Adrian and Shin 2008

Moreover, the combination of liquidity with derivatives and the leverage they induce is a dangerous formula which can lead to huge difficulties. This combination prevents a crisis and favours the quickly worsening of the crisis. Then, an important deleveraging process will freeze credit markets. The increase in the cost of borrowing can create a slowdown in economic growth. This de-leveraging process illustrates that the crisis has become systemic if supervising institutions don't manage to stop it (Brunnermeier, 2008). The IMF estimates expected financial institution losses over the next two years at almost \$1 trillion (Wall Street Journal, April 9, 2008).

Banks are exposed to various types of risks and in particular to market risk, credit risk, and operational risk. Credit risk stems from lending which generate fees and interest income. As major dealers in credit derivative markets and securitization, banks have extensive counterparty obligations and may be exposed to substantial market and counterparty credit risk. Due to the ineffective regulatory framework, the rise of securitization has changed the nature of the counterparty risk. The

counterparty risk is defined as the risk to each party of a contract that the counterparty will not satisfy its contractual obligations. In most financial contracts, counterparty risk is known as "default risk". Credit events may be bankruptcy, failure to pay or restructuring. Therefore banks are vulnerable to more agents acting in the financial sector. Banks are exposed to particular counterparty risk relative to this leverage. As suggested before, the explosion of securitization and derivative markets created interactions between banks and leveraged financial institutions or reinforced the ones existing and consequently modified risks incurred by banks.

We will focus on the counterparty risk borne by investment banks because it can echo in commercial banks. The impact of counterparty risk on investment banks passes on the one hand through their relationship with SIVs and on the other hand through their relationship with hedge funds. These both contagion channels reveal the systemic feature of SIVs and hedge funds.

Investment banks face losses on the one hand through their relationship with SIVs and on the other hand through their specific practices in the securitization process. Indeed during the securitization process, an important share of risk doesn't leave in reality the banking system (Duffie 2008). Originators' institutions generally don't keep equity tranches of the portfolio they have generated (Duffie, 2007 and Dodd, 2007). When an investment bank securitises credits it can hold some of the equity tranches on its balance sheet. It is done first to convince potential investors that they are good assets and second because they keep some these tranches they don't manage to sell. The originator bank usually retains the riskiest tranches (De Marzo, 2005); what finally worsens its risk even if a major part of risks has been moved off-balance sheets. It seems to be a common practice among international banks, even if there is no direct evidence supporting this assumption but only survey results (ECB, 2004 and Bundesbank, 2004). There is counterparty risk when SIVs undergo losses through equity tranches and consequently no longer satisfy their commitments (fees...). As investment banks absorb the first class losses (equity tranches), they may suffer substantial losses.

To get their best of securitization, investment banks create off-balance sheet vehicles. They provide for SIVs credit guarantees and credit lines, so that SIVs get an AAA rating conducive to a low cost of funding. The credit guarantees and liquidity lines make links between the sponsoring bank and the SIV sounder (Roubini, 2008). When many of these securities register losses, banks come under an increasing pressure to rescue the investment vehicles they have sponsored, either by providing liquidity or other support or, as it has become necessary, by re-intermediating the assets onto their own balance sheets" (Bernanke 2008). This re-intermediation combined with the downgraded rating

assets seriously erodes their capital. The decrease of their capital forces banks to reduce risk by cutting lending and raising interest rates to both financial institutions and non-financial agents.

When supervisory authorities allowed banks to create these entities legally separated from the bank and which are off balance sheet, they hadn't considered that during stress periods banks would have to reintegrate their assets on their balance sheet due to the liquidity lines they had granted them. This case hadn't been considered because it was widely admitted that securitised assets were absolutely liquid and that collateralised assets prices would always go on rising. So, banks seem adequately capitalised. Banks finally reintegrated SIVs' assets to prevent the whole securitised credit market from collapsing. If they hadn't reintegrated them, they would have been seriously impacted because of their counterpart relationships with SIVs which were significant. So, losses related to the reintegration of these assets represented in reality a less significant impact for banks.

Besides, banks buy securitised assets for their proprietary trading to benefit the high profits they generate. Fees have become the main income source of investment banks in the "originate to distribute" business model. The larger the investment bank, the bigger the scope of proprietary trading. By 2006, 70% of Goldman's total net income came from gambling with the firm's own capital. This illustrates investment banks' outstanding dependence on this source of income (*The Economist*, December 23, 2006). Merrill's higher management became addicted to the fees that flowed from financing CDOs. They were estimated around \$700 millions in 2006 (*Wall Street Journal*, May 2, 2008). Potential risk related to this business is huge. The new accounting rules ask banks to estimate their securities and assets at their market current value. Therefore banks' capital can evaporate when the price of these securities has dropped. This deleveraging process undermines collateral prices.

The duration between the time when the investment bank securitizes assets and the time when it sells them can be long. It can be difficult to find a buyer even for super senior tranches of MBS due to their low yields. When a crisis occurs in complex products markets (for example CDO market), these products can no more be sold except at a very low price. As banks are still holding huge amounts of these products on their balance sheets this generates credit risk and consequently large losses.

Investment banks also face to losses via their counterparty relationship with hedge funds. Indeed, hedge funds can generate leverage through derivatives markets provided by prime brokers which are generally a department of investment banks. Financial leverage is the major service that prime

brokers offer to hedge funds. Investment banks require margins to hedge funds in exchange of provided lending (Cole R. et al., FSF, 2007). Prime brokers bear the counterparty risk.

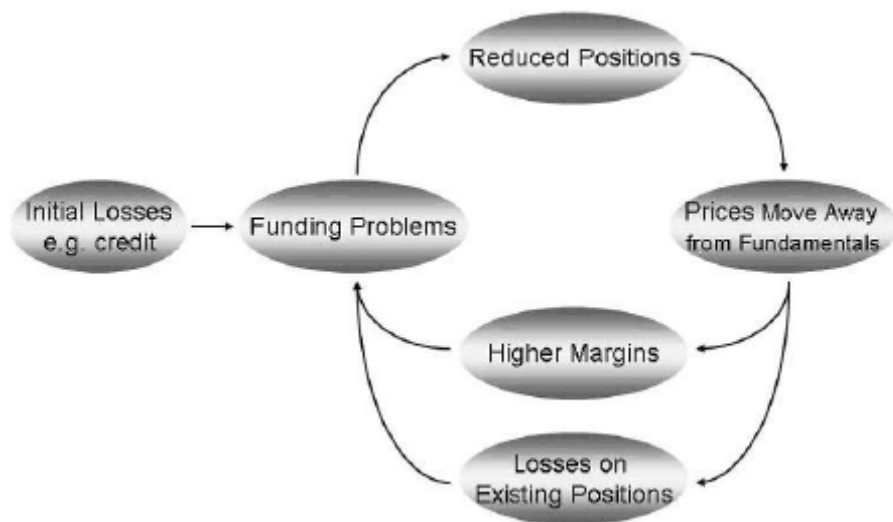
We note a huge increase of financial leverage via derivatives markets these last few years provided by prime brokers. The counterparty amount between hedge funds and prime brokers was estimated to 1300 billions of dollars in 2007 (Blundell-Wignall, 2007). In the same time, we observe a decrease in initial margins while risk did not drop and a great concentration in the prime broker market. Hedge funds represent 20% to 30% of the profit of investment banks (Mac Kinsey, 2007). Morgan Stanley and Goldman & Sachs represent 40% of this market. This profitable business illustrates the interdependence between prime brokers and hedge funds. This interdependence generates vulnerability whether a big hedge fund fails. All those factors tend to increase the counterparty risk.

There is another kind of counterparty risk via leverage which stems from subordinated tranches through securitized credit (ABS/MBS/CDO mezzanine and equity, leveraged CDS). Besides, off-balance vehicles have sold leveraged structured credit, mainly the subordinated tranches to hedge funds. Finally, hedge funds carry out risk-arbitrage in the structured credit markets. They have been major buyers of illiquid structured credit vehicles, such as CDOs and ABSs. Due to their large exposure in those markets, they can be meet hard liquidity problems and transmit them to their bank counterparts.

When home prices start to fall, losses on ABS pools may widely exceed the losses estimated by rating agencies and embodied into their ratings. In that case, subordinated tranches become quickly annihilated and senior and super senior tranches are affected. Risk re-evaluation has detrimental repercussions on securitization channels, particularly for hedge funds (heavily leveraged and) loaded with mezzanine and equity tranches. Therefore hedge funds are being forced to deleverage, triggering the mechanism (a negative dynamics). They sell their best assets to try to meet their debts, pushing all asset prices further down, except the most liquid Treasury securities that benefit from the flight to quality. Then lots of hedge funds are likely to become insolvent and to close, inflicting huge losses to their credulous institutional partners. (There will be many more casualties). Furthermore, crowded trades created strong correlations between hedge funds' strategies (see Khandani and Lo 2007 and, Brunnermeier 2008).

Figure 4: The two liquidity spirals: loss spiral and margin spiral





Source: Brunnermeier and Pedersen 2008, "Market liquidity and funding liquidity".

Hedge funds will entail boomerang effect on investment banks who have procured leveraged finance. (Counterparty risk is leading to more deleveraging requirements). Hedge funds and SIVs have been affected by the crisis because they had bought MBSs' equity tranches (Dodd, 2007, Kiff and Mills, 2007). The failure to meet their commitments will widen bank losses. In March 2008, hedge funds belonging to the Carlyle Group were unable to meet margin calls from their prime broker Bear Stearns, aggravating the liquidity squeeze on the latter to outright default (Aglietta M. & Rigot S., 2008).

Systemic risk arises and affects the real economy when investment banks' losses affect commercial banks. The contagion by commercial banks is different for a financial conglomerate and for regional banks or saving institutions. Large commercial banks form part of huge financial conglomerates which include investment banks. When an investment bank suffers losses because of the reasons we have developed, a universal bank must absorb these losses that may threaten its solvency. Consequently, credit derivatives and securitised securities can affect commercial banks through their impact on their investment banking arm.

When it deals with regional bank and savings institutions, losses are mainly related to counterpart relationship that is to say losses coming from the steady deterioration of home market or from a global economic slowdown. The trouble of Indymac and Washington Mutual are good examples. Once commercial banks are touched by losses, they have to reconstitute their equity capital which

was eroded. Then these banks become very reluctant to distribute new loans because they represent new risks. It is the same thing as a generalized contraction of credit supply. Banking credit becomes rarer. That leads to an economic slowdown and to the rise of unemployment. This results in a drop in consumption and in corporate profits which affects negatively stock markets. Therefore, we note that in new finance, systemic risk may occur via bank runs but also via credit supply contraction.

Commercial banks seemed to be adequately capitalized during booms, only because a high percent of their assets was kept off-balance sheet (Blundell-Wignall, 2008). In fact, they were dangerously leveraged. If these assets had been kept on-balance sheet, the excessive leverage would have been observable which would have involved further capital.

Kaminsky and Reinhart (2000) show that contagion is a phenomenon transiting mainly through the banking channel. The final cost of the Savings and Loan crisis was about \$200 billion but there were no serious consequences in other national financial markets. The 1997-98 Asian crisis no seriously affected Western financial systems. However, the subprime mortgage crisis in the US that began in 2007 caused more banking losses outside the country than inside. An Institute of International Finance report stated that in 2007 and early 2008, US banks lost \$166 billion in the crisis while European banks lost \$200 billion. The central bank (ECB) observed that “the risk of subprime mortgages has been dispersed to Europe and Asia, and within the euro area, bank losses were relatively widely spread” (Financial Times, June 6, 2008).

### **Part III: Toward enhanced leverage measurement tools.**

We have seen that leverage fuelled too optimistic anticipations of market participants on a continuous asset prices rise. Hence it is important to control leverage progress to contain this vicious cycle and its detrimental consequences on financial stability and real economy. We will study the current micro-prudential framework of commercial banks and financial institutions to detect weaknesses and put forward a complementary tool (ALR) for supervisor use to limit regulatory loopholes.

Micro-prudential and macro-prudential supervision are clearly intertwined at several levels. Micro-prudential supervision has traditionally been the centre of the attention of supervisors around the

world. The main objective of micro-prudential supervision is to supervise and limit the distress of individual financial institutions, thus protecting the customers of the institution in question.

The regulatory framework for commercial banks applied until 2008 was Basel I. Basel II has come into force in Europe in 2008 and will be implemented in the United States in 2009 but only for the biggest banks. In both Basel I and Basel II, prudential regulation aims at protecting deposits and at assuring financial stability. To achieve this last objective, the main instrument is capital adequacy requirements through a risk-based capital ratio. Moreover U.S. banks are required to comply with a leverage ratio requirement. The leverage ratio requires banks to hold capital as a cushion against losses arising from other risks associated with derivatives positions, such as operations risk. The risk-based capital ratio must be equal to 8 % and the US leverage ratio<sup>7</sup> to 2% (Freixas and Parigi, 2007). In the new Basel legislation supervisors require banks to hold capital functions of their exposition to risk. These demands apply to all the bank's on balance sheet assets and off balance sheet of which securitised assets and credit derivatives. But there are specific requirement for last ones.

Policymakers and supervisors have relied on an indirect regulation for hedge funds via their prime brokers. Indeed, most counterparts of hedge funds are regulated. They have also supposed that their trading in equity and debt markets was subjected to market discipline from their investment partners. Because of their huge counterparty risk with hedge funds, prime brokers have incentives to control them. Consequently, hedge funds' regulation rests on the promotion of standards of good conduct (no compulsory disclosures).

In the United States, investment banks have lower capital and disclosure requirements than commercial banks. They have disclosure requirements to the SEC. These disclosures can be made through two reporting forms: FOCUS (Financial and Operational Combined Uniform Single Report) or FOGS (Report on Finances and Operations of Government Securities Brokers and Dealers).

Finding information about SIV is a hard task given their opacity. They do not have disclosure requirement to any supervisory authority. The only information about SIVs is those disclosed to banking regulator when a bank wants to create a SIV. Besides, some of these SIVs are located in offshore places. That allows them to benefit a light prudential regulation and accountability rules. (Ashman, 2000). So, these vehicles don't belong to banks consolidation perimeter then it is difficult for supervisors to monitor the way these vehicles reallocate risks between geographical and sectorial

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<sup>7</sup> Tier one / Total assets

economic areas. Therefore, we observe that the most leveraged institutions (investment banks, SIVs and hedge funds) are paradoxically those on which supervisors have less control.

The fact that the financial system as a whole may be exposed to common risks is not always fully taken into account. Macro-prudential analysis therefore must pay particular attention to common or correlated shocks and to shocks to those parts of the financial system that trigger contagious knock-on or feedback effects. The objective of macro-prudential supervision is to limit the distress of the financial system as a whole in order to protect the overall economy from significant losses in real output. Macro-prudential supervision cannot be meaningful unless it can somehow impact on supervision at the micro-level; whilst micro-prudential supervision cannot effectively safeguard financial stability without adequately taking account of macro-level developments. Macro-prudential supervision of the financial system by central banks needs to be strengthened. There is an international consensus emerging on this need, in the context of the lessons from the financial crisis (De Larosière Report, 2009). This need for strengthened macro-prudential supervision has been taken into account with the development of early warning systems (EWS) literature.

## **Methodology and data**

In the first part of this paper, we have demonstrated that it is crucial for supervisors to control leverage coming from investment banks, hedge funds and SIVs and not only the one associated with commercial banks. We want to demonstrate that an aggregated leverage ratio may be a good leading indicator for supervisors to detect excessive credit in the economy. As certain economists, we think that a deep reform in prudential regulation is necessary.

Macro prudential regulation allows detecting the occurrence of significant fragilities within the financial system which may destabilize it. In this regard, there is a consensus on the need to devise an appropriate early warning system to reveal vulnerabilities of the financial system. However, there is no universally accepted set of indicators for monitoring financial markets. International Monetary Fund (IMF) has introduced *Financial soundness indicators (FSIs)* which are defined to be indicators compiled to monitor soundness of financial institutions and markets. Moreover, IMF has collaborated with national authorities and other international financial institutions in developing macro prudential indicators (MPIs) and formulating methods in analyzing these indicators of financial soundness. The IMF considers macro prudential analysis as a key element in designing a policy framework on vulnerability analysis (IMF, 2001). IMF's initial list of MPIs has three main

groups—aggregated micro prudential indicators, macroeconomic indicators and market-based indicators—to reflect the health of financial institutions and the broader extent of systemic soundness of the financial system. This paper attempts to propose a new leading macro prudential indicator (MPI) for monitoring vulnerability of financial markets. The indicator we estimate is an aggregated ratio could belong to the first group (Bhattacharyay, 2003).

IMF's aggregated micro prudential indicators are not perfect mainly because the relevance of individual indicators may vary from country to country. Indeed, MPIs cannot be used mechanically due to differences in each country practices. Despite this limitation, aggregated micro prudential indicators can be useful tools at a national level.

Prudential regulation and supervision should not focus only on commercial banks, but it should encompass all potential systemic institutions as well as nonbank depository corporations and non depository financial intermediaries. The current crisis corroborates this point. Therefore, prudential regulation has to be reconsidered to impose SIVs and hedge funds a minimal information disclosure. Consequently, prudential regulation has to be extended to all the financial system participants. This change is crucial to protect the financial system.

In order to limit the occurrence of systemic crisis, we construct a leverage indicator, the Aggregated Leverage Ratio (ALR) compounded of commercial and investment banks leverage. The formula used in our paper to estimate aggregated leverage is the ratio of total assets to total equity (total assets / total equity capital). So we are in line with a prudential regulation approach where equity is the pivot variable (Adrian T. and Shin H. S., 2008). However we will not integrate hedge funds and SIVs in our calculations for many reasons. The estimation of hedge funds' leverage is usually done through an approach based on their various strategies. This methodology can't directly be compared with our approach more based on the institutions' balance sheets (Blundell Wignall A., 2007). Moreover, data on hedge funds' equity and assets are not fully available. As far as SIVs are concerned, it is the lack of transparency inherent to these vehicles which don't allow us to obtain the required information for the calculation of global leverage. Indeed, we think that it could be a good indicator of credit boom.

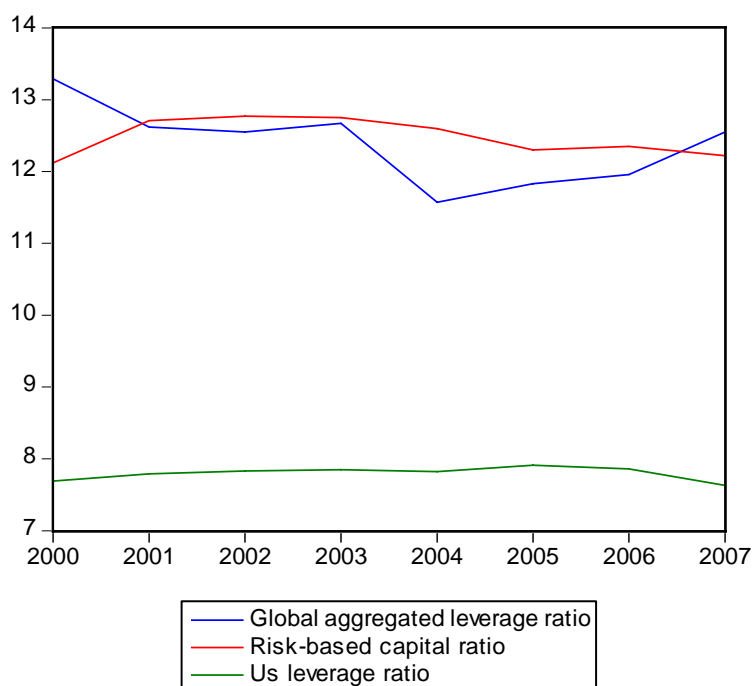
As investment banks as an individual entity almost exist in the United States (except for the case of UBS and Deutschebank in Europe), we choose to focus on U.S. financial institutions. Indeed, in Europe investment banks are included in more important structures : universal banks.

We use two distinct statistical sources for commercial and investment banks over the time period 1994-2008. We begin in 1994 because the FDIC quarterly banking profiles are fully available only since 1994. For commercial banks we use the aggregated quarterly data produced by the FDIC *Quarterly Banking Profile* (equity capital, assets, risk based ratio, leverage ratio). As far as investment banks are concerned, we sum the equity and then the assets of four of the biggest investment banks (Bear Stearns, Morgan Stanley, Merrill Lynch and Lehman Brothers) to obtain aggregated data. It is commonly admitted that the addition of these investment banks gives us a representative picture of investment banks' industry because they represent more than 70% of this industry. The data used are taken from the banks' annual reports. We use 10-Q form reports from the SEC.

### ***Graphic Analysis***

If the ALR is a good indicator of excessive leverage and consequently of a loss of control of indebtedness, we should find a growth of ALR that is to say a higher rise of assets than equity capital over the period 2000-2007. Over the period 2000-2007, GALR decreased around 5.6%. We can distinguish two phases: a downturn from 2000 to 2004 and upturn until 2007. It accounts about 13.29 in 2000, 11.57 in 2004 and 12.55 in 2007 (see graph 4). The level of the global leverage ratio isn't as high as we have thought. This can be explained by the fact that our ratio doesn't take into account off balance sheet activity due to the lack of data. Indeed, we know that contrary to the previous years the leverage used by institution is mainly the one stemming from securitised products.

Graph 4: Evolution of Risk-based capital ratio, US leverage ratio and Global Aggregated Leverage Ratio<sup>8</sup> over the 2000-2007 periods.

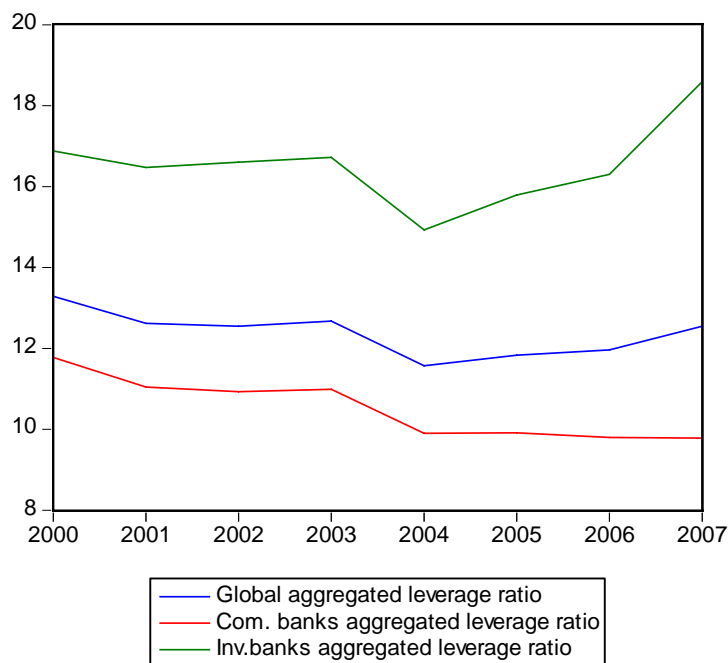


Source: authors' calculations

Investment banks aggregated leverage ratio was around 16.88 in 2000, around 14.93 in 2004, and around 18.59 in 2007. Concerning commercial banks, it was respectively around 11.78, 9.90 and 9.78. We observe an increase of commercial banks and investment banks aggregated leverage ratio. But this increase hides disparity between these financial institutions. Investment banks aggregated leverage ratio is twice higher than the one of commercial banks (see graph 5). Moreover, over the given period, investment bank aggregated leverage ratio is always higher than the commercial bank one. We can explain the difference between commercial and investments banks aggregated leverage ratio by the fact that commercial banks have a stricter regulation. This regulatory framework incites them to use SIVs. This result points out the need to take into account the other major non regulated financial institutions. Hence the ALR is a relevant tool for supervisors.

<sup>8</sup>In graphs 4 and 5, Global Aggregated Leverage Ratio corresponds to the Aggregated Leverage Ratio (ALR) we have constructed.

Graph 5: Evolution of commercial banks and investment banks aggregated leverage ratio and Global Aggregated Leverage Ratio (2000-2007)

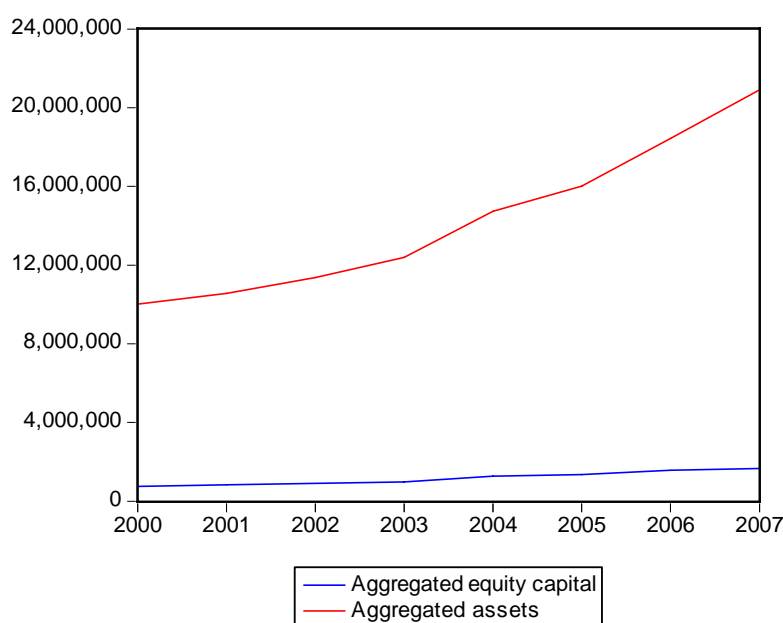


Source: authors' calculations

From 2000 to 2004 global equity capital increase around 68.9% and global assets increase around 47%. So over this period, the decrease of the global leverage ratio that we notice almost each year can be explained by a higher growth of global equities comparatively to the growth of global assets. From 2004 to 2007 global equities increase around 30.9% and global assets increase around 41.9%. Since 2004 the growth of the global leverage ratio can contrary to the previous period be explained by a higher growth of global assets comparatively to the global equities' one (see graph 6). These results are consistent with Kindleberger's description of the financial cycles' phases. In this description he explains that when the downturn phase occurs we can observe a reversal in banks behaviour. This trend confirms the change of banking funding structure in general and the one of commercial bank in particular. Banks use less and less their deposits and more and more market short term funding.



Graph 6: Evolution of aggregated<sup>9</sup> equity capital and aggregated assets (2000-2007)



Source: authors' calculations

After the graphic analysis of the aggregate leverage ratio, we observe the deviations of credit series from their long-term trend in order to identify boom credit periods. The indicators we consider in our study are the credit/GDP ratio (current credit indicator) and the ALR. This part of the paper is in line with the papers written by the IMF (2004), by Sa (2006) and more recently by Coudert and Pouvelle (2008) and Mendoza and Terrones (2008). This will allow us to demonstrate that ALR detects the same boom credit periods in the US economy than the traditional credit boom indicator (Credit/GDP). This part of the paper leans on theories in which excessive credit expansion is due to herding behaviour by banks (Kindleberger, 2000). Worst loans are granted at the peak of the financial cycle (Greenspan, 2001) that is to say that systemic risk is in reality built up during boom periods (Borio and Lowe, 2001 and, Borio and al, 2001).

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<sup>9</sup> Here we aggregate on the one hand commercial and investment banks equity capital and on the other hand their assets.

We estimate the indicators' long-term trend using a Hodrick-Prescott filter and then, we calculate the deviation of the indicators' value from their long-term trend. We have chosen  $\lambda=1600$  as is typical for quarterly data. To define the threshold, we choose to use the approach which calculates the threshold by constructing an interval proportional to the standard deviation around the trend ( $1.75\sigma$ ). Finally, we compare the deviation from the long-term trend to the threshold to identify boom credit periods. Whether the spread between the credit indicator and its long term trend is positive, we can conclude that there is a credit boom period. Table 3 shows that ALR and credit/GDP ratio reveal the same boom credit periods.

Table 3: Identification of credit booms period

Credit/GDP (from Q2 1999 to Q1 2008)	ARL (from Q2 1999 to Q1 2008)
Q4 1999 TO Q3 2000	Q3 1999 TO Q2 2000
4 2001 TO Q1 2002	Q2 2002
Q4 2003 TO Q2 2004	Q3 2003
Q4 2004 TO Q1 2006	Q3 2005
Q4 2006 TO Q4 2007	Q1 2006 TO Q2 2006
	Q2 2007 TO Q1 2008

Source: authors' calculations

We can express two main criticisms. The first one is linked to the choice of the calculation method. Calculation using a Hodrick-Prescott filter often lacks of robustness mainly when the series used are short. This is the case in our analysis for technical reasons (Coudert, Pouvelle, 2008, and Banque de France, 2002). The second criticism is related to the fact that a purely statistical approach to estimate the relevance of an indicator can't be enough. It is necessary to complete this analysis with an econometrical approach.

### **Econometrical analysis**

In this part of the paper, we try to confirm our previous findings with an econometrical analysis. There are several studies on macroeconomic analysis of systemic banking crisis. Early warnings systems (EWS) which have been developed to allow banking crisis prediction belong to this

literature. We can distinguish two main approaches for EWS: signal extraction approach (Kaminsky and Reinhart, 1999, Kaminsky, 1998, Borio and Lowe, 2002, Borio and Drehmamm, 2009) and multivariate logit approach (Demirgüt-Kunt, Detragiache, 1998,1999,2005). We perform a logit regression in line with these last studies.

In logit regressions, the dependent variable is qualitative and takes two values 0 or 1 according to the occurrence of a specific event. Contrary to the previous papers, we do not choose systemic banking crisis as event but stress period in the financial system. This choice is explained by the fact that, over our time horizon (1994-2008), there is only one systemic banking crisis in the United States (2007). Even if our time period excludes the 1980's US banking crisis, financial system often undergo weaknesses which may threat financial system soundness.

To create our dependent variable, we use the finding of Kindleberger (2000) and Borio and alii (2001) which establish the increase of excessive optimism in the pre-period banking crisis which leads to a high credit supply and then an increasing risk taking.

That is why we construct a stress index combining two variables: non performing loan to gross loans ratio and domestic credit to GDP ratio. We compute our stress index according the following formula (Hanschel and Monnin, 2008):

$$I_t = \sum_{i=1, \dots, k} (X_{t,i} - M_i) / \sigma_i$$

where  $k$  is the number of variables in the index,  $M_i$  is the mean of the variable  $X_i$  and  $\sigma_i$  its standard deviation.

We identify four stress periods which match to identified periods (in the literature) of high stress in US financial system: from Q3 1994 to Q4 1994, from Q1 2000 to Q4 2000, from Q1 2002 to Q4 2004, from Q3 2006 to Q1 2008. The stress in 1994 corresponds to the end of the US banking crisis which began in the 1980's. The year 2000 was stressful because of the dot.com crisis. The last interval Q3 2006 to Q1 2008 corresponds to the current financial crisis

In most EWS studies, the explanatory variables used to predict systemic banking crisis are mainly macroeconomic and financial variables. In our model, we use the same kind of independent variables. As far macroeconomics variables are concerned, we choose the real interest rate (R),

inflation rate (I), real GDP growth rate (CGPG), fiscal surplus (FS) and M2/reserve ratio (M2R) (Demirgüt-Kunt, Detragiache 1998, 1999). Concerning financial variables, we select CAMELS<sup>10</sup> variables to take into account the change in banking activities and structure (Bhattacharyay, 2003). These variables are liquidity ratio (LR), housing price index<sup>11</sup> (HPI) and our aggregated leverage ratio (ALR). Moreover, we use three more variables: credit growth rate (CG), risk based capital ratio (RBCR) and commercial bank leverage ratio (CBLR). The data we use are taken from IMF international statistics except for liquidity ratio and RBCR (*FDIC historical and quarterly banking data*)

On the one hand, we compare the ALR with RBCR and CG. These last ones are generally considered as the traditional excessive credit indicators. Moreover RBCR is currently the main banking supervisory tool. The aim is to confirm ALR as a relevant variable to explain stress periods and to demonstrate that it is a better indicator than CG and RBCR to detect indebtedness loss of control.

Table 4: Logit estimates, excessive credit indicator (estimation period: 1994-2008)

	Model (1)	Model (2)	Model(3)	Model (4)
	de base	ARL	CG	RBCR
GDGP (-1)	-0.2639*	-0.3494**	-0.4836	-0.3082*
R	0.0794	-1.1032**	0.2651	0.7519
I	-0.4291	-0.04848	-0.3799	-0.2818
FS	-64.9965	-52.5403	-149.1197*	-53.6182
M2R	-0.5697	-0.5169	-1.5927	-1.2839
LR	0.6577***	0.5021*	0.8502**	0.9879***
HPI	-0.1206**	0.092	-0.1629**	-0.1836***
ALR		9.3056***		
CG			-0.609***	
RBCR				4.4665*
CBLR				
C	-7.3395	-137.6641***	-0.6379	-65.5577*
Mc Fadden R <sup>2</sup>	0.3275	0.5042	0.4947	0.3683
Crisis corrected predicted (%)		80.95	76.19	71.43

<sup>10</sup> CAMELS : Capital, Asset quality, Management, Earnings, Liquidity, Sensitivity

<sup>11</sup> Case-Shiller Home Price Indices

False alarms (%)	19.05	23.81	28.57
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We observe that there is a positive and significant relationship between financial institutions leverage (ALR) and the probability of the occurrence of stress periods. One explanation of the strongly significance of the ALR may be that when financial institutions rise their market short term funding, they bear an increasing liquidity and counterparty risk. In case of liquidity freeze, they cannot refund themselves anymore. Then the crisis quickly spreads to the whole financial system. Introducing a variable which illustrates excessive indebtedness provides useful information because  $R^2$  of models (1) (2) (3) is always better than the base model. According to  $R^2$  criteria, the ALR seems to be the best expression of bank excessive credit supply (0.504 against 0.494 for CG and 0.368 for RBCR).

This result is confirmed with the false alarm criteria. Indeed, the model (2) yields a good ratio of correct predictions: more than 80% of crises are correctly predicted against 76.19% for the model (3) and 71.43 for model (4) (see table 4).

On the other hand, we compare the commercial bank leverage ratio (CBLR) to the ALR which is compounded of investment and commercial bank leverage ratio to demonstrate that a global leverage which integrate most of leverage financial institutions give a better excessive credit signal.

Table 5: Logit estimates, leverage indicators (estimation period: 1994-2008)

	Model (1)	Model (2)	Model (5)
	de base	ARL	CBLR
GDPG (-1)	-0.2639*	-0.3494**	-0.2866
R	0.0794	-1.1032**	-0.3709
I	-0.4291	-0.04848	-2.7085
FS	-64.9965	-52.5403	-60.5526
M2R	-0.5697	0	0.1172
LR	0.6577***	0.5021*	0.8753***
HPI	-0.1206**	0,092	0.0021
ALR		9.3056***	
CBLR			6.7895***
C	-7.3395	-137.6641	-109.7533***
Mc Fadden $R^2$	0,3275	0.5042	0.4702

Crisis corrected		80.95	70.67
predicted (%)			
False alarms (%)		19.05	29.33

We observe that there is also a positive and significant relationship between commercial bank leverage (CBLR) and the probability of the occurrence of stress periods. ALR outperforms CBLR in terms of  $R^2$  (0.504 against 0.47). It means that leverage is a better indicator when it takes into account the more financial institutions as possible like investment banks (SIVs and hedge funds when it is possible). This result is confirmed with the false alarm criteria. Indeed, the model (2) yields a good ratio of correct predictions: more than 80% of crises are correctly predicted against 76.19% for the model (5) (see table 5).

Lastly, we test the predictive power of the ALR over one and two year horizons to show that it is a leading indicator for the detection of stress periods and then it could be integrated into macro-prudential tools.

Table 6: Logit estimates, ALR predictive power (estimation period: 1994-2008)

	Model (1)	Model (2)
	de base	ARL
Mc Fadden $R^2$ (1Y)		0.208
Crisis corrected		60
predicted 1 year (%)		
False alarms		40
1 year (%)		
Mc Fadden $R^2$ (2Y)		0.2648
crisis corrected		60
predicted 2 years (%)		
False alarms		40
2 years (%)		

Over one year and two year horizons, ALR seems to predict correctly stress periods (60% of tension periods corrected predicted and 40% of false alarms for the two time horizons). That is why we can conclude that the ALR may be a good leading indicator of the build up of financial vulnerabilities.

This result confirms our intuition that is to say ALR may be a useful complementary indicator to signal the need for supervisory action despite it is a simple ratio. In addition of its simplicity, it is costless to compute and consequently easy to implement.

## **Conclusion**

This paper attempts to propose a leading macro prudential indicator (MPI) for monitoring vulnerability of financial markets.

The empirical analysis demonstrates that the level of the ALR isn't as high as we have thought. This can be explained by the fact that our ratio doesn't take into account off balance sheet activity due to the lack of data. Indeed, we know that contrary to the previous years the leverage used by institution is mainly the one stemming from securitised products. These results are consistent with Kindleberger's description of the financial cycles' phases.

Moreover, we show that over the given period, investment bank aggregated leverage ratio is always higher than the commercial bank one. We can explain the difference between commercial and investments banks ALR by the fact that commercial banks have a stricter regulation. This result points out the need for integrating the other major non regulated financial institutions. Hence the ALR is a relevant indicator for supervisors.

The statistical analysis reveals that the ALR and the credit/GDP ratio are good indicators to detect boom credit periods. If regulatory authorities accept to introduce ALR, it will allow them to enlarge their global view and not to only focus on equity that is to say on regulatory capital ratios. They will be able better anticipate systemic risk and give a timely response.

In order to demonstrate that the ALR is a good leading indicator for supervisors to detect excessive credit in the economy, we perform a logit regression over 1994-2008 periods in line with EWS second main approach, the discrete dependent variable. Contrary to the previous papers, we do not choose systemic banking crisis as event but stress period in financial system. In our model, we use macroeconomic and financial as independent variables.

We observe that there is a positive and significant relationship between financial institutions leverage (ALR) and the probability of the occurrence of stress periods. According to the  $R^2$  and the false alarm

criteria criteria, the ALR seems to be the best expression of bank excessive credit supply in comparison with credit growth and risk based capital ratio.

Another main result is that leverage is a better indicator when it takes into account the more financial institutions as possible like investment banks (SIVs and hedge funds when it is possible). Hence there is a need for the extension of prudential regulation to all firms or entities conducting financial activities of a potentially systemic nature, even if they have no direct dealings with the public at large

Lastly, ALR seems to predict correctly stress periods over one year and two year horizons. That is why we can conclude that the ALR may be a good leading indicator of the build up of financial vulnerabilities. This result confirms our intuition that is to say ALR may be a useful complementary indicator to signal the need for supervisory action despite it is a simple ratio. In addition of its simplicity, it is costless to compute and consequently easy to implement.

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