Lessons from the Global Financial Crisis

1. Introduction

In this web chapter we focus on the financial crisis and the rich lessons that can be drawn from it with special emphasis on making contact with the material in IFT. The Global Financial Crisis (GFC) indisputably started as a good old real estate crisis in the US, but this national problem rapidly took a global character, from which it received its name, and then morphed into a European public debt crisis. In this chapter we will try to explain the three elements in this development by asking first what makes the real estate sector so vulnerable and crisis-prone (Section 2), then what made the US real estate crisis an international occurrence (Section 3) and finally by what mechanism or chain of events did this international financial crisis develop into a deep economic crisis in Europe, one that is typically – but partly incorrectly as we will see –identified as a pure public debt problem. After having covered these 3 questions we will ask why banks chose to be so fragile in the first place and why regulators accepted this state of affairs. While we will place the bulk of the responsibility on a question of poorly structured incentives, we will also assign some of the blame to a deficient regulatory framework resulting in the world's regulators accepting (largely unknowingly) an extreme level of bank fragility.

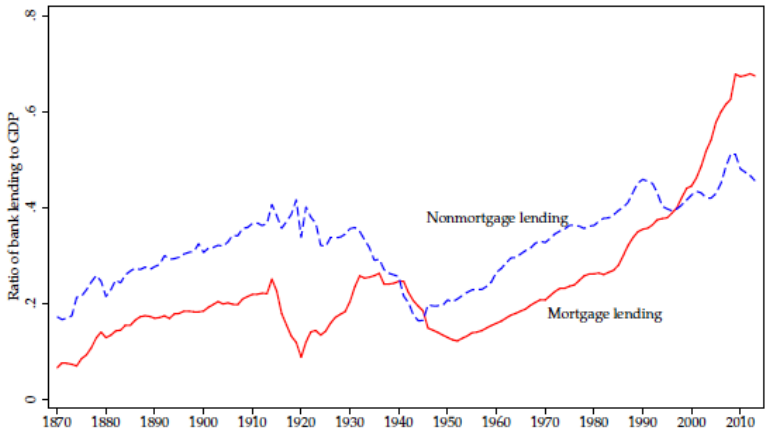
2. What makes the real estate sector so vulnerable and crisis-prone?

The critical element of the real estate sector is that it is always associated with **high leverage** and, possibly even more important, a bubbly real estate sector seems always to be associated with an **increasing degree of leverage**. Everywhere in the developed world housing purchases are predominantly financed by borrowing and the leverage level typically considered prudentially reasonable, even though it is often exceeded, is 4 to 1, that is, a loan- to- value ratio of 80%. Viewed through the lens of what is typical of other economic sectors (The mean leverage level for the US corporate sector is closer to 50%), this is a very high leverage level indeed. The effective leverage at the height of a boom is often even larger. Nominal loan-to-value (LTV) ratios in excess of 100% are not at all uncommon. As a

matter of fact, 100% LTV ratios corresponded to prudential norms in some advanced countries such as the Netherlands before the crisis. Moreover, in a bubble, prices are inflated beyond realistic values; the effective LTV ratio computed with realistic values (smaller V) are systematically very much higher; this compounds the outstanding risk.

Why is such a degree of leverage viewed as acceptable in the housing arena while it would be considered unimaginable in other sectors? This is likely because investment in housing is **deceptively plain** and, moreover, it is **collateralized**. Credit is backed by the value of the object being purchased which functions as collateral. In times of rising house values – a movement that very easily appears 'normal' - mortgage lending looks extraordinarily safe. The potential inability of the debtor to service her debt would lead the creditor into taking possession of an object whose sale would easily cover the extended credit.[1]

Figure 1: The growth of mortgage lending in advanced economies



Note: Mortgage and Nonmortgage lending as a ratio to GDP, averaged over 17 advanced countries. Mortgage lending is to households and firms. Nonmortgage lending is unsecured lending primarily to businesses.

Source: Jorda, Schularick and Taylor (2016)

A third characteristic of the real estate sector is the **social and public policy value of home ownership**. In many advanced countries home ownership is seen as a socially desirable "good" to be encouraged and promoted by public policy measures, be they in the form of

[1] The common practice (in the US) of periodically increasing the loan size when the collateral value increases absorbs part of this extra cushion, however!

interest mortgage deductibility (very pervasive) or loan guarantees issued by semi-public entities (Fannie and Freddie in the US). To some extent this feature may even lead to prudential measures being rejected as being asocial, and the growth in mortgage volumes being a source of public pride. In this context the extraordinary growth of the mortgage credit to GDP ratios in most advanced economies in the last 40 years is worth noting (Figure 1). The explosion of mortgage credit explains most of the growth of credit-to-GDP ratios over this period. On average across advanced economies private-sector debt increased from 50% of national income in 1950 to 170% in 2006 (see Reinhart and Rogoff, 2013). It also explains a significant portion of the simultaneous increase in the size of the financial sector relative to GDP. See Greenwood and Scharfstein (2013) for a more complete description and discussion.

The mechanism behind a real estate bubble is well understood and can easily be described. At its heart is the fact that in an up-cycle- which may initially be built upon valid fundamentals such as a demographic expansion linked to immigration (see, for example, Santos (2014), Section 2, for a discussion of the possible initial causes of the recent Spanish real estate bubble), there is nothing as easy and tempting as a mortgage loan. When house prices are rising, the mortgage credit is always and easily covered by the resale value of the collateral, should the debtor fail to honor her debt. And defaults are rare anyway because the credit holder has herself the option to sell with no loss. Banks make a good return on maturity transformation (that is, on financing long maturity loans with client's deposit or short term borrowing on the money markets), delinquencies are rare, increased credit volumes can compensate for lower margins in periods of low interest rates or generate rising profits otherwise, expectations of rising prices are realized, those engaging in a rational long run comparison between the cost of renting and the cost of buying are left behind and feeling stupid, and prudent lending practices progressively look excessively conservative. For example, an 80% loan-to-value ratio justified by 20% protection against a fall in value looks excessive if "prices never fall" and exceptions to a prudent policy that take advantage of business opportunities are increasingly frequent.

Of course all this is fine only as long as prices keep rising. Once doubts on the state of the market or outside factors such as a recession or an increase in interest rates interrupt the movement, the situation turns out to be very fragile. Price stabilizations at high levels are

rare; upswings are more often than not followed by periods of falling prices where all assumptions made during the price rise are falsified. Debtors are led to default either because of falling income (unemployment is often the main culprit) or because of rising debt service (resulting from increases in interest rates) or both. Creditors incur losses that rapidly threaten the financial health of the less well capitalized. Fire sales depress prices and reinforce the vicious cycle as asset holders in difficulty because of falling prices are forced to sell, thus fueling further downward pressure on prices.

This description is generic. The last US real estate crisis was compounded by at least two additional factors: Securitization and financial innovation.

The practice of **securitization** is not new. It is not a necessary condition for a fragile real estate market (witness the fact that it is much less common in Europe where, nevertheless, real estate crises have been as frequent and severe as in the US). But it may make a given market more vulnerable for at least two reasons. The first is that securitization makes it possible for international investors to participate in a booming real estate market. This is particularly relevant in the case of the US market because of its size and because the attractiveness of the dollar as a reserve and investing currency may (and did) make US real estate a relevant and attractive asset class for investors throughout the world. One of the consequences of this fact is that the supply of credit became practically limitless, fueling market growth and further pushing up prices. Another is that securitization led to an international sharing of the associated risks, and thus introduced an international element of fragility. This will be part of the answer to the question raised in the next section: what made the US real estate crisis an international occurrence?

The second reason why securitization exacerbates the fragility of real estate sector is that incentives are destroyed when the issuers of the securitized mortgage do not retain enough "skin in the game". Indeed, after a mortgage-backed security has been issued and placed in the market, the consequences of a borrower's default are no longer borne by the mortgage issuer. This greatly diminishes the incentive of the issuer to be prudent when issuing the credit and honest when describing the associated risk, i.e., when recording and describing the mortgage-holder's characteristics, and it further eliminates the incentive to monitor the

compliance of the borrower with the terms of the contract. Conclusive evidence on the impact of these decreased incentives is provided by Keys et al. (2010).

The **financial innovation** of the last decade has compounded the problem. On the face of it, financial innovation has made it possible to distribute risks more widely among the various classes of risk takers. I.e., by slicing the risks associated with a mortgage portfolio into various tranches, whose risk levels were measured by official ratings, it has allowed a broader and theoretically better market participation. In the process, however, exuberance (led by an excessively short experience of very low delinquency rates) and over-confidence (in the ability to precisely identify and measure the corresponding risk levels), if not concealment or outright fraud (the readiness to sell as "safe" some opaquely packaged asset that one knew or should have known to be very risky) have transformed the theoretical construct into an extremely fragile house of cards.

How do these first observations on the GFC relate to the material in the book?

First, they directly relate and complete, as the next two sections will as well, our discussion in Section 1.7 on Financial Crises. More importantly, they provide a concrete illustration of the potential impact of behavioral deviations from perfect rationality as introduced in Section 3.7 on Behavioral Finance. There are likely elements of herding – the same sort of behavior that underlies the momentum effect alluded to in Section 3.7.3 and underlying the portfolio construction in Section 14.6.2 of the book – in a real estate bubble; there are also probable manifestations of overconfidence, a behavioral trait also mentioned in Section 3.7.3. (and more generally but in the same spirit, an underestimation of the probability of bad future scenarios – "this time is different" - and its impact on the ability to service one's mortgage debt). But one should not put all the weight on mistakes for two reasons. First, because some types of asset price bubbles is consistent with rationality as demonstrated by Tirole (1982). Here, however, we have to introduce the possibility of multiple equilibria in models of the world where expectations play an important role. (This is discussed in Web Chapter C). Second, because, as already suggested, the real estate and credit markets are also affected by all sorts of frictions and distortions that are not present in the theoretical models reported in the text but are nevertheless very important in understanding reality. Here we mean not only those non-market elements such as taxes and tax deductibility of

interest payments which very significantly impact behavior – the only tax issues we have dealt with was in our discussion of the Modigliani-Miller Theorem, but also other policy measures encouraging home ownership such as the mortgage guarantees provided by Fannie et Freddie. These are important illustrations of the need to complete our vision of the work of markets – on which we focus on in the text – with "real life" features that may sometime override the rational decision making that we model. Another important departure from pure rationality comes from the credit supply side and it relates to the (distorted) incentives of bankers to manage their risks prudently. We tackle this issue in Section 5 of the present Web Chapter.

Finally, but not exhaustively, the notion of real estate bubble does put into question the efficient market hypothesis of Section 18.5. Indeed, it is common to hear that the GFC constitutes proof that financial markets are not efficient and thus falsifies the efficient market hypothesis (EMH), one of the pillars of modern financial theory since the 1970's. We cannot exhaust this big topic here but will be content to make the following observations. First the status of the EMH in financial theory was much less dominant than typically represented in non-academic circles. This is well illustrated by our discussion of the empirical tests of the CAPM in Section 8.9. Second, there are different levels of informational efficiency (as succinctly described in Section 18.5), not all of which are equally challenged by the occurrence of an asset price crash. Thus an asset market crash goes against the notion that today's price always reflects all the publicly available information (as is the case in the model of Section 18.3) because it is often not plausible to relate the sudden fall in the asset price to the arrival of a specific piece of information. It is more plausible to think that there exist episodes where market participants, acting as a 'herd', narrow in on extraordinarily high values for an asset that are only justified by the belief that the price will keep on rising and that, in this process, the asset price can temporarily but significantly deviate from what is justified by the underlying fundamentals. Even in those circumstances, however, a central tenet of the EMH, that it is impossible to consistently and significantly "beat the market" on the basis of non-privately held information, remains plausible as attested to by a wealth of studies on the performance of asset managers. (But recall our discussion of the forecastability of returns at long horizons in Sections 7.3 and 7.5). Finally, as already

asserted, rational bubbles are not impossible, that is, bubbles that are fully compatible with the rational expectations (and thus in a given sense, the efficient market) hypothesis.

3. What made the US real estate crisis an international occurrence?

A real estate crisis is painful for mortgage borrowers many of whom lose their hope of becoming home-owners. It has also a deep impact on mortgage lenders often leading to a very significant restructuring of the banking sector. As an example, the real estate crisis of the 1990's in Switzerland, a purely local event, led to the disappearance of almost one third of the pre-existing banking institutions.

In the case of the US real estate crisis, the fact that international financial institutions participated in the lending that subsequently turned sour provides a first channel of international crisis transmission. This channel is largely the outcome of the securitization process which enabled financial institutions across the world to bear some of the risk of the US real estate market. They thus shared in the losses when things turned bad. Notably, European institutions of various size and reach had taken on board, sometimes massively, American mortgage- backed securities which generated substantial losses, thereby weakening these institutions in some cases to the point where public authorities were forced to come to the rescue. The salvage of UBS by the Swiss Confederation and the Swiss National Bank (SNB) is a case in point. In the same way that a banking industry weakened by local real estate related losses may start being restrictive in its lending, potentially initiating a local credit crunch, international banks weakened by US real estate related losses started being more restrictive in their local lending, with the same macroeconomic consequences in those instances where their market share was large. There is indeed evidence that the massive exposure of Irish banks to the US mortgage-backed securities and the related losses significantly affected their local lending capacity, thus precipitating or at least aggravating, the real estate crisis in Ireland. This illustrates one particular mechanism through which a local real estate crisis can have an international impact with potentially devastating consequences. See Section 4 for a complementary discussion of the Irish real estate crisis.

But the reality of the last GFC is that the international link was even broader and deadlier. The core of the transmission mechanism was located in the money markets on which international banks had been increasingly relying to fund themselves. What happened can

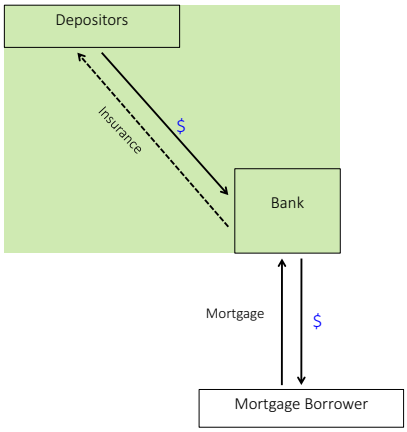
be seen as a bank run. In the traditional bank run, depositors run on the bank (withdraw their deposits en masse) out of fear for the solvency of the institution at which they have deposited their money. In so doing they precipitate the very event they sought to avoid. In the modern world of international banking, institutions that have loaned money, often for the very short term, to other international institutions start to be more cautious and stop rolling over their loans and/or increase the haircut imposed on the collateral provided.[2] With international banks financing themselves massively in the short-run interbank market, this change in behavior may correspond – and did so in the days post-Lehman - to a massive withdrawal of funds affecting most, if not all, institutions. These withdrawals can take the form of a vicious cycle by which the protective action taken by individual lenders – to stop lending and/or to sell assets to protect their balance sheets – worsens the situation of other lenders – who are cut off from their short term funding and/or see their assets losing value - leaving unscathed only those with sufficient holdings of the very best collateral (typically US or AAA state Treasuries). This process is described in detail in Gorton (2009) and Gorton and Metrick (2012) who come up with a back-of-the envelope estimate of the amounts involved: "If repo haircuts increase to an average of 20%, then between $1.6 and $2 trillion must be raised by the banking system". Banks throughout the world were affected. Some failed (Northern Rock), others had to be saved by their respective authorities (UBS, Lloyds, RBS, and many more), and deposit insurance guarantees had to be increased in many jurisdictions to avoid more traditional bank runs. Some financial institutions collapsed (Lehman Brothers). Most importantly, the overall weakening of the banks drastically affected their capacity to lend thereby generating a global credit crunch. Together with very pessimistic (endogenous) reevaluations of economic future prospects, we have here the main explanation for the unprecedented (since the Great depression) fall in economic activity that followed the demise of Lehman Brothers[3].

[2] Most interbank lending occurs in the form of secured loans often in the form of repurchase agreement or repo, a contract by which a party transfers an asset (the collateral) in exchange for cash (the loan) with the commitment to repurchase the same asset at a fixed maturity and a fixed price (which takes account of the agreed interest). The cash transfer includes a haircut taking account of the price risk of the collateral, i.e., the possibility that the resale value of the collateral decreases over the course of the contract.

[3] We are also at the heart of the Too Big To Fail issue: letting fail 'systemic institutions' would have a strong negative impact on real markets, i.e., on the consumption and investment decisions of large numbers of

The massive withdrawal of liquidity that we have described amounted to a giant monetary shock in the face of which central banks could not remain inactive. This implication of the lender of last resort function of central banks was a well-understood lesson of the Great Depression. The reaction took place in the days and weeks that followed the fall of Lehman. It took the form of unusually large declines in interest rates – which were driven almost everywhere close to or at zero – as well as a massive provision of liquidity by the major central banks of the world. The dollar funding market being the most affected, the Fed was led to propose the establishment of a network of swap agreements with major central banks permitting the distribution of dollars under the responsibility of the latter in their own markets. Similar agreements were concluded by the ECB to improve the euro funding situation in the euro-area and by the SNB wishing to avoid the negative consequences of a potential shortage of CHF in Central European economies where borrowing in CHF had been prevalent before the crisis.

Figure 2: The bank of the past

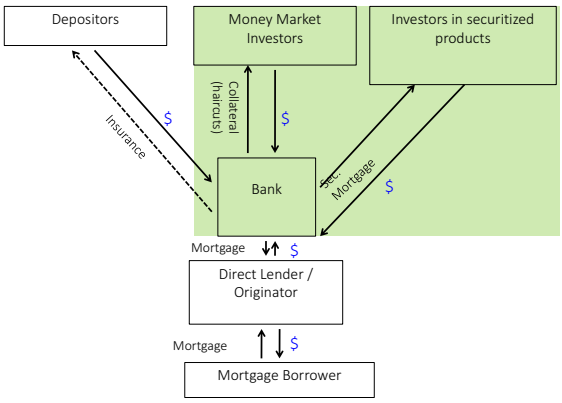


The episode just described is an essential element of the GFC. It was also unprecedented being the consequence of a recent (post-1980) movement of financial globalization. The

individuals and firms cut off from accessing their bank accounts or credit lines, with strong recessionary or depressionary tendencies. As a consequence, these big financial institutions must be rescued; they are TBTF.

(misunderstood) fragility of this new global financial system also played an important role. We return to this issue later on.

Figure 3. The Bank of today



At this stage we have a very clear answer to the question in this Section's title. The global dimension of the financial system, in particular of the international funding of large banks, fully explains how the initial shock registered first in the US real estate sector was propagated worldwide. Figures 2 and 3 illustrate an important observation that can be made on the basis of this discussion in relation to the main text. It concerns the conception one may have of what a bank is and what it does. A bank is typically viewed as an institution that takes deposits from retail clients and lends the proceeds to commercial borrowers. Remember our Chapter 1 description of the function of the financial system being to channel the savings of consumers to entrepreneurs with investment opportunities. The reality of modern banking appears to be significantly different. On the liability side, many banks (but not all) today are primarily funded through the interbank and money markets, leading, as we have pointed out, in their being exposed less to traditional bank runs than to the fragility of the interbank market.[4] The second major difference, alluded to in Section 2, is that for many banks, the dominant target of lending today is the real estate sector either directly via mortgage loans or indirectly via mortgage backed securities. This recent feature certainly justifies a revisiting of the value added by the banking sector, the function of lending for real

[4] In addition, in most jurisdictions, a form of deposit insurance protects deposit-taking institutions against bank runs.

estate having very different implications for the growth of the real economy than those of lending to entrepreneurs to finance TFP enhancing productive investments.

This note complements Section 2.7 (Banks) of the Text. Other connections with the text are not obvious, because the institution of a bank has typically not taken a large place in standard financial theory, that focuses more on markets than on specific institutions of intermediation.

4. **What is the link between the US real estate crisis, the GFC and the European public debt crisis?**

The third leg of our set of questions is of interest because it can be argued that the GFC would have been limited to a very severe but short crisis episode had it not been followed by very significant developments taking place in the Eurozone starting with Greece in the fall of 2009, a time when world markets were recovering and strongly so in certain parts of the world (notably in emerging markets).

A first element of the response is that the credit crunch we described in the previous section, and the resulting weakening of the global economy, could not in Europe be countered with an adequate policy response: the fiscal capacity was too limited when the crisis started to unfold and was perceived to have been fully exhausted by the required support to the banking sector. A second element is that the debt run-up before the crisis had extended much beyond the public sector as a result of very large and asymmetric cross-country capital flows within the Eurozone. The crisis manifested itself as a sudden stop to these developments.

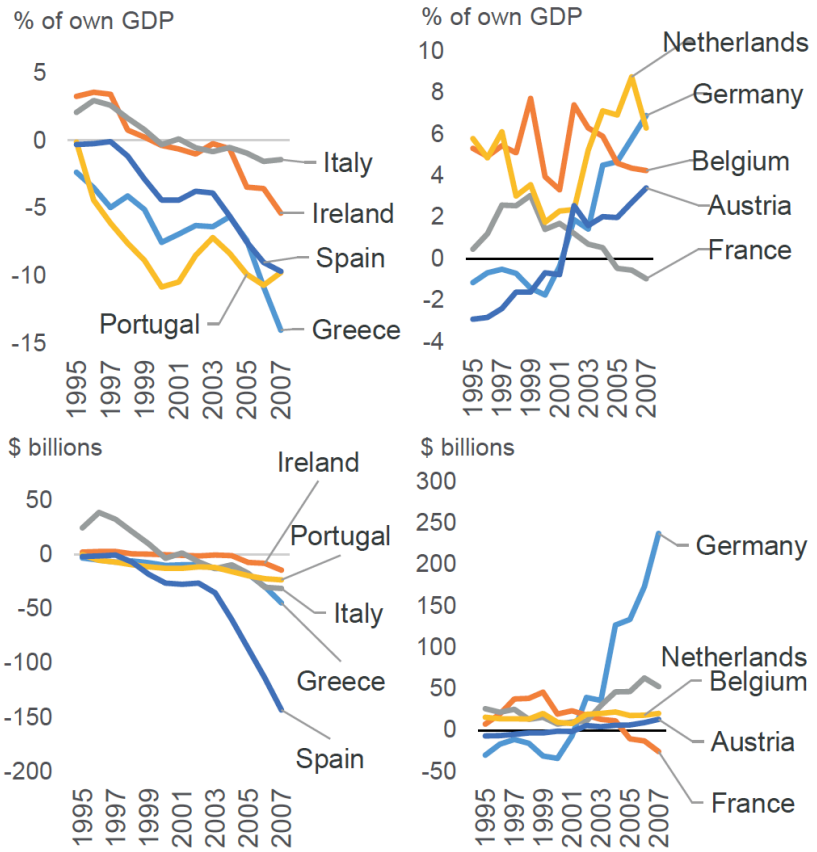
Let us develop these two points. The Maastricht Treaty of the European monetary union had anticipated that a monetary union among countries that retained full fiscal autonomy could turn sour unless some mechanism ensuring fiscal discipline was introduced. Accordingly, the Treaty proposed to limit budget deficits to no more than 3% of GDP and to constrain debt-to-GDP ratios below 60%. Penalties were foreseen in case of violation but the penalty mechanism was very weak and prone to be viewed as an infringement of the sacred national sovereignty of the participating countries. Moreover, the mechanism lost all credibility when the largest members, France and Germany, failed to respect the criteria without being

subject to the foreseen penalties. In the meantime, the upper-limits to the debt and deficit ratios appear to have been increasingly viewed as the norms, so that the average debt-to-GDP ratio of the Eurozone was above 60% just prior to the crisis. It can be argued a posteriori, however, that the 3% - 60% values of the Maastricht Treaty did not provide a sufficient fiscal cushion in case of prolonged stress. The first phase of the crisis marked by the sometimes massive public support to the banking sector pushed debt-to-GDP ratios way above the threshold and left many governments with the view that fiscal austerity was their last and only remaining choice.

This first element of answer thus appears to justify the usual label given to the European public debt crisis. In a recent contribution, Baldwin and Giavazzi (2015) argue convincingly, however, that there was more to the European crisis than this public debt dimension. In their view, the European crisis was more fundamentally an external debt crisis and they cite in support of their thesis the fact that the nations that suffered most were all economies with large current account deficits despite the fact that some of them (notably Ireland and Spain, but not Greece and Portugal) had been fiscally responsible ahead of the crisis. For Baldwin and Giavazzi (2015), the EZ crisis was the result of excessive foreign borrowing within the Eurozone. Countries in the European periphery borrowed massively from countries in the core. This is clearly attested to by the evolution of current accounts as represented in Figure 4. Simultaneously the predominance of bank financing in Europe meant that these intra-European capital flows went hand in hand with huge increases in bank balance sheets, leading to TBTF (too big to fail) and TBTS (too big to save) considerations. The latter in turn meant that when the sudden stop occurred and banks found themselves unable to roll over the loans with which they were funding their foreign lending, the sovereign had to step in. It is thus through the banking sector that the public debt problem took shape. The last turn of the cycle being due to the privileged treatment of national public debt in the balance sheet of the banks (Bonds issued by an institution's own sovereign are assigned a zero capital weight as if they are totally riskless, according to Basel 2). This policy had the effect of encouraging banks to hold large quantities of national Treasuries, thus resulting in the banks being weakened when their sovereigns got into trouble (since they were effectively holding assets of doubtful quality with no corresponding capital back-up). To this description one should add that the lending to the periphery went

predominantly to the real estate sector (Ireland and Spain and to a lesser extent Italy) or to public consumption (especially in Greece). It thus fueled real estate booms and stimulated price and labor cost increases without in any way improving the future ability of the country to repay the incurred debt.

Figure 4: Current accounts in the euro-area – 2000 to 2007



Source: Baldwin and Giavazzi, 2015

Was there a direct link with the US real estate crisis? The increased borrowing by the periphery and increased lending by the core had nothing to do with the real estate bubble in the US, nor with the growth of the short term interbank funding markets described in our answer to the previous question. But it evidenced a similar spirit of financial exuberance and overconfidence in the ability of financial institutions to manage their risks. In that sense the connection between the European and the Anglo-Saxon sides of the GFC is to be found more in "l'air du temps" of the financial world than in a direct mechanical linkage.

There is a limited exception to this view, however. While real estate bubbles in Europe were in themselves largely unrelated to the US real estate bubble, the fact that they burst almost simultaneously was probably more than a coincidence. First there is the direct link already suggested in Section 2: International banks weakened by US subprime losses became more prudent in their local lending, thus contributing to the real estate bubble bursting in their own countries. The losses of Irish banks appear to have been large and pervasive enough to suspect that they did indeed provoke credit restrictions in Ireland sufficient to have been the trigger for the bursting of the bubble. This does not seem to have been the case in Spain where losses related to US subprime lending were too small and in and of themselves unlikely to have substantially altered the ability of Spanish banks to lend. Can we then conclude that the Spanish bubble bursting shortly after the fall of real estate prices in the US was a pure coincidence? Not quite. Indeed, a pure contagion phenomenon may have been at work: the observation of the deep and prolonged fall of prices in the US, the confirmation of the existence of a bubble and the evidence of its bursting may have led to a revision of the consensus view of what was happening in Spain. This purely mental reevaluation may have instilled doubts in the mind of the local actors sufficient to alter their behavior and trigger a similar development in the Spanish market.

5. Why were banks willing to be so fragile? The incentive problem in banking

While there is evidence that the excessive risk-taking leading to the last financial crisis was at least partly attributable to knowledge or competence problems[5], another important element was the misalignment of the incentives of the various stakeholders of financial institutions. This is particularly apparent in the case of institutions that were deemed too big to fail. Before developing this point a few remarks on risk and risk taking are in order.

Progress in risk measurement: its role in the crisis

[5] Fahlenbrach and Stulz (2011) show that the losses of banks whose managers' incentives were most closely aligned with the long-term interests of the firm they managed were at least as large, in the last crisis, as those at the financial institutions where governance was more obviously lacking. This suggests that wrong incentives were not the only factor in the behaviour and decisions that led to the crisis. Knowledge and competence were also at play.

There is no doubt that significant progress in both the definition and measurement of risk has been made in the recent past. As an example, the function of a risk manager was almost non-existent some 20 years ago. However, it is equally hard to dispute the fact that the extent of this progress has been over-estimated. For instance, it was regularly claimed in the early 2000s that the financial system had never been as resilient and robust as it was at the time[6]. Clearly, developments since the beginning of the financial crisis in mid-2007 have proved the contrary, and we need to draw suitable lessons from that experience.

Progress in the definition and measurement of risk may well have played a role in the recent financial crisis. A reason for this is that – as so often in modern finance – conceptual progress, in tandem with progress in the methodology of risk management, has led to a rather blind trust in models. In general, a trained economist learns to interpret models as abstract approaches to reality, with these models serving as support to economic and business reasoning. Models are not meant to be substitutes for complete, partially qualitative reasoning including, in particular, a discussion of the model's assumptions and their degree of robustness. In some areas of finance, however, it appears that quantitative models had increasingly been viewed as the alpha and omega of business reasoning. They had often served as a substitute for an independent evaluation by experienced business managers and decision-makers alike. We should therefore welcome some of the ideas put forward in the new 'Financial Modellers' Hippocratic Oath', such as "I will remember that I didn't make the world, and it doesn't satisfy my equations" (Wilmott, 2009).[7]

Excessive risk-taking

Let us now turn to the question of financial risk-taking. Overall, there is no (expected) return and no growth without risk so we have to be careful to foster a sufficiently pro-risk society. But risk calculus – weighing the marginal advantages and disadvantages of taking more risk –

[6] « Banking organizations of all sizes have made substantial strides over the last two decades in their ability to measure and manage risks » leading to « a greater resilience of the banking system »- B. Bernanke, Jackson Hole Speech, 2005
« Financial institutions are able to measure and manage risk much more effectively. Risks are spread more widely, across a more diverse group of financial intermediaries, within and across countries. Theses changes have contributed to a substantial improvement in the financial strength of the core financial intermediaries and in the overall flexibility and resilience of the financial system in the U.S. » - Tim Geithner, 2006

[7] Wilmott, P. (2009) 'Financial Modelers' Manifesto', available at www.willmott.com, January 2009.

is a difficult exercise. It is difficult because it entails probabilities that are hard to assess over future scenarios which are themselves often hard to describe fully and accurately. And the difficulty increases by an additional step if there is an externality; that is, if the private and social cost and benefit of additional risk-taking differ. One can plausibly argue that the recent financial crisis was, to some extent, the result of excessive risk-taking. For the proponents of this hypothesis, however, the ultimate cause is in question. One possibility is that this excessive risk-taking was the result of wrong incentives, with decision-makers wilfully taking more risk for themselves or their institutions than would have been privately or socially desirable. As we have noted the (non-exclusive) alternative view - that a misperception of the probabilities and possible consequences of the decisions was the prime cause of the crisis (a lack of knowledge or competence) - has supporters as well.

Incentives are an important component in risk and risk-taking. If there is an important lesson in economics and finance that has not been invalidated by the financial crisis, it is that incentives really do matter. The excessive risk-taking that was observed prior to the financial crisis is likely to have been – among other things – the result of the fact that key decision-makers were not provided with the right incentives to carefully analyse and balance the possible consequences of the risks they agreed to take. Let us take a bank as an example and look at the incentives with regard to risk-taking guiding its various stakeholders, then try to gauge the likelihood that these incentives have been conducive of decisions that are optimal from society's viewpoint.[8] The main relevant stakeholders are the depositors, the shareholders, the managers and the bondholders.

- **Depositors**

  Deposit insurance ensures that it is not the business of depositors to worry about the amount of risk that the bank, in which he has deposited his money, decides to take. A key lesson of the Great Depression was that deposit insurance is a socially justified feature of the banking system. This follows from the fact that banks are institutions vulnerable to bank runs, no matter how well they are managed. The principle of deposit

[8] The focus here is placed on a typical banking institution, but other financial institutions might be similarly affected.

insurance is widely accepted and we will not further question it. Yet, the extent of deposit insurance and the form of its financing remain important questions.

- **Shareholders**

The incentives for shareholders differ from those of depositors. At first sight shareholders, as ultimate owners of the bank, can be counted on to discipline risk-taking by the institution they own. After all, they stand to lose their entire stake if the risks taken lead to bankruptcy. This is only true to a limited extent, however. Indeed, if we go beyond an initial, superficial consideration of the situation, we soon realise that shareholders cannot be expected to discipline risk-taking by a bank. There are a number of reasons for this. In addition to the fact that individual shareholders are often small and scattered, they only have limited ways of exerting pressure on management, short of disposing of their share. Importantly, the reality of limited liability seriously biases shareholders' perspectives on risk. While shareholders benefit from the upside of risk-taking, they are not symmetrically penalised on the downside. This asymmetry is particularly acute in the case of highly levered institutions. For these institutions, the return on equity in good times is high, say above 20%. The trade-off between high returns if the risky gamble pays off, and zero, if it does not, is particularly lopsided. Both limited liability and the highly leveraged nature of banking thus come with a natural propensity for socially excessive risk-taking on the part of banks' owners. In this sense, shareholders cannot be relied upon to impose on managers the socially optimal level of risk-taking.[9]

- **Managers**

What about the bank's managers? Here theory tells us that, apart from reputation and other soft considerations, the behaviour of managers will crucially depend on the link between their remuneration and the firm's performance. What is at issue here is less the level of managerial remuneration, and more the relationship between the remuneration and the medium to long-run performance of the bank. Clearly, a managerial

[9] Though determining the precise level of socially optimal risk-taking is difficult to gauge for the economy as a whole, excessive risk-taking by an individual institution is easier to detect.

remuneration scheme that depends exclusively on the bank's current performance places managers in a situation similar to limited-liability shareholders. They cash in on lucky gambles but bear few of the negative consequences of unlucky ones. We return to this very serious problem in our concluding section.

Bondholders

Let us now turn to the issue of whether bondholders – the final stakeholder group – contribute to a balanced weighting of risk and return in a bank's decisions. Under normal circumstances, discipline arises through the possibility and reality of default and eventual bankruptcy. Bondholders who are deprived of the upside potential of the risks taken by the bank and lose part (or all) of their stake in the event of default can be counted on to ensure that the negative consequences of the risky gambles taken by the bank are given proper weight. Indeed, the cost of debt increases with additional risk-taking, thus reminding managers and shareholders of the downside of the risks they are naturally inclined to take. In reality, this is precisely where the moral hazard issue associated with the implicit guarantee of the 'too big to fail' (TBTF) status becomes relevant. By definition, a TBTF financial institution can expect to be rescued from bankruptcy. As a consequence, the banks' bondholders know they will not bear the cost of excessive risk-taking and therefore they need not take this cost into account when assessing the risk profile of the institution to which they lend.[10]

To sum up, the combination of deposit insurance, limited liability of shareholders, short-term employment contracts of managers and the TBTF implicit state guarantee provide strong support for the hypothesis that an excessive willingness to take risks may also have been a factor in the recent financial crisis. In the case of systemically relevant financial institutions, it is not clear that any of the major stakeholders had the incentive to perform a balanced risk calculus. As mentioned before, competence and knowledge may also have been lacking. They can be improved through further investment in teaching and research in finance. This will be to no avail, however, if the incentive structure in systemically relevant financial institutions is not simultaneously corrected.

[10] The argument outlined here is particularly relevant for holders of senior bonds.

Relation to the main text: most explicit with Section 4.9 where it is shown that under limited liability a levered cash-flow first order stochastically dominates its unlevered counterpart (Corollaries 4.5.1 and 4.5.2).

6. Why did we let banks become so fragile? A view on financial regulation before the crisis

It is one thing to argue that banks took excessive risks because the incentive structure facilitated this bias. But as we know the banking industry is and has been for a long while one of the most heavily regulated. The question that then follows is, why did we let them be as fragile as they in fact were? This is a difficult question on which opinions may differ widely. To try and answer it let us first review the motivation for regulation in banking. We will then provide two complementary elements of an answer.

Why do we need to regulate banks more tightly than ordinary corporations? The main reason lies in their important role in the economy: the private and social costs of a bank failure differ. This is the case even if we assume that the full private cost is being borne by bank stakeholders. But it is even more patent in the case of TBTF institutions where it is expected that the taxpayers will come to the rescue in case of insolvency. One can assert that the less aligned are private incentives with the social interest, the more an intrusive regulation is justified. Conversely, the more rigorous one can be in correcting incentives the less detailed and intrusive regulation will need to be.

The first element of answer to the question in this section's title is that in a world where incentives are partly misdirected (see Section 5), i.e., where those who take the risks reap the full upside but do not pay the full negative consequences of the risks they take, then banks will naturally lobby for less or laxer regulation. Think of equity capital requirements. An increased degree of leverage renders banks more fragile since the cushion they have to absorb negative shocks is smaller. But if the cost of that fragility is not borne by bank stakeholders – because a bank in difficulty will be saved by the authorities - and if equity capital is seen as expensive, then bank managers will lobby for lower equity capital ratios. This tendency is exacerbated if the return on equity is taken as the yardstick of success with a direct implication on remuneration (most often via bonus payments): it is much easier to reach a high return on equity if there is little equity thanks to a high leverage ratio.

The second element of answer is that the intellectual climate of the 1990's did not leave regulators with much ammunition for countering bank lobbying. The very significant progress made by financial theory since the sixties – attested to by the material reviewed in IFT which is almost entirely post-1960 finance - gave plausibility to the claim that risk management techniques were not only much better than ever before but in the absolute were also up to the task given the risks borne by the financial system (witness the quotes mentioned in footnote 6).

Why did regulators let banks become so fragile? Our answer thus is partly knowledge, partly incentives: on the one hand, we did not quite realize that they were as fragile as they were, on the other hand, given the intellectual context, regulators were not in a strong position to resist the lobbying of increasingly large and powerful international banks.

Others will add a dogmatic component to this answer. Following a period of intense regulation and highly cartelized economies, the mid-1980's saw a phase of deregulation associated with the names of Ronald Reagan in the US and Margaret Thatcher in the UK and in Europe. This movement affected the financial sector where "light touch" regulation and self-regulation became the calls of the day. The efficient market theory was riding high, often interpreted (wrongly) that most regulation was unnecessary. There is likely an element of truth in this additional element of the answer. We tend to resist it, however. The bulk of the economic profession never deviated from the view that markets may fail and market failures normally require corrective actions. There may be disagreements on the form these corrections should take and, in particular, on whether governments had a chance to implement truly beneficial corrective actions. But it is a fact that for outside observers the deregulation phase has often been interpreted as the result of an essentially dogmatic movement associated with the notion of neo-liberalism, a term that dates from this period.

7. Are we home? Progress is being made … but still a critical missing piece

There is little debate that the main cause of the Great Financial Crisis (GFC) was excessive risk taking by large international financial institutions. Most observers would also agree that much has been accomplished under Basel 3 to address the problem. Banks today are required to have more and better equity capital, they are required to prepare Recovery and

Resolution Plans (RRP)[11], and they must finance themselves through debt instruments that are bail-in-able or can be converted into equity (Cocos). Bank owners and their creditors thus have significantly more "skin in the game" than before the GFC. But is it enough to reduce to an acceptable degree the risk of a repeat? The 10th anniversary of the financial crisis has been the occasion of several comprehensive assessments (see for instance Baldwin, Huertas, Ogden, 2017). On the academic side the dominant view is that while much has been done, it is probably not enough. In particular, the level of capital requirements still appears insufficient (see Admati and Hellwig (2013) for a forceful call for higher levels). In addition, it is often pointed out that new risks have emerged, notably linked with the obligation to centrally clear derivatives, leading to the emergence of new systemic actors (Financial Market Utilities[12]). Here we will focus on a further element of the incentive dimension where we are of the opinion that more remains to be done. Our main point is that the combination of very high leverage and limited liability, uniquely typical of modern banking, constitutes a toxic cocktail that continues to be a source of excessive risk taking and needs to be explicitly confronted. That convexity in remuneration patterns encourages risk taking is well-known and for the most part intended. The circumstances and the numbers involved in the financial sector, however, pervert the purpose of limited liability and generate highly problematic incentives that persistently undermine regulatory efforts and endanger financial stability.

Leaving depositors aside (who are protected by deposit insurance that we do not contest), ensuring that the other main groups of creditors of a bank are not similarly exempted from their monitoring duties has been an important work area of the post-GFC regulatory process. As mentioned above, bondholders should contribute to a balanced weighting of risk and return in a bank's decisions, but the moral hazard issue associated with the implicit guarantee of the "too big to fail" (TBTF) status itself implies that the bank's bondholders need not take this cost into account. The recovery and resolution plans imposed by Basel 3 are designed to remedy this problem. Ideally (but we are not there yet), even large and complex financial institutions should be resolvable over the course of a week-end without

[11] See Huertas (2014) for a very forceful and complete reference.

[12] See https://www.federalreserve.gov/paymentsystems/designated_fmu_about.htm

extreme consequences for the real economy. The ultimate responsibility of the bank creditors would thus be restored, as is the case with industrial firms. The inclusion of large quantities of bail-in-able debt (debt instruments that can be called in, that is, cancelled out at least in part, by the regulators in case the equity capital of the bank falls below some minimum regulatory requirement) and Cocos in the balance sheet of large banks underlines this responsibility and should in due course alter the landscape most significantly.

As to the 'limited liability cum high leverage' problem arising in the case of bank managers and other internal stakeholders entitled to bonuses, notably traders, we refer to the Squam Lake Report (SLR, 2010), which argues that what is primarily at issue here is less the level than the structure of pay, that is, the link between the remuneration and the medium to long-run performance of the institution. Clearly, a managerial remuneration scheme that depends exclusively on a bank's current performance and traders' bonuses that are related to a single or a few decisions taken over a short horizon constitute inappropriate incentives. While we agree with the SLR that the level of remuneration should not be directly regulated, we are somewhat less confident that the extreme remuneration levels seen in banking are innocuous or necessarily the result of productivity or skill differences.

Risk is intimately linked with luck. In a risky world, heroes are as likely to be lucky as smart. In asset management, Barras, Scaillet and Wermers (2010) find that around 8 per cent of mutual funds display a significant positive alpha, but of them only about 0.5 per cent deliver a positive alpha that is not driven by luck. We find it presumptuous to assume that the associated statistics are radically different in the population of successful bank managers and traders. Bonus payments could as often be a reward for luck as they are compensation for actual skill or effort. A first lesson is that we need to improve our ability to distinguish between skill and luck and must be prudent before concluding the former. Simultaneously we need to draw adequate conclusions from the difficulties that will always exist in signal extraction on this issue. This means, notably, that compensation should be geared to the medium to long term performance of the individual and the institution and not to a single trade or the current financial result.

Limited liability is designed as a way to encourage risk taking in situations where the prospect of moderately positive rewards for the decision maker can be swamped by the

possibility of extremely large losses, unlikely to be bearable by a single individual. In this context limited liability is necessary to promote the risk-taking required for a growing economy. Limited liability, however, leads to excessive risk taking and can hardly be socially justified if it means securing – for "good" – huge personal gains following a successful gamble, even when the risks undertaken increase the probability of large institutional losses in the subsequent accounting periods. There is no social or economic justification either for the asymmetry arising from extremely large compensation when a trader's gamble pays off and a null bonus when it results in large losses for his institution. The practice of risk takers cashing in fully on lucky gambles while bearing very limited negative consequences of the unlucky ones delivers excessive risk taking with no social benefit.

To make matters worse, the sums involved in the financial arena regularly amount to multiples of the lifetime remuneration of individuals who contribute to society in a more obvious manner. What restraint in risk taking can one expect from a trader when his gamble (with other people's money) brings him a lifetime level remuneration in the case of success while, at the very worst, a job change in case of a negative outcome? Similarly, it is not irrational for a CEO to initiate large gambles possibly compromising his firm's survival if the odds are not too unfavorable when success would enable him to retire with a comfortable lifetime income while failure is followed by only benign consequences (in particular, if the State is expected to come to the rescue).

As articulated by the Squam Lake Report, the partial solution to the problem outlined above is deferred compensation; that is, "systematically important financial institutions should withhold a significant share of each senior manager's total annual compensation for several years." Noting that the goal is to align the incentives not to the interests of shareholders but those of society, the Report adds: "the withheld compensation should not take the form of stocks or stock options. Rather, each "holdback" should be for a fixed dollar amount, and employees would forfeit their holdbacks if their firm goes bankrupt or receives extraordinary government assistance."

A number of comments are in order. First, one observes that, unfortunately, this recommendation has not found its place in explicit regulation (Basel 3) but has remained a recommendation only (endorsed by the FSB). As a result, compliance is not monitored. This

is highly regrettable as constructive behavior from bankers in regulatory matters and, ultimately financial stability, are unlikely to be attained if the deep incentive problems highlighted here are not squarely confronted.

Second, the excess risk-taking behavior engendered by limited liability combined with very high remuneration can be fully corrected only with very long claw back periods that may be hard to implement legally. The SLR suggests a period of five years. This has to be viewed as a minimum. As the GFC has shown, the negative consequences of ill-guided risky investments can take many years to unfold, in particular when the sector in its entirety is supported by public policies. The case of zombie-institutions hobbling along ten years after the start of the crisis provides vivid illustrations. Unless one finds a way to secure long duration claw backs as the default rule for large remunerations, one should have the courage to question the very notion of limited liability itself, at least for compensations exceeding a certain threshold.

Third, the problem does not concern the top managers of a financial institution exclusively but all individuals entitled to high compensation levels, particularly in the form of bonuses. The many incidents that have occurred in the last ten years, most conspicuously outright frauds on LIBOR and in forex markets, have highlighted the intuitive fact that large and complex institutions cannot be controlled from the top in the absence of a perfect alignment of their incentive structure with the long run interests of the institutions. This requires that all highly paid individuals, notably traders, are subject to very strict and long maturity claw back clauses.

Finally, let us conclude on an interesting and positive development, the awarding of bonuses in the form of vested high trigger contingent convertibles (Cocos). As Elliott (2015) notes: “Paying banker bonuses in bonds makes sense. Cash bonuses are hard to claw back, while stock awards have unlimited upside.” Thus, UBS announced in January 2015 that 40 per cent of the bonuses of its employees earning more than $300,000 would be deferred and a fraction (40 per cent again) of these deferred bonuses would be paid in Cocos that vest after five years and would be wiped out if, in the meantime, UBS’s common equity (Tier 1) ratio falls below 7 per cent (or 10 per cent in the case of executive board members). This innovation goes exactly in the direction advocated here. It should be firmly endorsed and

promoted by regulators. A universal adoption of similar principles would go a long way in restoring individual incentives conducive to financial stability.

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