Assessing bank leverage through flows: an early warning tool of risk-taking

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ABSTRACT

This paper discusses the concept of leverage, its components and how to measure and monitor it. It proposes an innovative approach to assessing leverage based on flows using the concept of a marginal leverage ratio, which reveals the leverage related to new activities, as a valuable supplement to the traditional absolute leverage ratio. The marginal leverage ratio can be used as an early warning tool to signal potential episodes of excessive leverage and to understand if, and how, banks deleverage. Besides capturing the leveraging-deleveraging cycles better than the absolute leverage ratio, the marginal leverage ratio provides an indication of risks that a stable absolute leverage ratio can conceal.

KEYWORDS

Leverage, financial intermediation, financial crisis, prudential requirements.

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The data (for the Euro area and at country level) used in this paper can be downloaded at: http://rvburke.com/datos/Marginal_leverage_ratio_-_DATA.xls

Contents

PREFACE

On November 19, 2004 the most beautiful mountains in Slovakia were hit by an unprecedented storm. The forests in the High Tatras National Park mountain range were obliterated after a powerful windstorm blew over Slovakia […]. The devastation was horrendous as trees were blown away like straws, by gusts of wind reaching speeds of up to 173 km/ hour.

The windstorm completely destroyed 13,000 hectares of forest, equivalent to a third of the total of High Tatras National Park's 46,000 hectares […]. The storm is believed to have damaged approximately 3 million cubic meters of soft wood, which is approximately 90 per cent of the wood extracted annually in Slovakia. Petra, DePaul University, Chicago, extracted from http://students.depaul.edu/~prehusov/.

In 2013, I spent a week skiing at the Tatras. My mind immediately connected the story of massive destruction in Slovakian forests with a similar episode which occurred in Aquitaine (France) in 1999: the cyclone Martin obliterated 240,000 hectares, including 30 per cent of the Landes forest[1].

The powerful windstorms acted as a trigger, but there was a structural risk embedded in the characteristics of the soil. The Tatras Mountains are one of the tallest mountain ranges in Europe, with very rocky soil. The Landes forest grows on top of a sand dune. The forest was planted to stabilise the mobile dunes that were threatening the villages. These two types of soil reduce the ability of the roots to hold down trees under extreme events such as windstorms. On the rocky soil, roots are unable extend to sufficient depths; on the sandy soil, roots are unable to hold onto the solid ground. The question to ask is whether the roots were too weak or whether the treetops had grown to excessive heights.

1. INTRODUCTION

While the mandate of monetary policy used to be markedly focused on price stability, the crisis has changed expectations about which should be the role of central banks. Broader mandates would include economic growth and financial stability and how they interact with the price stability mandate (Markus, 2013). In this context, Praet (2013) argues that leverage cycles interact closely with the liquidity cycles, which ultimately stem from central bank policy. With that background, this paper discusses the concept of leverage, its components and how to measure and monitor it. The goal is to provide monetary authorities with additional tools to improve the understanding of bank leverage.

A bank's balance sheet can be compared to a tree. The capital or equity would be the roots which feed and support the rest of the balance sheet. The debt or liabilities would be the aerial part of the tree (trunk and treetop). The proportion of the overall size of the tree with respect to its roots would be the leverage.

The financial crisis triggered the reinforcing of capital requirements. The question may not be whether the health and quality of capital is enough but rather whether excessive liabilities could make banks vulnerable to financial turmoil. Storms are not a daily occurrence but they are equally not an unusual phenomenon. To prevent disaster, financial systems should be designed to withstand recurring financial turmoil.

Deficiency in the supervision of banks was one of the multiple causes of the crisis. Public authorities reacted, both at national and international level, by reinforcing the supervisory framework. In the EU, for instance, the European System of Financial Supervision (ESFS)[1] was created and the Banking Union (European Commission, 2012a) is about to become fully operational.

At global level, the Basel Committee on Banking Supervision (BCBS) (2011) established a new framework of prudential requirements for financial institutions commonly known as the Basel III Agreement. In order to address some of the risks detected during the recent crisis, Basel III introduces, for the first time, a leverage ratio

[1] For more information about Cyclone Martin, see http://fr.wikipedia.org/wiki/Temp%C3%AAte_Martin.

[1] The ESFS was created following the recommendations put forwards by the report of the high level group chaired by de Larosière (2009). The ESFS consists of a European Banking Authority, a European Securities and Markets Authority, and a European Insurance and Occupational Pensions Authority. A European Systemic Risk Board was also established entrusted with macro-prudential oversight. Further information on the European financial supervision can be found at European Commission (2013c).

as an international standard prudential tool (some jurisdictions, such as the US, already had a leverage ratio as part of their prudential tools). Although often seen as a classic concept in finance, leverage is sometimes ambiguously or inaccurately employed, not only in the media and policy arenas but also in academic literature.

This paper aims to contribute to a more robust use of the concept of leverage as an analytical and policy tool. For this, the paper presents a new approach to leverage based on flows, the marginal leverage ratio, which can be used as an early warning tool to detect periods of excessive leverage.

The paper is organised as follows. In section 2, the concept of leverage is explained and the innovative marginal leverage ratio is introduced. Section 3 presents the main drivers of leverage: the valuation effects and the leverage targets. Section 4 applies the findings of the previous two sections to country data. Finally, some conclusions, recommendations and avenues for further analysis are discussed in Section 5.

2. WHAT IS FINANCIAL LEVERAGE AND HOW TO MEASURE IT

This section explains the concept of financial leverage. The classical measure of leverage based on the static picture shown by the balance sheet does not seem to properly capture the risks embedded in the build-up of leverage. A "marginal" leverage ratio appears to be a good complement to better grasp the increasing risks linked to leverage. This new marginal leverage ratio is a dynamic measure of leverage based on the activities undertaken over a certain period of time.

2.1. WHAT IS FINANCIAL LEVERAGE

The concept of financial leverage has been borrowed from physics. A lever allows the amplification of an input force in order to provide a greater output force. In a similar way, financial leverage allows to amplify the assets that can be obtained from a given amount of (own) resources.

Financial derivatives, such as options, futures or forwards, are typically highly leveraged products. The payment of a premium or a margin is just a fraction of the strike price that will (or could, in the case of an option) be paid by the delivery date.

For an economic agent, the financial leverage indicates the relative importance of debt with respect to its capital (or equity). Leverage is commonly expressed as the ratio of total assets to equity but an alternative formulation of debt to total assets is also possible. Throughout this paper, the definition of leverage as the ratio of total assets to equity will be used.

A certain level of leverage is not only healthy, but it is also critical for the well-functioning of an economy. Leverage stems from the fact that some of the assets of a corporation are financed with funds other than equity. The existence of debt (and leverage) enables economic agents to allocate their resources (or consumption) over time according to their preferences. In other words, debt (and leverage) facilitates the channelling of resources from savers with an excess of funds to investment projects in need of financing.

The banking system through its intermediation function constitutes a cornerstone in the process of channelling funds from savers to investors and, therefore, banks operate with unusually high leverage (Flannery, 1994, p. 320). The role of prudential regulation and supervision is to avoid extreme positions in the financial sector, including in respect of leverage, which can eventually become highly damaging.

Prudential rules require banks to hold a minimum amount of capital due to its capacity to absorb losses, but the risks embedded in leverage go beyond incurring losses to also include liquidity risks as identified by Flannery (1994) and Diamond and Rajan (2001). One of the traditional functions of banks is maturity transformation, where short term (liquid) deposits are transformed into long term (illiquid) loans. The demand for liquidity by depositors may arrive at an inconvenient time and force the quick-fire liquidation of illiquid assets.

This liquidity risk was present in both sides of the Atlantic at the outbreak of the crisis. Angelides et al. (2011, pp. xix-xx) states that, as of 2007, the five major US investment banks were operating with leverage ratios as high as 40 to 1 and much of their borrowing was short-term. For example, at the end of 2007, Bear Stearns had to roll over $70 billion of liabilities every day, while its equity was $11.8 billion. In Europe, the European

Central Bank (ECB) (2009, p. 10) shows that, in the run up to the crisis, European banks also increased their dependence on money market funding providing short-term liquidity.

Supervisory authorities should be able to steer the growth of banks using different approaches. The introduction of liquidity ratios such as the LCR and NFSR (Basel III, par. 40-42) should not exclude the use of a leverage ratio to capture the overall liquidity risk.

With the outbreak of the crisis, leverage and deleveraging have become fashionable terms but they are not always used accurately. In particular, one should highlight two uses that can create confusion.

Firstly, “deleveraging” is often used to mean an "undesirable" or "disorderly" contraction in total assets as opposed to an expansion in equity. However, as leverage is the relation between assets and equity, it is inaccurate to use the term to indicate the evolution of one of the components only (unless you are explicitly undertaking a *ceteris paribus* analysis).

Secondly, Basel III defines leverage as the ratio of capital to total assets[2], which is an inverse of the usual definition. Although mathematically equivalent, the Basel III formulation conceals the multiplicative effect of leverage and the liquidity risks explained above. In this sense, it seems counterintuitive that Basel III proposes to *constrain [excessive] leverage* by imposing a *minimum leverage ratio* (paragraphs 152 and 165). When the leverage ratio is defined as total assets to equity, a cap can be imposed to avoid excesses. The 3 per cent floor for the (inverse) leverage ratio proposed by Basel III would correspond to a cap of about 30 to 1 under the usual definition of leverage.

Maybe the regulators participating to the Basel III process did not feel comfortable with a complex expression such as "N to 1" or they preferred to normalise the leverage ratio with a percentage. In order to address these concerns, a definition of leverage as debt to total assets could be used, because it expresses better the relative size of the debt. With this definition, the cap would be 97 per cent (the complementary of 3 per cent).

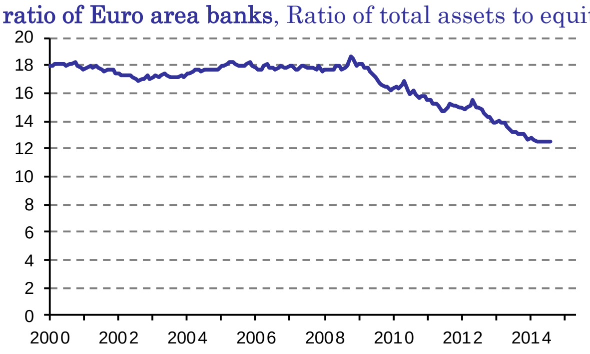
Once the concept of leverage has been clarified, the actual evolution of leverage can be analysed.

2.2. Evolution of leverage and increasing risk

"One of the underlying features of the crisis was the build-up of excessive on- and off-balance sheet leverage in the banking system. […] During the most severe part of the crisis, the banking sector was forced by the market to reduce its leverage in a manner that amplified downward pressure on asset prices, further exacerbating the positive feedback loop between losses, declines in bank capital, and the contraction in credit availability". Basel III, paragraph 152.

A first look at the evolution of leverage ratio for Euro area banks (Chart 01) does not warrant the dramatic language used by Basel III. In the run-up to the crisis, the leverage ratio remained stable at a value of 18 to 1. The subsequent decline, from 18-to-1 to 14-to-1, between 2008 and 2013 seems rather modest and does not reveal the amplified consequences of a process of deleveraging argued by the drafters of Basel III.

Chart 01: **Leverage ratio of Euro area banks**, Ratio of total assets to equity, number of times



Source: ECB Statistical Data Warehouse and own calculations.

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[2] In fact, Basel III speaks about total exposures (instead of total assets). Capital would be defined as total regulatory capital or Common Equity Tier 1. Total exposures comprise on and off-balance sheet items (paragraph 153). The Basel Committee on Banking Supervision recognises that leverage is generally formulated as total assets to equity: BCBS (2013b, Section 4).

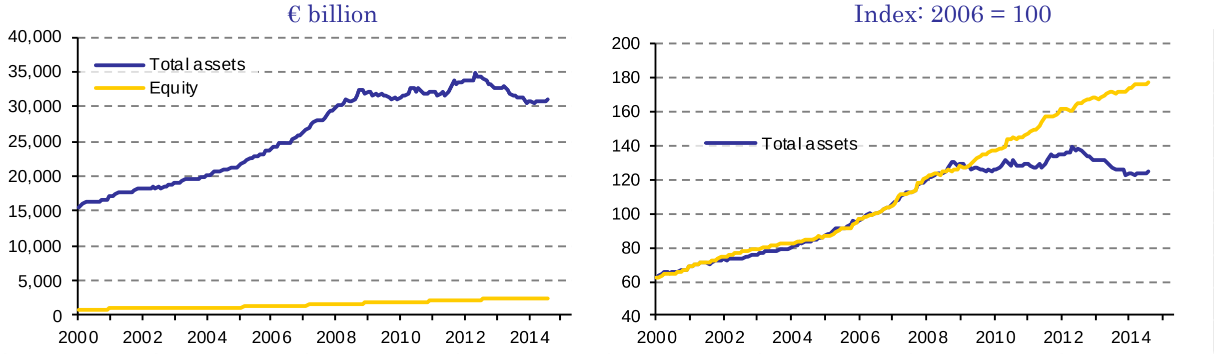
Shin (2010) and Adrian and Shin (2010) shed some light on this conundrum. They argue that even stable leverage may lead to increased risk in the balance sheets of banking systems, both in the assets and the liabilities side, as it may conceal hyper-activity and pro-cyclicality. Their arguments will be illustrated with the help of an example. Let's assume that a leverage ratio of 18 to 1 is considered sound. When a bank obtains new equity (e.g. €1,000), it will try to maximise its capacity within this "sound" leverage of 18 to 1 by expanding its balance sheet (by €18,000). To do this, the bank can accept new assets and customers for €18,000 and additional funding for €17,000 (as €1,000 is already financed with the new equity).

If this situation is repeated over time, all good borrowers may already have a mortgage and the bank will have to lower its credit standards to capture new customers. At the same time, stable long-term funding (typically deposits from households) may not expand as quickly as banks' financing needs and the bank will have to recourse to less stable funding sources: borrowing in the wholesale markets from another financial institution or institutional investors, financial innovation and securitisation… Bruno and Shin (2012a) argue that the availability (or sudden withdrawal) of non-core financing corresponds to a leverage cycle of global banks.

But Adrian and Shin (2008, 2010) go a step further. The €1,000 of initial equity expansion may stem from an actual inflow of funds (e.g. through the issuance of new shares in the markets or retained earnings), but it can also be a pure accounting effect resulting from a change in the market value of an asset (or a liability). In the latter case, the bank will still have an incentive to expand its balance sheet up to €18,000, with the same increased risks mentioned above, but now without a single Euro of actual inflow to back this expansion[3]. And this is not just a theoretical hypothesis; Basel III (paragraph 52 and footnote 10) foresees the phasing out of deductions and prudential filters so that unrealised gains and losses will directly impact capital[4]. The consequence of all of this is pro-cyclical activity from banks. Boom periods with climbing asset prices can trigger massive expansions of the balance sheet while the loss of value in downturns can be amplified in dramatic deleveraging episodes.

So, if the traditional leverage ratio conceals the actual risks, is there an alternative measure of leverage? This is discussed on the next section.

Chart 02: **Total assets and equity of Euro area banks**



Source: ECB Statistical Data Warehouse and own calculations.

2.3. From absolute to marginal leverage ratio

The previous section has shown the difficulties of the traditional measure of leverage to fully capture the evolution of risks embedded in leverage. The first step to achieve a robust understanding of leverage is to analyse how its components, assets and equity, have evolved over time. Between 2000 and 2008, both total assets and equity expanded along a very similar path (Chart 02, right-hand panel), which explains the stable leverage ratio on Chart 01. The decline in leverage from 2008 onwards is explained by a combination of a more

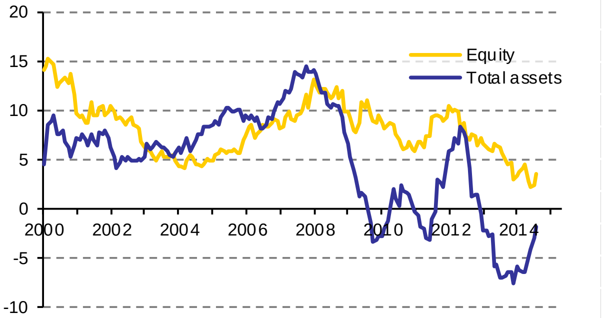
[3] An alternative theory explaining the processes of leverage and deleverage is based on the debt overhang problem first illustrated by Myers (1977). Firms in financial distress find it difficult to raise capital for new investments because the proceeds from these new investments mostly serve to increase the value of the existing debt instead of equity. At the same time, incumbent shareholders resist a bank recapitalization because their participation would be diluted.

[4] In the EU, deductions and prudential filters will still be applied as far as new accounting rules on the classification of assets (IFSR 9) do not enter into force. See European Commission (2013d).

moderate expansion of assets and sustained growth in equity. From 2012 onwards, equity continued to expand while assets declined or stagnated.

While the leverage ratio is a snapshot of any given moment, the process of leveraging and deleveraging is linked to evolution over time. Growth rates provide a first approach to the dynamics of leverage (Chart 03). Growth for both total assets and equity evolved at similar rates until late 2008, when total assets' growth sharply decelerated while equity maintained a fairly sustained growth.

Chart 03: **Total assets and equity: annual growth rates**, Euro area banks, percentage

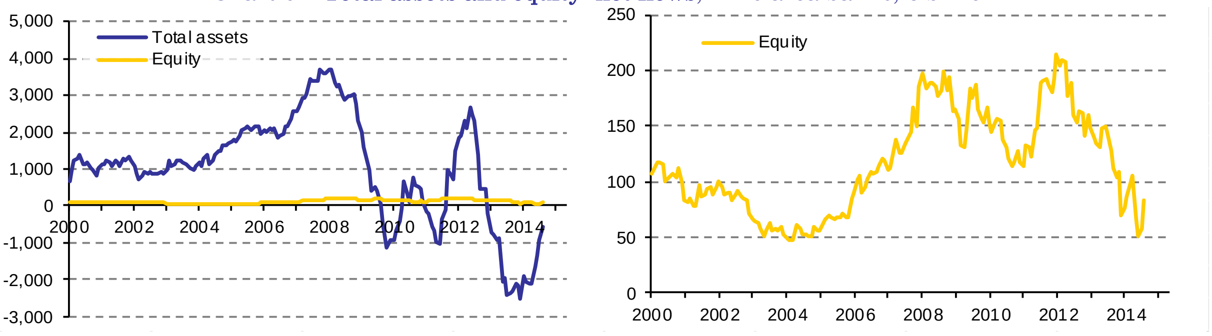


Source: ECB Statistical Data Warehouse.

This sudden decline in assets' growth seems to signal the existence of a period of deleveraging, and its potential negative effects. However, the predictive capacity of the growth of assets for signalling changes in leverage is weak. When the financial markets are mature, their evolution in terms of total activity or assets should not diverge significantly from GDP growth or another an indicator of general economic activity. While during the boom period, the growth of assets in Euro area banks was higher than GDP growth (which was around 5 per cent; see European Commission, 2008), it is difficult to deduce from this information that there was a build-up of excessive leverage particularly because it is not correct to assess leverage on the basis of just one of its components.

Most macroeconomic variables, such as prices (inflation) or GDP, are geometrical (logarithmic) in nature and expressing them in terms of growth rates is a simple tool to "linearise" them. This linearisation enables comparisons to be made between economies of a different size and facilitates analysis over long periods of time. However, to compare various items within the same balance sheet, a standardisation of size is not needed. On the contrary, under an expansionary context, the computation of growth rates can introduce a downwards bias due to a continuously increasing denominator.

Chart 04: **Total assets and equity: net flows**, Euro area banks, € billion



Notes: Annual flows are computed as the sum of twelve consecutive months in a rolling window. "Net" refers to new transactions minus redemptions.
Source: ECB Statistical Data Warehouse and own calculations.

This downwards bias can be avoided by expressing the evolution in terms of flows[5], which combine the information content of both absolute terms and growth rates. The relation between total assets and equity, the

[5] High frequency series, as the monthly series used throughout this paper, are embedded with seasonality. Monthly flows can be adjusted for seasonality by computing annual flows as the sum of twelve consecutive months in a rolling window. For instance, the *annual net flow* for March 2010 is computed as the sum of the monthly flows from April 2009 to March 2010. This is similar to a moving average but without dividing by the number of periods. The result is an absolute annual growth measured in Euros. For further details, see Annex B.1.

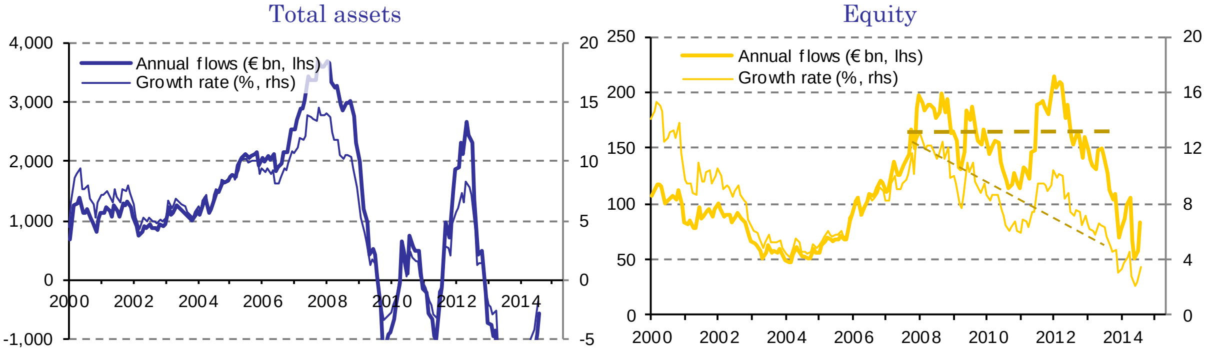
leverage, stands out when both series are expressed in terms of flows (Chart 04, left-hand panel). At the same time, trends and changes are clearly outlined (Chart 04). When expressed in terms of flows, the evolution of total assets captures both episodes of boom and bust in a clearer way than growth rates (Chart 05). For instance, during the run up to the crisis, flows of total assets increased 4-fold (from less than €1,000 billion a year to almost €4,000 billion), while growth rates increased only 3-fold (from 5 per cent to less than 15 per cent), due to the "downwards bias" generated by a continuously growing denominator.

It could be argued that this is just a matter of scale, but the series on equity refutes this argument (Chart 05, right-hand panel). With the outbreak of the crisis, banks received multiple pressures to offset losses and to increase capital buffers: new regulatory requirements[6], stress tests (see European Banking Authority, 2011b), EBA recapitalisation exercise, public capital injections to bailout banks (see European Commission 2012b)… This reality is better captured by equity flows, which remained high as shown by the thick dotted line in Chart 05, than by growth rates, which seem to decline from a peak in 2008 (thin dotted line). The two dotted lines illustrate, once again, the downwards bias of growth rates.

Once the relevance of flows is highlighted, it is possible to calculate an alternative leverage ratio as the relation of flows of assets and flows of equity. This can be called the *marginal* leverage ratio as it reveals the leverage related to new activities. A major advantage with respect to the traditional *absolute* leverage ratio is that the marginal leverage ratio is free from the "legacy" or inertia of the overall balance sheet. In other words, banks cannot conceal new activities undertaken with high levels of leverage within the overall balance sheet.

Total assets and equity (in absolute terms) are somehow correlated due to the requirement to maintain a minimum amount (ratio) of prudential capital. Flows are free of that constraint so that they provide a better insight of the policy of a bank in relation to the use of leverage and its evolution over time.

Chart 05: **Total assets and equity: net flows vs. growth rates**, Euro area banks



Notes: Annual flows are computed as the sum of twelve consecutive months in a rolling window. "Net" refers to new transactions minus redemptions.
Source: ECB Statistical Data Warehouse and own calculations.

The marginal leverage ratio can be used as an early warning tool to signal potential episodes of excessive leverage. Let's suppose that it takes 10 years to roll over the whole balance sheet of a bank. The flows accumulated throughout these 10 years would provide the same information as the balance sheet in year 10. As an early warning tool, flows provide, from the very first moment, information about what is changing in the balance sheet and potential effects in the future. This can help to assess whether or not corrective measures would be convenient without waiting for the 10 years to be completed.

The marginal leverage ratio helps to explain how banks deleverage and the amplified effects of the deleveraging process. It has been mentioned in Section 2.1 that banks' balance sheets are characterised by long term assets. As a consequence, they can only change the characteristics of the contracts when they arrive to maturity and are

[6] The Basel III Agreement of December 2010 increases the capital requirements for the banks. While it foresaw some transitional period, both markets and public authorities have applied pressure to frontload the requirements. For example, capital requirements were raised to levels higher than Basel III in some programme countries: the Irish programme required the banks to maintain a core tier 1 capital ratio of 10.5 per cent (European Commission, 2013a, p. 61); the Greek programme required all banks to achieve a core tier 1 capital ratio of 9 per cent by Q3-2012 and of 10 per cent in Q2-2013 (European Commission, 2012c, p. 98); the Spanish programme requires under measure 26 for all Spanish credit institutions to meet a Common Equity Tier 1 ratio of at least 9 per cent until at least end-2014 (European Commission 2013b, p. 42). The EBA (2011a) capital exercise of 2011 also frontloaded some of the requirements that were supposed to be implemented at a later date.

rolled-over or substituted by new contracts. In order to have an effect on the overall leverage ratio, new activities need to have very extreme values. Let's illustrate it with an example.

Let's imagine a bank with €300 of total assets and €10 of capital, therefore operating with a leverage ratio of 30 to 1. Let's assume that 10 per cent of its assets (€30) arrive to maturity this year and that the bank has generated profits for €1 so that the new capital is €11. The bank has decided to reinforce its capital position and would like to achieve a leverage ratio of 25 to 1. With this target, one could think that the €30 that have matured should be substituted by €25 of new assets and that the bank could use the €1 of "fresh" equity to back €25 of new activities. In these circumstances, the final size of the bank would be €320 (300-30+25+25=320). But €320 of total assets backed by €11 of capital leads to a leverage ratio is 29 to 1 and not the target of 25 to 1.

In order to achieve the 25 to 1 leverage target, new activities need to have a much lower leverage to compensate for the high leverage of the other assets that remain in the balance sheet. The €30 of assets that have matured allow for €2.5 of new assets and the €1 of new capital allows for another €2.5 expansion in assets. Under these circumstances, the banks' size would be €275 (300-30+2.5+2.5=275) and it will indeed be operating with a leverage of 25 to 1.

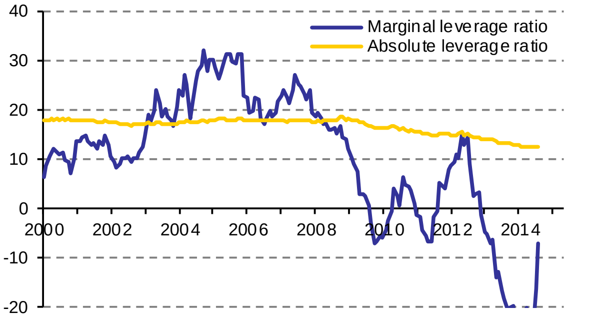
The marginal leverage ratio focuses on these new activities, which are the ones over which the banks have some margin of manoeuvre. The need for new activities to be limited to a marginal leverage ratio of 2.5 to 1 only to pull the absolute leverage ratio from 30-to-1 down to 25-to-1 illustrates what have happened during the recent crisis and corresponds with the "*amplified downward pressure"* described by Basel III.

Supervisory authorities could investigate avenues to integrate this new tool, the marginal leverage ratio, in their toolbox to supplement the traditional measure of leverage.

The Basel III statement about *"build-up of leverage"* is an implicit reference to flows. Marginal leverage ratio shows much more extreme values and with more drastic swings than the absolute leverage ratio (Chart 06). This evolution is consistent with the dramatic effects described by Basel III for both the build-up of excessive leverage and for the quick deleveraging processes. And this is already evident within a Euro area series, which aggregates over 7,500 banks (a country analysis is presented in Section 4).

The next section investigates how the build-up of leverage is driven by leverage targets and valuation effects.

Chart 06: **Absolute vs. marginal leverage ratios**, Euro area banks, number of times



Notes: The *absolute* leverage ratio is computed as total assets to total equity. The *marginal* leverage ratio is computed as annual net flows of total assets to annual net flows of equity. Annual flows are computed as the sum of monthly flows for twelve consecutive months in a rolling window. "Net" refers to new transactions minus redemptions.
Source: ECB Statistical Data Warehouse and own calculations.

3. DRIVERS OF LEVERAGE: LEVERAGE TARGETS AND VALUATION EFFECTS

This section contrast the extent to which the dynamics of assets and equity in banks' balance sheets presented above have or have not played a role in the recent crisis by addressing three questions:

- To what extent is leverage taking place in the banking system?
- Are expansions in total assets financed by stable liabilities?
- Do swings in the markets affect banks' balance sheet and can they trigger a process of leveraging-deleveraging?

3.1. To what extent is leverage taking place?

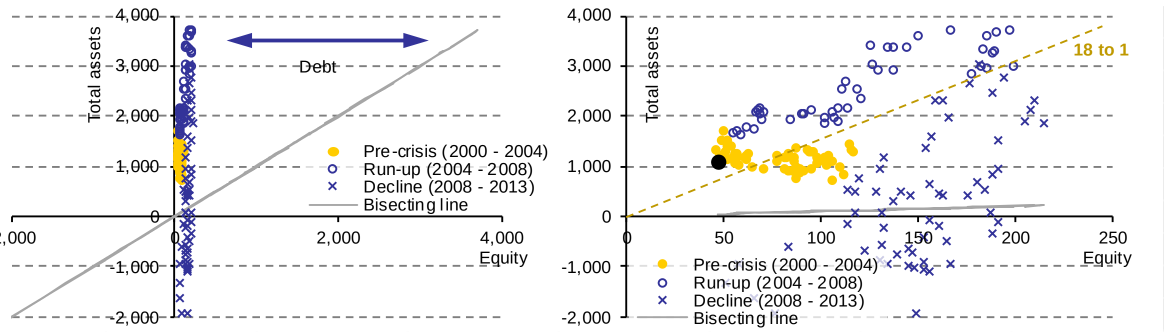
Section 2 shows that, in the run up to the crisis, the absolute leverage ratio for Euro area banks remained stable at a value of around 18 to 1, but the marginal leverage displayed a greater variation with peaks beyond 30 to 1 (Chart 06). Section 2 also highlights the importance of analysing the components of leverage (total assets and equity) to better grasp the dynamics behind the processes of leveraging and deleveraging.

A scatter graph allows us to plot the marginal leverage ratio and its components in a single chart. As explained in detail in Annex B.2, the data on annual flows of total assets and equity presented in Chart 04 (left-hand panel) can be translated into a Cartesian coordinate system. Net flows of assets would be shown on the vertical axis and net flows of equity on the horizontal axis (Chart 07). For instance, the big black dot on the right-hand panel corresponds to the flows accumulated in the year up to February 2004 (March 2003-February 2004). During this period, Euro area banks generated about €1,000 billion of new assets and €50 billion of new equity. The leverage of each observation corresponds with the slope of its radius (for instance, the observations falling on the dashed line have a marginal leverage ratio of 18 to 1 and the black dot has a marginal leverage ratio of 20 to 1).

A line could have been drawn across the dots in chronological order, but due to the many observations, this would make the chart unreadable. As an alternative, the observation period has been divided into three stages: pre-crisis (from January 2000 to September 2004), build-up of leverage (from October 2004 to September 2008) and deleveraging (from October 2008 to the last observation), so that an indication of the overtime evolution is provided.

Chart 07: **Net flows of total assets vs. net flows of equity,** Euro area banks, € billion

Symmetric axis — Zoom for the horizontal axis (equity flows)



Notes: "Net flows" correspond to annual flows which are computed as the sum of net flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions. The observation period has been divided in three sub-periods: Pre-crisis: from Jan-2000 to Sep-2004; Build-up of leverage: from Oct-2004 to Sep-2008; deleveraging: from Oct-2008 to the last observation. The bisecting line marks the points where flows of assets equal flows of equity, that is, where the leverage is 1 to 1. The black dot is highlighted as an example. It corresponds to the observation in February 2004 (flows accumulated from March 2003 to February 2004). It indicates €1,000 billion of net flows of assets and €50 billion of net flows of equity and, therefore, a marginal leverage ratio of 20 to 1. The dotted marks indicates a leverage of 18 to 1, which was the average value before the crisis.
Source: ECB Statistical Data Warehouse and own calculations.

The scatter plot (Chart 07) shows that flows of equity always remained positive, while flows of total assets were either positive or negative (decline in total assets), in particular during the crisis phase (this was already observed in Chart 04). The mere existence of leverage makes the expansions in assets (up to €4,000 billion a year) much larger than the expansions in equity (up to €250 billion a year). As a visual indication of leverage, the left-hand panel shows all points populated close to the vertical axis. The right-hand panel zooms in the horizontal axis to facilitate the analysis of the cloud of observations.

The concept of "deleveraging" is often used in a vague way. A first understanding is that it means a reduction in total assets or a negative leverage. However, media, financial analysts and academia commonly interpret "deleverage" in a broader sense. They implicitly (and most of the time unknowingly) compare the absolute and the marginal leverage ratio. When new activities have a lower leverage than the overall (absolute) leverage of the balance sheet, this is interpreted as deleveraging. This corresponds to a deceleration in leverage rather than negative leverage.

The scatter plot can help to clarify the difference. Strictly speaking, all points over the bisecting line imply leverage (marginal leverage ratio higher than 1 to 1). In this sense, not only during the boom but also during (most of) the bust, banks were operating with leverage. The dashed line corresponds to a leverage ratio of 18 to 1, the absolute leverage ratio before the crisis, and marks the implicit boundary between leveraging and deleveraging relative to the historical leverage ratio. The points over the dashed line have a marginal leverage higher than the absolute leverage and would correspond to a build-up of leverage, in a broad sense. The points below the dashed line have a marginal leverage lower than the absolute leverage and would correspond to a phase of deleveraging in a broad sense.

In other words, a bank (or a banking system) enters in a process of deleveraging when the marginal leverage ratio crosses below the absolute leverage ratio. The distance between both ratios marks the intensity of deleveraging. The scatter plot (Chart 07) helps to understand if the process of (de)leveraging is undertaken mainly through assets or through equity.

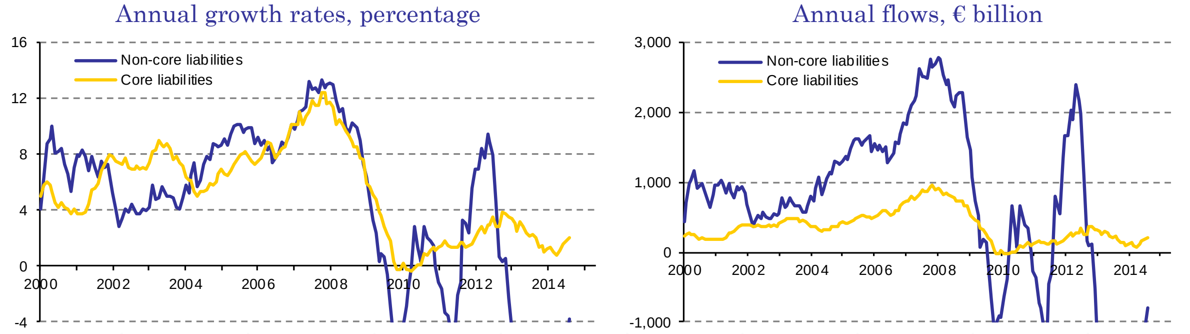
The Chart shows how the bust shifted the cloud of observations below the dashed line. This corresponds to a process of "deleveraging" where the lower leverage in new operations pulls down the overall (absolute) leverage. A marginal leverage ratio of 10 to 1 (corresponding, for instance, to a point with €2,000 billion of total assets expansion and €200 billion of equity expansion) is indisputably much lower than an absolute leverage ratio of 18 to 1. However, a marginal leverage ratio of 10 to 1 is not trivial and it implies that a bank continues to expand its assets substantially faster than its equity.

3.2. ARE THE EXPANSIONS IN ASSETS FINANCED BY STABLE FUNDING?

As discusses in Section 2.2, Adrian and Shin argue that a stable leverage ratio over time imply that the expansion in assets may not be able to be financed with stable funding. To assess this question, the evolution of core and non-core liabilities and of loan-to-deposit ratio is investigated. Data on the assets of banks providing global liquidity complements the analysis.

Following Psalida and Sun (2011, p. 29) and Bruno and Shin (2012a), monetary aggregates (e.g. M3) can be used as proxies for core banking liabilities (traditional retail deposits). Data show that most of the expansion in assets during the boom period was financed by sources other than core liabilities (Chart 08, right-hand panel). The high volatility of non-core liabilities, particularly during the downturn, illustrates the instability or risk embedded in these sources of financing. Core banking liabilities are much more stable, with flows virtually remaining always positive.

Chart 08: **Funding of banks: core vs. non-core liabilities**, Euro area banks

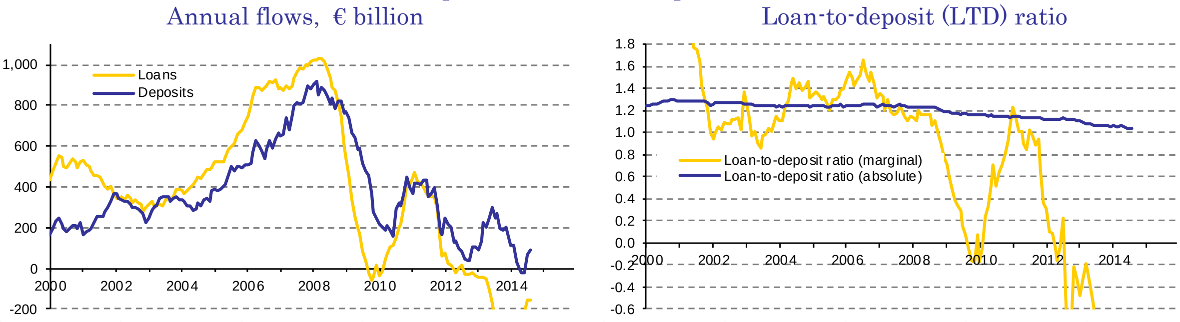


Notes: M3 is used as a proxy for core liabilities. Non-core liabilities are computed as the difference to total assets. Annual flows are computed as the sum of net flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions.
Source: ECB Statistical Data Warehouse and own calculations.

In a traditional banking system customer deposits are used to finance the loans and, therefore, the flows of loans closely follow the flows of deposits. However, data show that, before the crisis, the expansion of loans was higher than the expansion of deposits. For instance, in 2006, Euro area banks received around €600 billion of new deposits but they granted around €900 billion of new loans (Chart 09, left-hand panel). Marginal loan-to-deposit (LTD) ratio[7] reached 1.6 at its peak. This means that €60 out of €160 of new loans (almost 40 per cent) had to be financed by sources other than deposits (Chart 09, right-hand panel).

[7] The "marginal" loan-to-deposit ratio is constructed in a similar way to the marginal leverage ratio: net flows of loans to net flows of deposits. As for leverage, we consider the marginal LTD ratio provides useful insights beyond the absolute LTD ratio because the "inertia" of the overall balance sheet conceals the features of the latest banking activities.

Chart 09: **Loans, deposits and loan-to-deposit ratio**, Euro area banks



Notes: Loans and deposits of households and NFCs. Annual flows are computed as the sum of net flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions. The "absolute" LTD ratio is computed as total loans to total deposits. The "marginal" LTD ratio is computed as annual net flows of loans to annual net flows of deposits.
Source: ECB Statistical Data Warehouse and own calculations.

In the downturn, pressed by an environment of declining availability of funds, banks used deposits to finance assets other than loans. This is reflected in flows of loans below the flows of deposits and in a marginal LTD ratio below 1. In the year from November 2008 to October 2009, new deposits (€365 billion, Chart 09, left-hand panel) and new equity (€155 billion, Chart 04) were not sufficient to compensate for the loss of €1,150 billion of financing from non-core liabilities (Chart 08). This financing gap of €630 billion is one of the main factors explaining the pressure on banks to deleverage and the need for governments to support them. The sudden appearance of this gap stems from the collapse of non-core financing sources.

The improvement in banks' funding situation, the massive liquidity injections by the ECB (2011a) and other measures to promote the transformation of public support to the financial sector into credit to the real economy[8] have not led to an increase in the provision of loans by banks (ECB, 2013, p. 23), despite the fact that banks reduced their reliance on wholesale funding and increased core funding sources (ECB, 2013b, p. 32).

The shift in the funding model from non-core to core liabilities is probably not the result of an active and deliberate bank policy but rather the outcome of the leverage cycle of global banks postulated by Bruno and Shin (2012a). The authors claim that (European) global banks operate as wholesale lenders in the capital markets. They supply the non-core liabilities to local banks so that they can expand their balance sheets. For instance, a typical case in the early 2000's was the provision of funds by German banks to finance the expansion of banks in Ireland or Spain.

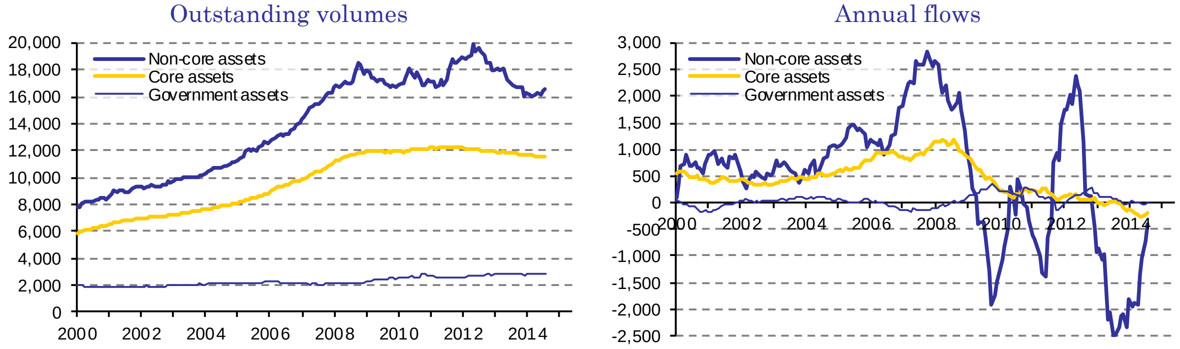
The distinction between core and non-core can also be applied to assets. Core banking assets would be the credit provided to the real economy (households and non-financial corporations) through loans, bonds and shares. Non-core assets would be the credit provided to other banks and other financial institutions and to foreign institutions (which are, in most cases, also financial institutions). The credit provided to governments typically contains some hybrid features. On the one hand, it is a source of funding and liquidity for the real economy, on the other, banks use sovereign bonds as high quality collateral for a variety of purposes, in particular, to obtain liquidity from the Central Banks or in the interbank markets.

Chart 10 shows how (wholesale) banks from the Euro area exponentially expanded their non-core assets in the run-up to the crisis before their holdings of such assets collapsed thereafter. In the year to October 2007, Euro area banks provided almost €2,300 billion new financing to financial institutions and non-residents (non-core assets); in the year to October 2009, banks repatriated €1,100 bn of non-core assets: a total reversal of €3,400 bn (40 per cent of Euro area GDP)[9].

In this global liquidity cycle, the crisis triggered a reversal of cross-border claims, with funds flowing from the periphery to the core. For instance, German and British banks repatriated the funds they previously lent to finance the expansions in Spain or Ireland as it is reflected on the evolution of TARGET2 balances.

[8] Such as the *Funding for Lending Scheme* of the Bank of England (2012) or the acceptance of additional credit claims (i.e. loans) as a collateral for open market operations by some Euro area National Central Banks (ECB, 2012) or the recent targeted LTRO of the ECB.
[9] The case of British banks is even more dramatic, they went from providing £1,100 billion of new funds a year in early 2008 to redeeming £550 billion a year later. This net decline of £1,650 billion in the flow of non-core assets provided by British banks represents 130 per cent of British GDP in 2009.

Chart 10: **Core and non-core assets**, Euro area banks, € billion



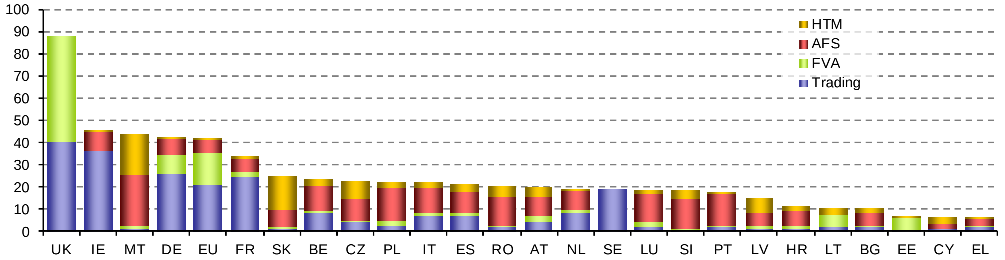
Notes: Annual flows are computed as the sum of net flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions. Series aggregate the credit provided by banks in the form of either loans or the purchase of securities (equity, debt securities and derivatives). Core assets: credit provided to the real economy (households and non-financial corporations). Non-core assets are calculated as the residual of subtracting core assets and government assets from total assets.
Source: European Central Bank and own calculations.

The collapse on the provision of wholesale funding by global banks explains the unavailability of non-core liabilities for local banks (Chart 09) a few months later. Data presented in this section suggest that a significant part of the expansions in total assets was financed by non-core liabilities, which became much less available during the bust.

3.3. To what extent are the balance sheets sensitive to market swings?

About 40 per cent of assets of EU banks depend in a certain way on market valuation (Charts 11). A significant proportion of banks' balance sheets can be affected by the evolution of financial markets. This is the case for more than one third of the balance sheet of banks in the UK, Ireland, Malta, Germany and France. According to the BIS (2009), banks in the US, Switzerland or Japan were in a similar situation.

Chart 11: **Breakdown of financial assets**, percentage of total assets, 2013



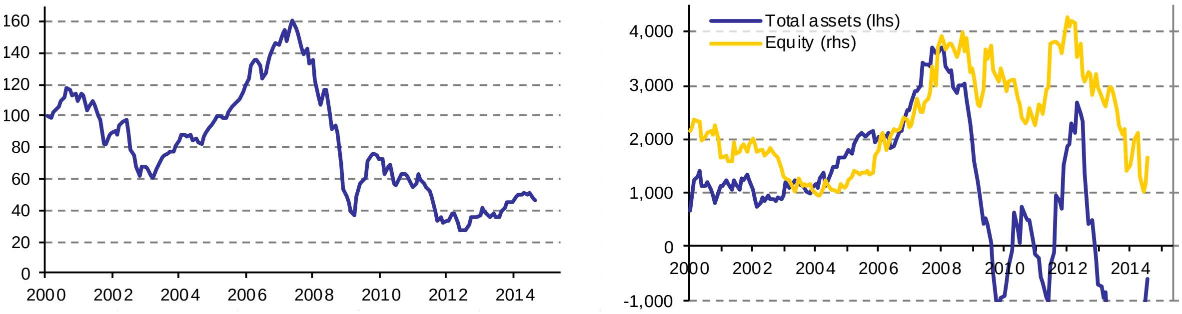
Notes: HTM: held-to-maturity investments; AFS: available-for-sale financial assets; FVA: financial assets designated at fair value through profit or loss; Trading: financial assets held for trading. Data for DK, HU and FI are unavailable.
Source: ECB Consolidated Banking Data.

While the exact composition of banks' portfolios is not known, Kolanovic et al. (2011) argue that markets across countries and across asset classes have become increasingly correlated in the last 20 years; in other words, the major global indexes follow similar patterns. On this basis, the Eurostoxx 50 index can be used as an indication of the evolution of markets. Flows of total assets and equity seem to be highly influenced by the evolution of market indexes, at least up to early 2009 (Chart 12). Three main factors explain the weakening in the relation between markets and flows since the outbreak of the crisis. First, not all financial assets are influenced by markets in the same way. Bonds are typically less risky than shares and their prices are more stable[10]. The collapse of financial markets also triggered portfolio reallocations through what is usually known as "flight to quality". Secondly, adjustments in the form of write-downs, write-offs and other balance sheet adjustments are excluded from the calculation of flows. The crisis triggered significant amount of such adjustments. Finally, public authorities have intervened in a major way in the financial markets and the financial system with a non-negligible effect on banks' balance sheets: liquidity injections by the ECB through open market operations, purchase of securities by the ECB, capital injections by public authorities, government guarantees on bonds…

[10] Though, this is not always the case. Bonds, including sovereign bonds, can also default or lose a significant part of their value. See, for instance, the evolution of Greek, Irish and Portuguese sovereign bonds throughout the crisis.

Chart 12: **Market indices vs. flows of total assets and equity**, Euro area banks

Eurostoxx 50 Banks Index (Jan 2000=100) Annual flows, € billion



Notes: Market index correspond to monthly averages. Annual flows are constructed as the sum of net flows for 12 consecutive months through a rolling window.
Source: ECB Statistical Data Warehouse, Bloomberg and own calculations.

As a conclusion, data suggest that the value of many items on banks' balance sheets can be highly influenced by the evolution of markets and it cannot be excluded that market effects, which impact certain items of the balance sheet, could spill over to other parts of the balance sheet.

3.4. Drivers of leverage: conclusions

According to the analysis presented above, the answer to the three questions formulated at the beginning of this section could be summarised as follows:

- A process of build-up of leverage has taken place in the Euro area banking system during the early 2000s. The leveraging process continued during the crisis, with Euro area banks expanding their assets faster than their equity, but at a slower path than before. These dynamics are reflected on a marginal leverage ratio lower than the absolute leverage ratio (but higher than 1 to 1) and in a declining absolute leverage ratio.

- Throughout the 2000s, the expansion in non-core liabilities remained above the expansion in core liabilities. Moreover, in the run-up to the crisis, the expansion in assets was increasingly financed by new non-core liabilities, which are less stable than core liabilities.

- The value of many items on banks' balance sheets can be highly influenced by the evolution of market prices.

4. Country analysis

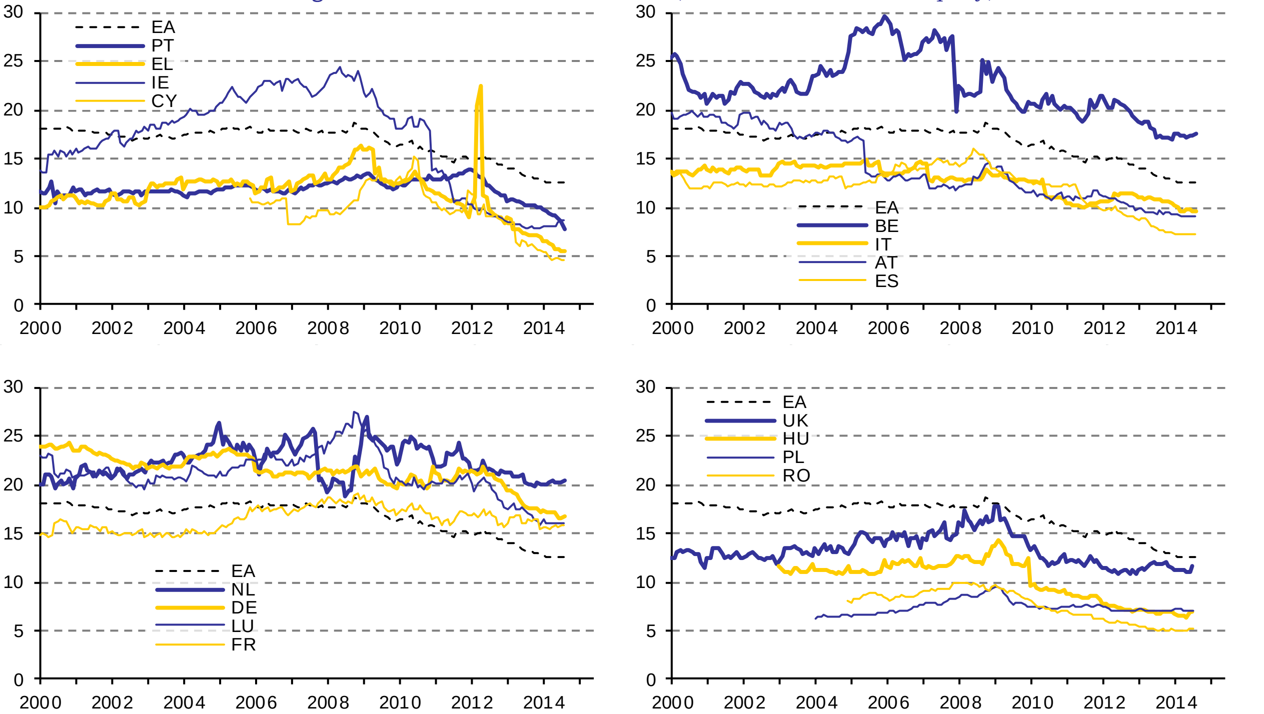
Section 2 introduces the marginal leverage ratio and compares its evolution with the evolution of the absolute leverage ratio for the Euro area as a whole. Such a level of aggregation can conceal strong disparities across countries and banks. In this section, country data for a selection of EU Member States will be examined. Data for all 28 EU Member States are available in Annex A.2.

Following the outbreak of the crisis in 2007-2008, data show a reduction in leverage in all countries. However, a wide range of variation in the value for absolute leverage ratio is still observed across countries: from about 5 to 1 in Cyprus and Greece to above 20 to 1 in the Netherlands (Chart 13).

Higher absolute leverage ratios do not necessarily mean a higher risk. They could be linked to different business models. Depending on the risk profile of their assets, two banks can be subject to the same amount of total risk with very different amounts of asset holdings. However, findings from the BCBS (2013c and 2013d) imply that some banks have developed advanced internal models which stretch the room for manoeuvre in accumulating risk for any given asset holding permitted under the legal framework (see Annex A.1 for details). The co-existence of different methodologies for the risk-weighting of assets jeopardises the comparability of the assessment of risks provided by risk-weighted assets across banks and jurisdictions. This constituted one of the main reasons for introducing a (non-risk-weighted) leverage ratio in Basel III.

While a transitional period for calibration is foreseen, Basel III imposes a unique threshold for the absolute leverage ratio. It was provisionally set at around 30 to 1 (see Section 2.1). The absolute leverage did not cross this value in the last decade in any of the EU countries (Chart 13 and Annex A.2). Therefore, this threshold for the absolute leverage ratio would not have prevented or even predicted the outbreak of the current financial crisis. This paper shows that the marginal leverage ratio supplements the absolute leverage ratio with valuable information (Section 2). This is already the case for the Euro area as a whole and becomes even more relevant at country level. In all countries, data show episodes with a marginal leverage ratios of 30-to-1, 50-to-1 or even above those figures (Chart 14 and Annex A.2).

Chart 13: **Absolute leverage ratio of banks in EU countries**, Total assets to total equity, number of times



Notes: The spike for Greece (EL) corresponds with the losses stemming from the restructuring of the Greek sovereign debt and the subsequent capital injections in Greek banks with funds coming from the EU/IMF programme.
Source: ECB Statistical Data Warehouse and own calculations.

Ireland and Spain were not able to cope with the problems in their banking systems and had to apply for financial support from their European partners[11]. In both cases, data show episodes with extreme marginal leverage ratios. Germany, France and Italy also illustrate periods with extreme marginal leverage ratios as recently as in 2012 in some cases. The case of MdP di Siena, with derivatives that began generating huge losses in 2009 but which was only disclosed by the new board in November 2012, could have probably been detected earlier by monitoring the marginal leverage ratio (see The Economist, 2013).

However, it is not possible to draw conclusions on the basis of the marginal leverage ratio alone. While investigating the origins of these extreme values for marginal leverage ratios goes beyond the purpose of this paper, they could be used by supervisory authorities to detect episodes that deserve more careful scrutiny. Borrowing from the Basel III proposal for the absolute leverage ratio, the threshold of marginal leverage ratio to trigger an in-depth review could tentatively be set at 30 to 1.

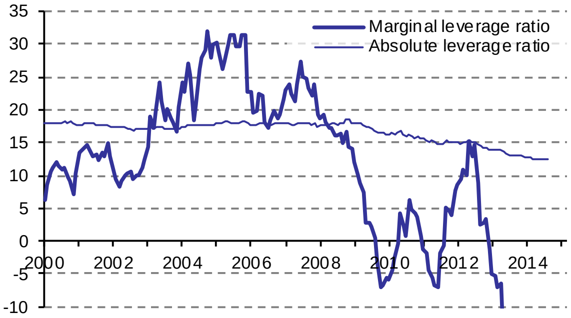
Besides detecting potential pockets of excessive leverage, the marginal leverage ratio also provides information about the deleveraging process, which is evident from the outbreak of the crisis (2007-2008), albeit with different patterns across countries. Banks in France, Germany and Italy underwent some periods of extreme negative marginal leverage in 2009-2011. Soon after, they came back to positive leverage with marginal leverage climbing above absolute leverage. In Spain, marginal leverage has remained subdued for a very long time. Irish banks have experienced a long period with negative and declining marginal leverage. This has impacted the absolute leverage ratio significantly, with a sharp correction from almost 25 to 1 in 2008 to less than 9 to 1 from

[11] For the Irish programme, see European Commission (2013a); for the Spanish programme, see European Commission (2013b). For further details about the architecture of financial support to sovereigns in Europe, see Villar Burke (2012).

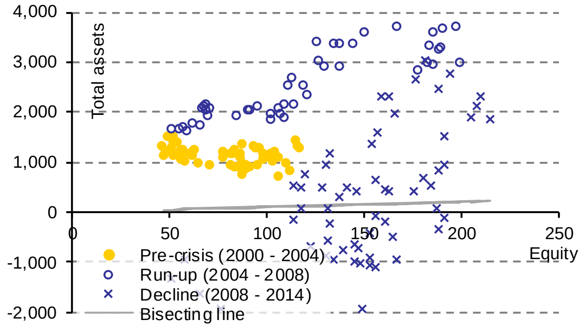
late 2012 onwards. An acceleration in the process of deleveraging is observed across the board from early 2013, although it seems to be winding down in the last few months.

Chart 14a: Absolute vs. marginal leverage ratios,
Euro Area

Absolute vs. marginal leverage ratios, no. of times

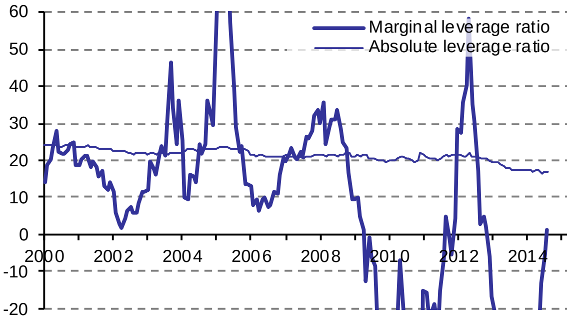


Flows of assets vs. flows of equity, € billion

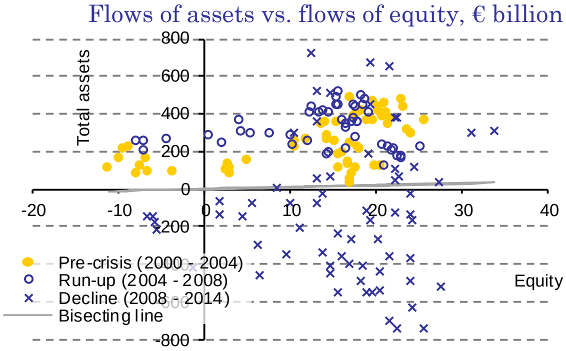


Germany

Absolute vs. marginal leverage ratios, no. of times

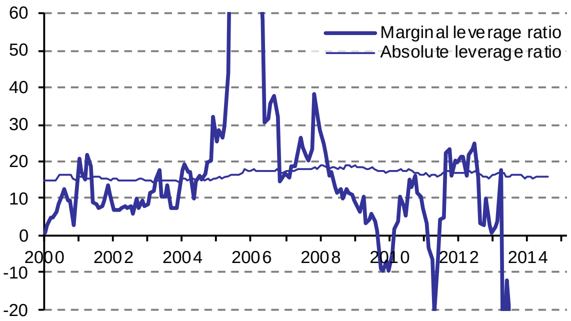


Flows of assets vs. flows of equity, € billion

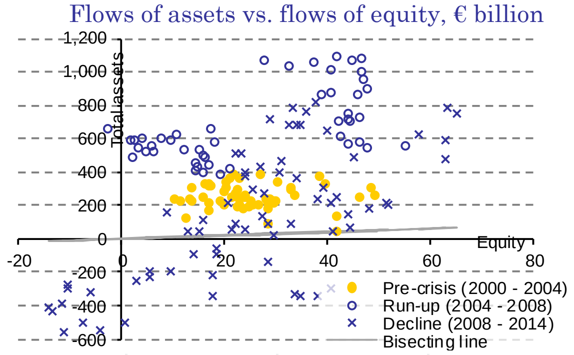


France

Absolute vs. marginal leverage ratios, no. of times

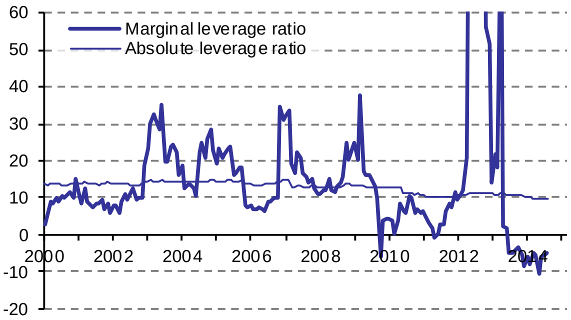


Flows of assets vs. flows of equity, € billion

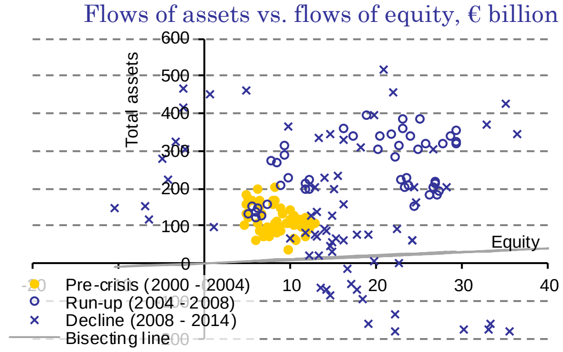


Italy

Absolute vs. marginal leverage ratios, no. of times



Flows of assets vs. flows of equity, € billion

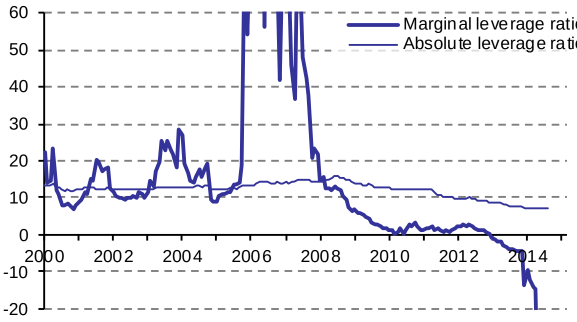


Notes: The absolute leverage ratio is computed as total assets to total equity. The marginal leverage ratio is computed as annual net flows of total assets to annual net flows of equity. Annual flows are computed as the sum of flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions. Pre-crisis: Jan-2000 to Sep-2004; Run-up: Oct-2004 to Sep-2008; Decline: Oct-2008 to the last observation. Additional countries are available at Annex A.2.
Source: ECB Statistical Data Warehouse and own calculations.

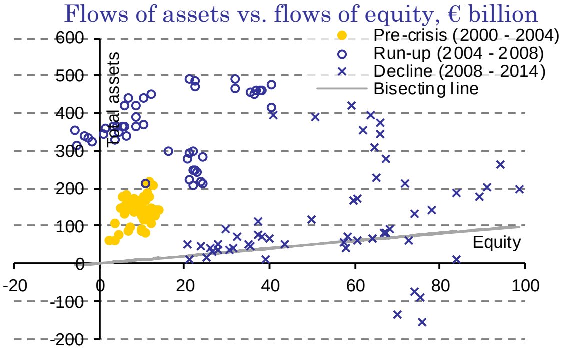
Chart 14b: **Absolute vs. marginal leverage ratios** (continuation)

Spain

Absolute vs. marginal leverage ratios, no. of times

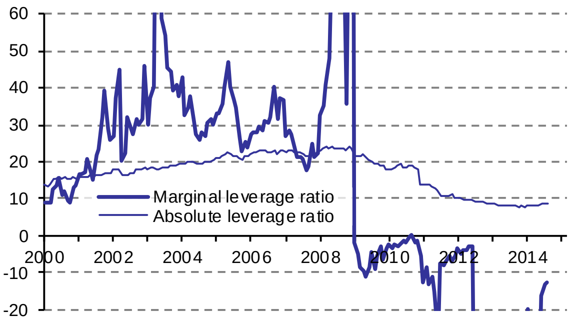


Flows of assets vs. flows of equity, € billion

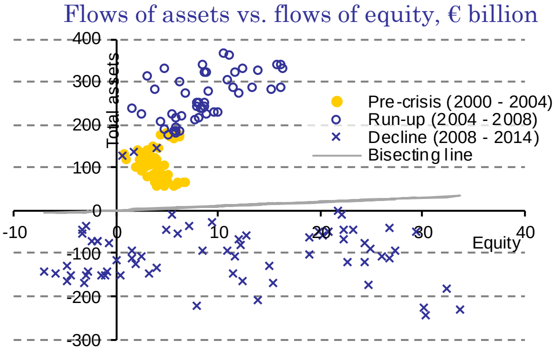


Ireland

Absolute vs. marginal leverage ratios, no. of times



Flows of assets vs. flows of equity, € billion



Notes: The absolute leverage ratio is computed as total assets to total equity. The marginal leverage ratio is computed as annual net flows of total assets to annual net flows of equity. Annual flows are computed as the sum of flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions. Pre-crisis: Jan-2000 to Sep-2004; Run-up: Oct-2004 to Sep-2008; Decline: Oct-2008 to the last observation. Additional countries are available at Annex A.2.
Source: ECB Statistical Data Warehouse and own calculations.

5. Conclusions, recommendations and further research

Two main conclusions can be extracted from the discussion presented in this paper. First, the potential use of the marginal leverage ratio to complement the traditional absolute leverage ratio (Section 5.1.) and, second, the need to better exploit the potential of an approach through flows (Section 5.2).

5.1. A closer monitoring of leverage: the marginal leverage ratio

This paper introduces the marginal leverage ratio as a warning tool to signal potential episodes of excessive leverage and to understand if, and how, banks deleverage. Many macroeconomic models work only under a a logarithmical or differential specification and not on "level". Similarly, it should not be surprising that a measure of leverage expressed in the form of flows (which is indeed the same as differences) may complement or event sometimes substitute a leverage expressed in levels or absolute terms. Supervisory authorities could investigate avenues to integrate this new marginal leverage ratio in their toolbox to supplement the traditional measure of leverage.

The analysis presented in this paper could be extended to other jurisdictions to assess if they remain valid beyond the EU and the Euro Area. It could also be extended to off-balance sheet elements.

A bank-by-bank analysis is another potential extension. This could be undertaken either through the financial statements published by banks or through an anonymous microdata database[12]. Examples of questions worth

[12] This is not an easy task. Banks present their accounts at most quarterly, with many banks only presenting accounts twice a year, not to speak about the months of lag for its publication. Monetary statistics are covered by confidentiality requirements in order to safeguard data quality. Data may not be employed for purposes other than calculating statistics (monitoring individual bank behaviour or sanctioning are included among the non-permitted uses of confidential statistical databases). See, for instance, article 20.2 of Regulation 223/2009 on European statistics. The disclosure of microdata has the problem that big banks may easily be identified (so that microdata cannot be

exploring would include: to what extent is the hyper-activity of banks correlated within a country? Do country aggregates conceal extreme values in specific banks? Are the episodes of extreme values in the marginal leverage ratio provoked by just a few banks within a given country or does it correspond to group herd behaviour?

5.1. THE IMPORTANCE OF FLOWS AS A MONITORING TOOL

The use of flows for monitoring the financial system constitutes a tool which has not been exploited to its full potential by financial analysts, public authorities or academia. A clear example of the importance of flows in financial economics but the still nascent understanding of them could be the targeted LTROs of the ECB. Indeed, the benchmarks and the borrowing allowances are expressed in terms of net flows; however, the explanations and the graphical analysis rely strongly in outstanding amounts[13].

This paper shows how flows can be used for detecting the build-up of excessive leverage and for better understanding the processes of leveraging and deleveraging. Other uses of flows are also outlined: the evolution of core and non-core assets (Chart 10); analysis of bank funding (Chart 08) and analysis of loans, deposits, and loan-to-deposit ratios (Chart 09).

The analysis of flows has a wider potential. Heath (2013) constitutes an example of how public authorities and regulators across the globe are trying to fix the data gaps that prevented them from foreseeing the arrival of the financial crisis. Were national and international authorities and institutions to be more aware of the usefulness of flows, they would collect and disseminate more data on flows.

This being said, a number of databases are already available, although not always exploited to their full potential. The ECB maintains a database with extensive information. Thousands of monthly and quarterly series are available for a wide range of assets and liabilities with various breakdowns: maturities, countries, counterparty sector… Generally, series on flows are directly available; if this is not the case, difference of stocks can be used as a proxy; although, breaks in series may become challenging. Information about the generation and use of funds, that is, data from the profits and loss account, is much scarcer: there is a lot of room for improving the breakdown and frequency of income data (income data are almost limited to a few annual series starting only in 2007 or 2008 compiled on the *"Consolidated Banking Data"* database).

In addition to these monetary statistics available at most central banks, the IMF and the BIS also compile noteworthy databases with data from many countries which are easily comparable. Of particular interest are the monthly *IMF International Financial Statistics*[14], the quarterly *BIS international locational banking statistics*[15] and the quarterly *BIS debt securities*[16].

Finally, the possibility of using flows for the analysis of sector accounts, which compile data for households, non-financial corporations, financial corporations and government, and which are available for many countries could be used more often[17].

disclosed). A compromise solution could be to use anonymous microdata for medium and small banks and public financial statements for the big banks.

[13] See ECB (2014) for further details.

[14] It includes 32,000 time series covering more than 200 countries starting in 1948. It provides, for instance, information on the balance sheet of central banks and financial institutions. See International Monetary Fund (2013).

[15] It includes series on cross board claims by banks since the 1970s. Besides the outstanding amounts, they also calculate exchange rate adjusted changes in stocks that can be used as proxies for flows. See Bank of International Settlements (2012a).

[16] Previously, the database was restricted to international debt securities, but recently it has been extended to also domestic debt securities. See Bank of International Settlements (2013a) and Bank of International Settlements (2012b).

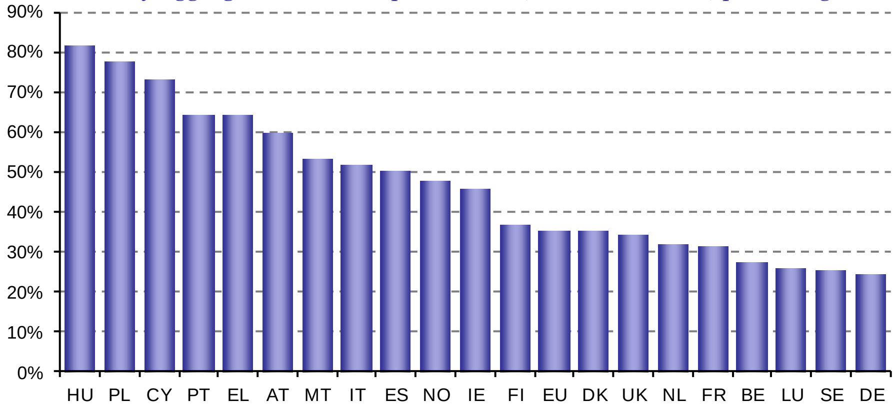
[17] For an example of the use of sector account flows, see Duc and Le Breton (2009) and European Central Bank (2011b). Sector accounts for EU Member States are available at: http://sdw.ecb.int/browse.do?node=2019183.

ANNEX A – ADDITIONAL CHARTS

A.1. RISK PROFILE OR CAPITAL EFFICIENCY

Chart A1 shows the ratio between risk-weighted assets (RWA) and total assets (TA). If the risk-weight were to indicate accurately the risk and all the banks were to use the same model, that ratio of RWA to TA would indicate the risk profile of each bank. Capital regulation sets risk-weights for a broad category of products. However, because it is difficult to establish the actual risk of financial assets beforehand, banks are allowed to use their own internal models to assess the risk of their portfolios. These models are normally based on probabilistic mathematical models built on the concept of value at risk (VaR) for market risk or on probabilities of default (PDs) and loss given default (LGDs) for credit risk. Those advanced models usually yield a lower risk profile than the generic weights proposed in legislation.

Chart A1: **Risk-weighted assets to total assets**
Country aggregates for a sample of banks, December 2011, percentage



Source: EBA – Capital exercise, Bloomberg and own calculations.

The rationale of the flexibility allowed by the legislator was for banks to be able to assess their risks more accurately. However, in some cases, banks have interpreted that flexibility as a quest for "capital efficiency". Bruno and Shin (2012a, Figure 4) show how, for Barclays, risk-weighting barely changed, even when the raw assets are adjusted by large amounts. Similarly, Nordea's CEO Christian Clausen (2013, Part 5, minutes 19:20 to 21:00) explains how banks try to structure their lending in a way that requires the least risk-weighted assets. Indeed, as measured in Chart A01, the Swedish banking system is the second most "efficient" one in terms of capital.

Basel III (paragraph 152) understands the leverage ratio as a supplement of risk based capital requirements, that allows the build-up of leverage in the banking sector to be constrained and to reinforce the risk based requirements with a simple, non-risk based “backstop” measure.

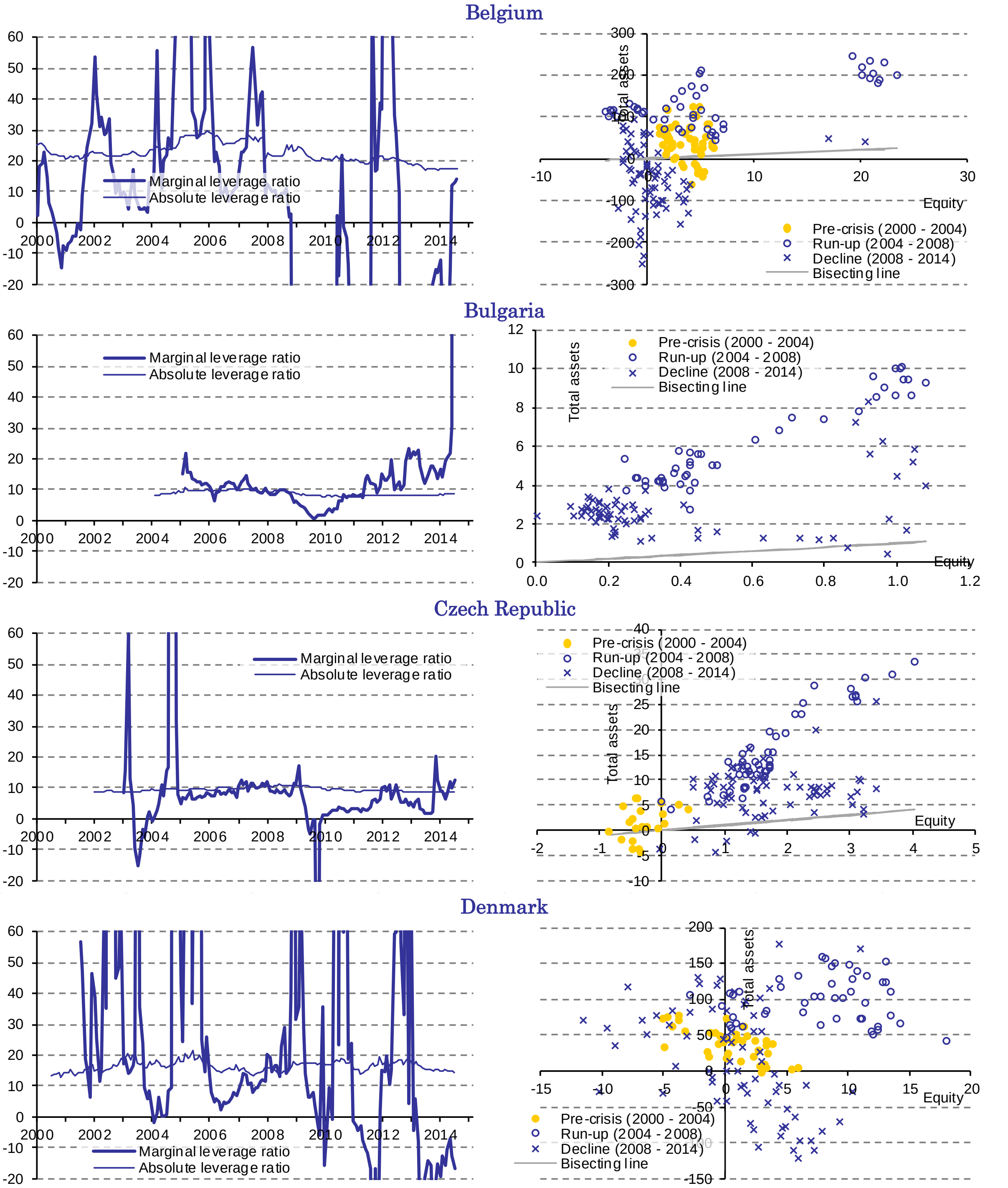
A.2. ABSOLUTE AND MARGINAL LEVERAGE RATIOS AND ITS COMPONENTS

In this Annex, data on absolute and marginal leverage ratios are gathered for all 28 EU Member States. The left-hand panels present the absolute and marginal leverage ratios and the right-hand panels illustrate the components of the marginal leverage ratio: flows of assets and equity. As in Charts 07 and 14, the observation period (2000 – 2013) has been divided into three stages: pre-crisis (from January 2000 to September 2004), build-up of leverage (from October 2004 to September 2008) and deleveraging (from October 2008 to the last observation). Although some countries have entered each stage with some lag, I have retained the same breakdown for comparative reasons.

The ECB does not publish flow data for Denmark and the UK (although, at least for the UK, they are available at the National Central Bank). For these two countries, the annual flows have been replaced with the difference of stocks.

Chart A2a: **Absolute vs. marginal leverage ratios and components**

Absolute vs. marginal leverage ratios, no. of times — Flows of assets vs. flows of equity, € billion



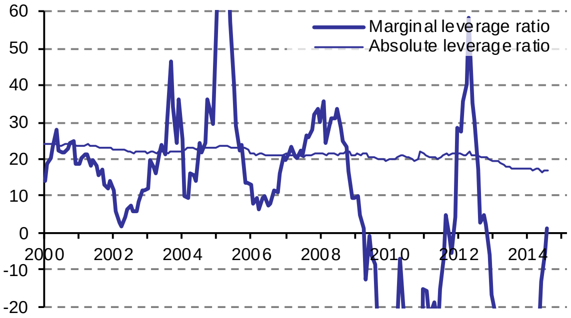
Notes: The absolute leverage ratio is constructed as total assets to total equity. The marginal leverage ratio is computed as annual net flows of total assets to annual net flows of equity. Net flows correspond to annual flows which are computed as the sum of net flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions. For Denmark, differences of stocks are used as a proxy for net flows. Pre-crisis: Jan-2000 to Sep-2004; Run-up: Oct-2004 to Sep-2008; Decline: Oct-2008 to the last observation.
Source: ECB Statistical Data Warehouse and own calculations.

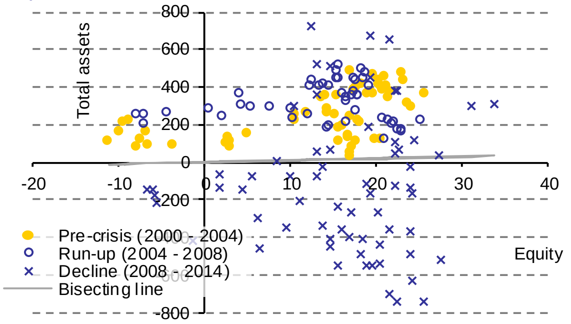
Chart A2b: **Absolute vs. marginal leverage ratios and components** (continuation)

Absolute vs. marginal leverage ratios, no. of times

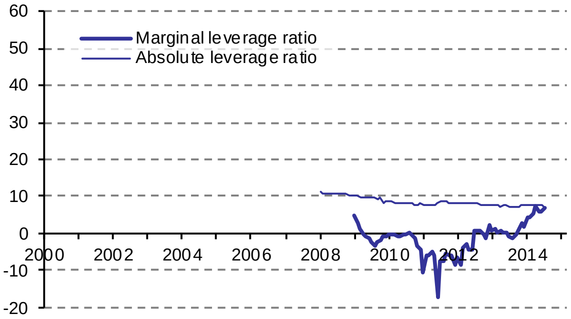
Flows of assets vs. flows of equity, € billion

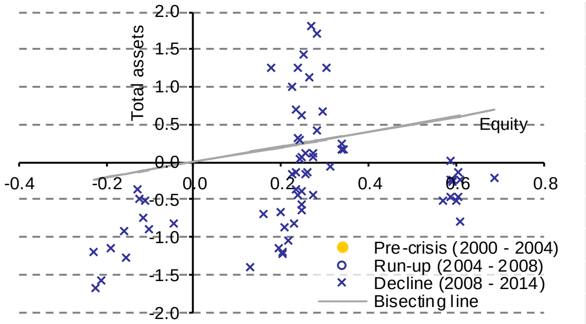
Germany



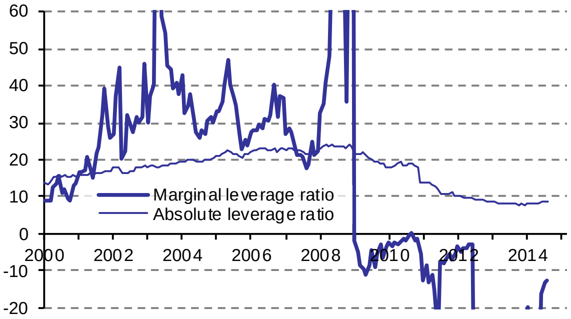


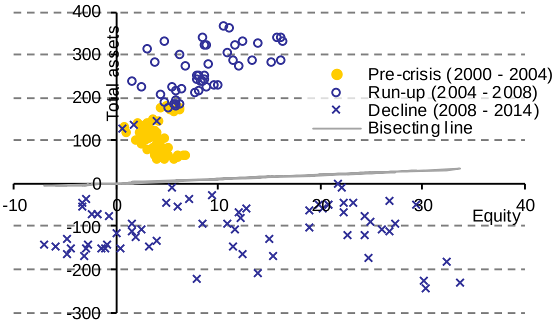
Estonia



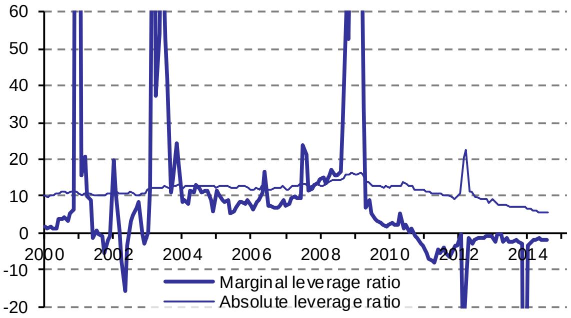


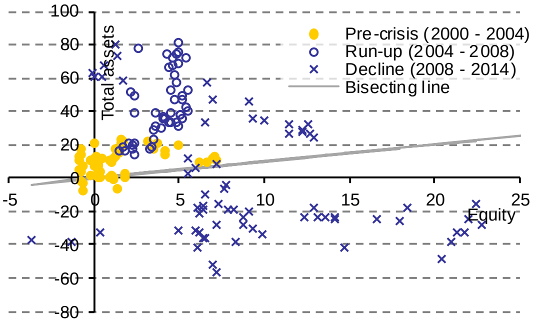
Ireland





Greece



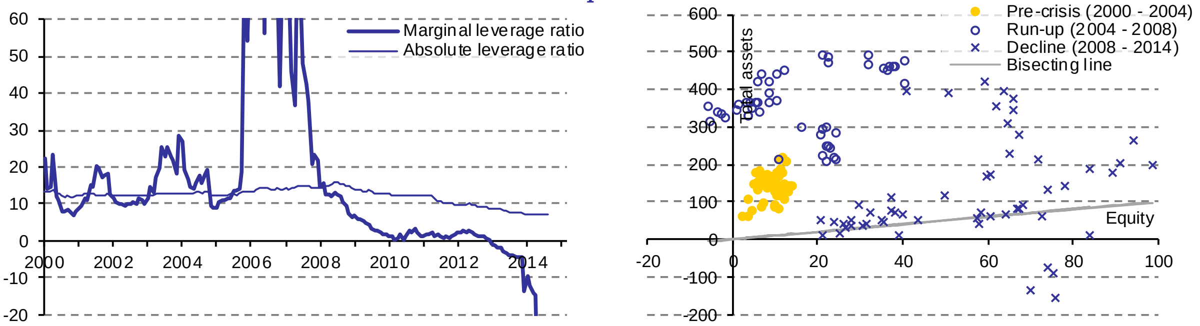


Notes: The absolute leverage ratio is constructed as total assets to total equity. The marginal leverage ratio is computed as annual net flows of total assets to annual net flows of equity. Net flows correspond to annual flows which are computed as the sum of net flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions. Pre-crisis: Jan-2000 to Sep-2004; Run-up: Oct-2004 to Sep-2008; Decline: Oct-2008 to the last observation.
Source: ECB Statistical Data Warehouse and own calculations.

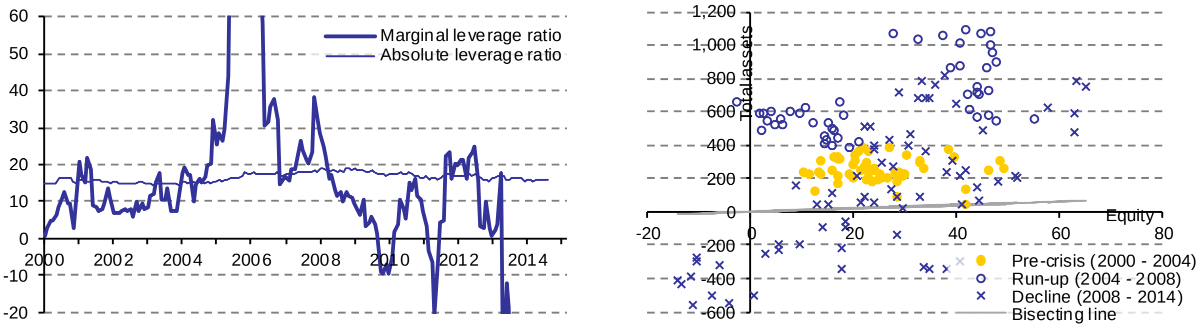
Chart A2c: **Absolute vs. marginal leverage ratios and components** (continuation)

Absolute vs. marginal leverage ratios, no. of times — Flows of assets vs. flows of equity, € billion

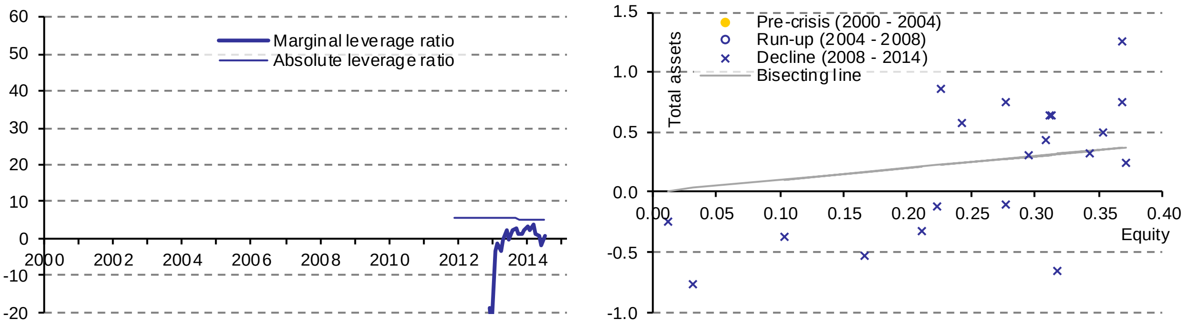
Spain



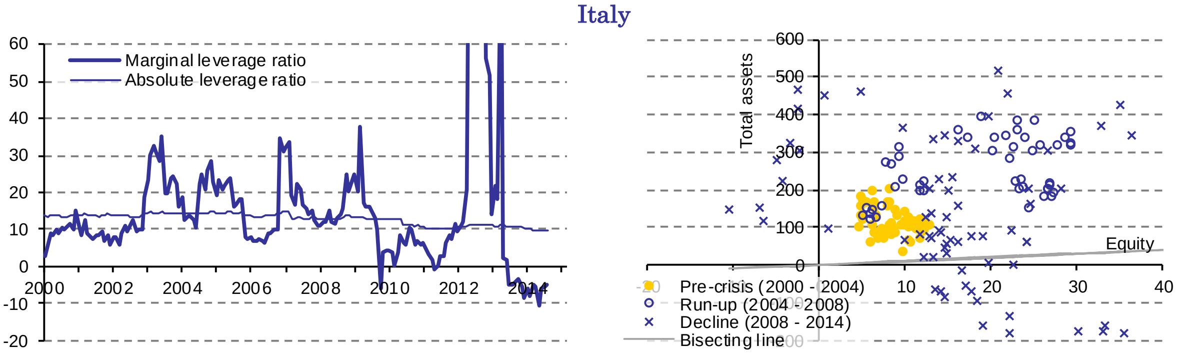
France



Croatia



Italy

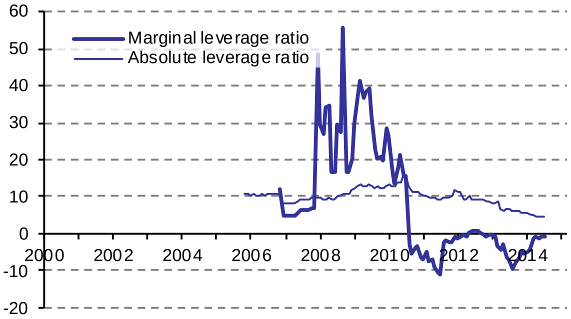


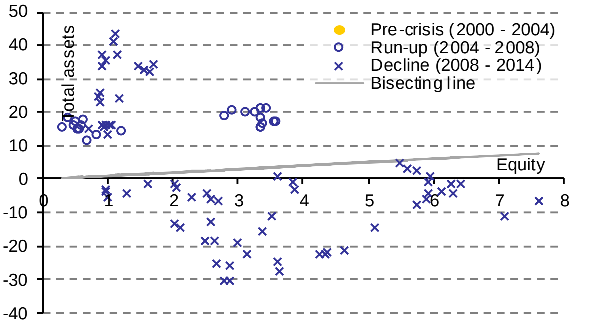
Notes: The absolute leverage ratio is constructed as total assets to total equity. The marginal leverage ratio is computed as annual net flows of total assets to annual net flows of equity. Net flows correspond to annual flows which are computed as the sum of net flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions. Pre-crisis: Jan-2000 to Sep-2004; Run-up: Oct-2004 to Sep-2008; Decline: Oct-2008 to the last observation.
Source: ECB Statistical Data Warehouse and own calculations.

Chart A2d: **Absolute vs. marginal leverage ratios and components** (continuation)

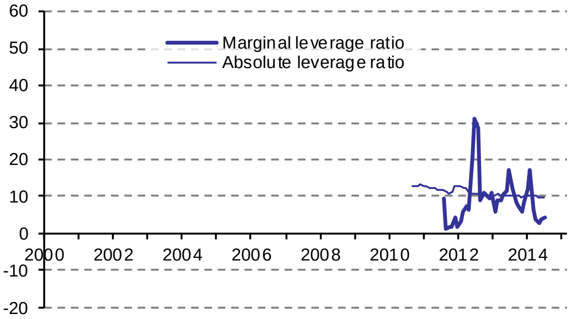
Absolute vs. marginal leverage ratios, no. of times — Flows of assets vs. flows of equity, € billion

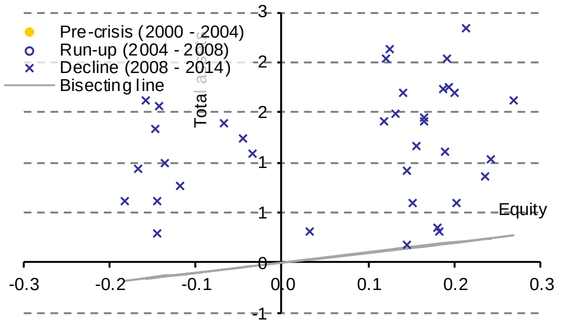
Cyprus



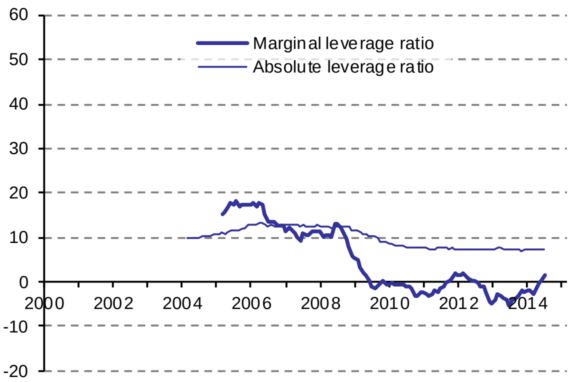


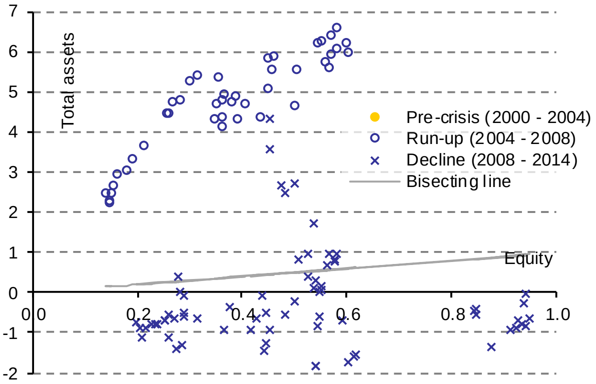
Latvia



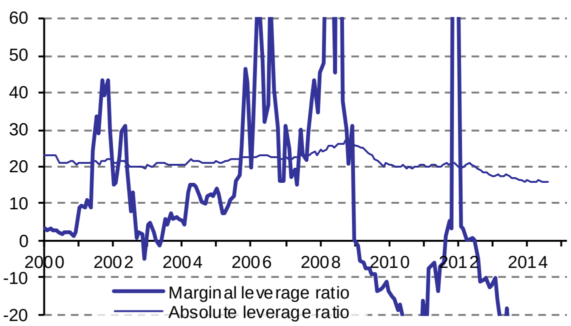


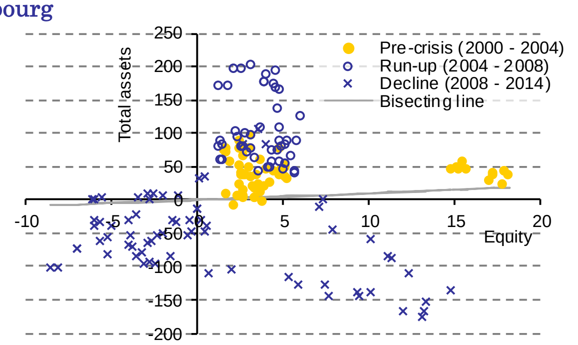
Lithuania





Luxembourg



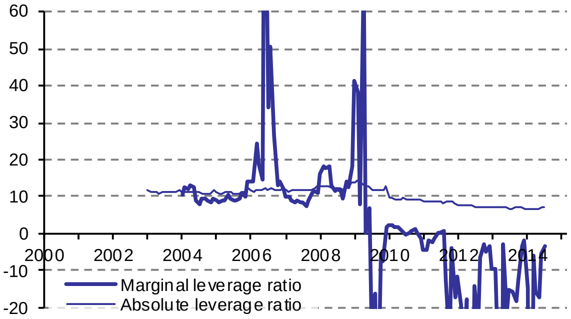


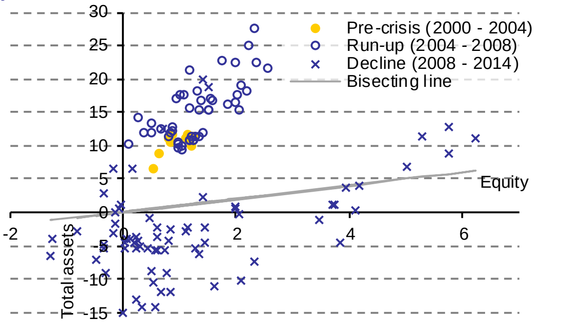
Notes: The absolute leverage ratio is constructed as total assets to total equity. The marginal leverage ratio is computed as annual net flows of total assets to annual net flows of equity. Net flows correspond to annual flows which are computed as the sum of net flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions. Pre-crisis: Jan-2000 to Sep-2004; Run-up: Oct-2004 to Sep-2008; Decline: Oct-2008 to the last observation.
Source: ECB Statistical Data Warehouse and own calculations.

Chart A2e: **Absolute vs. marginal leverage ratios and components** (continuation)

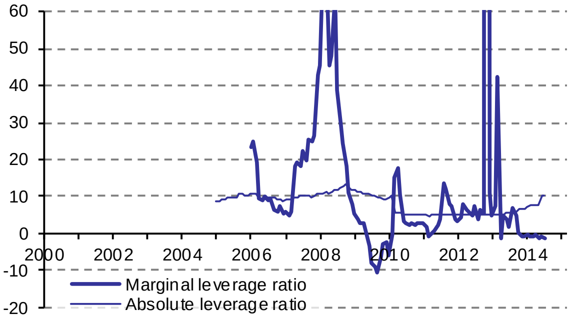
Absolute vs. marginal leverage ratios, no. of times — Flows of assets vs. flows of equity, € billion

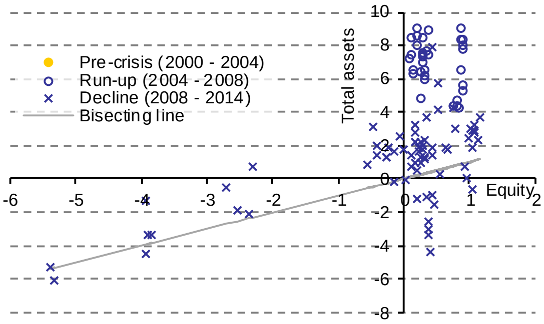
Hungary



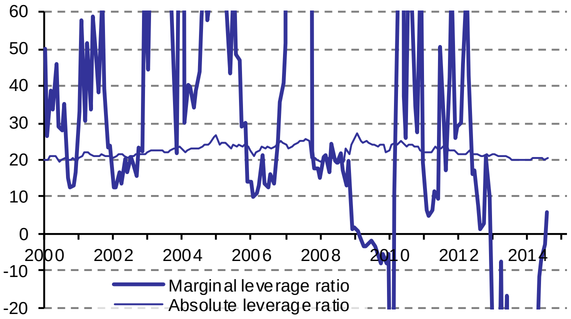


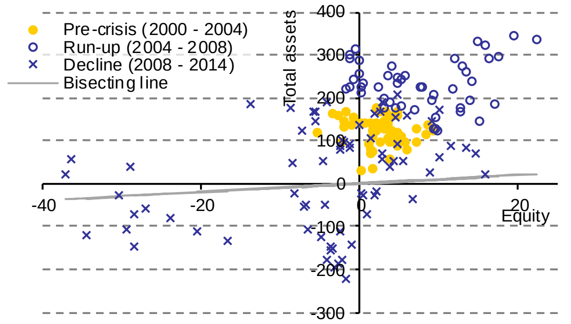
Malta



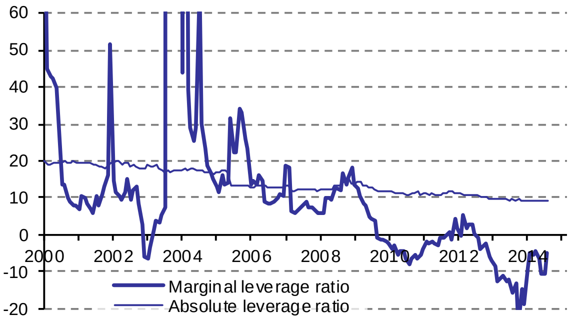


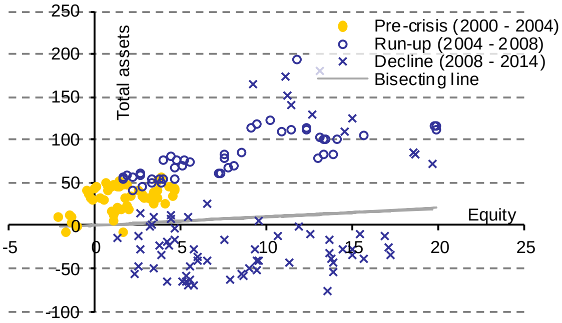
Netherlands





Austria



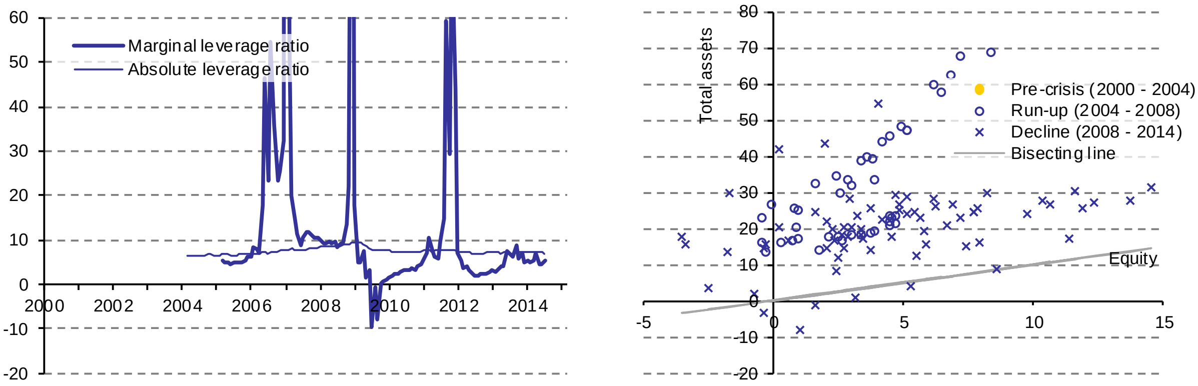


Notes: The absolute leverage ratio is constructed as total assets to total equity. The marginal leverage ratio is computed as annual net flows of total assets to annual net flows of equity. Net flows correspond to annual flows which are computed as the sum of net flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions. Pre-crisis: Jan-2000 to Sep-2004; Run-up: Oct-2004 to Sep-2008; Decline: Oct-2008 to the last observation.
Source: ECB Statistical Data Warehouse and own calculations.

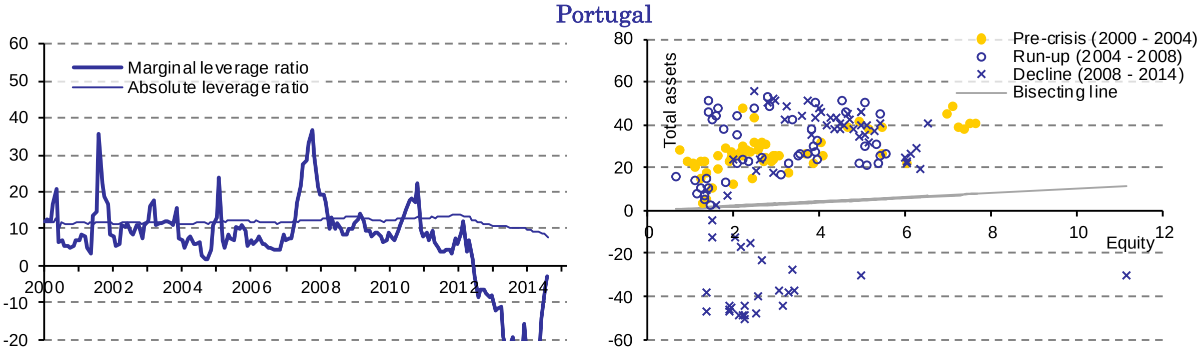
Chart A2f: **Absolute vs. marginal leverage ratios and components** (continuation)

Absolute vs. marginal leverage ratios, no. of times | Flows of assets vs. flows of equity, € billion

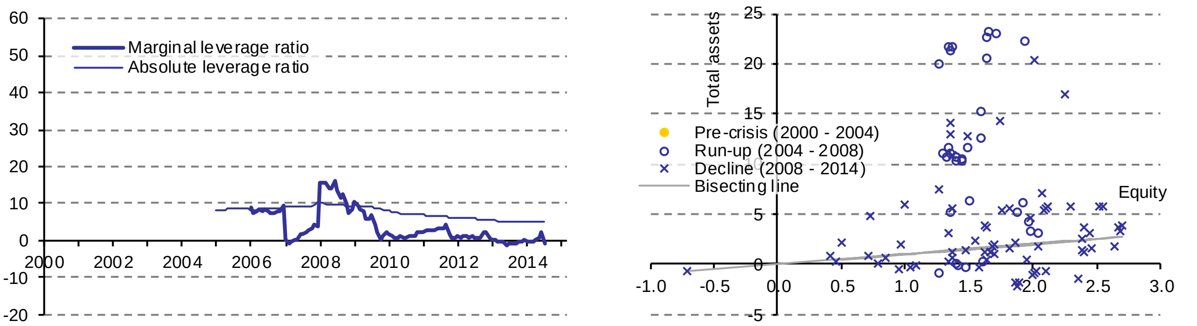
Poland



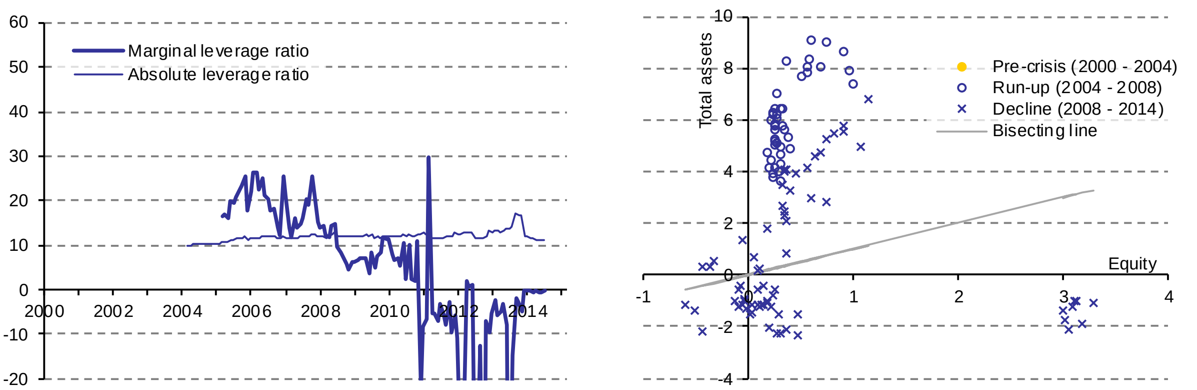
Portugal



Romania



Slovenia



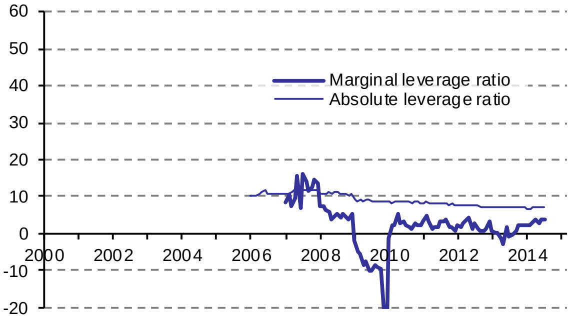
Notes: The absolute leverage ratio is constructed as total assets to total equity. The marginal leverage ratio is computed as annual net flows of total assets to annual net flows of equity. Net flows correspond to annual flows which are computed as the sum of net flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions. Pre-crisis: Jan-2000 to Sep-2004; Run-up: Oct-2004 to Sep-2008; Decline: Oct-2008 to the last observation.
Source: ECB Statistical Data Warehouse and own calculations.

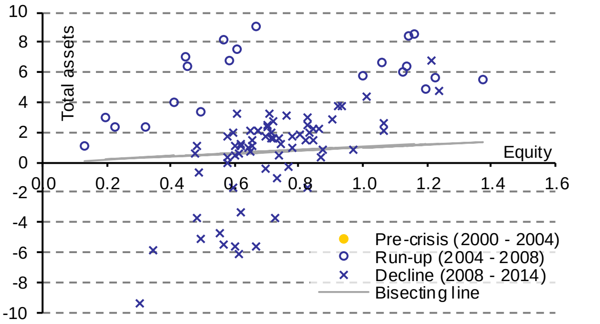
Chart A2g: **Absolute vs. marginal leverage ratios and components** (continuation)

Absolute vs. marginal leverage ratios, no. of times

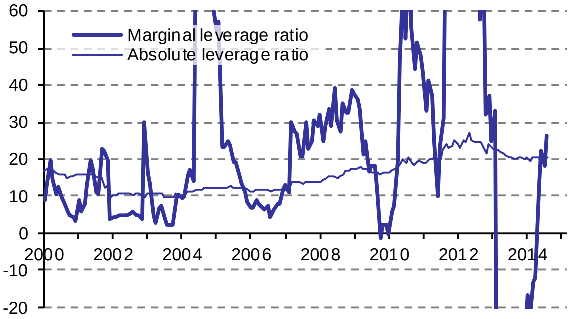
Flows of assets vs. flows of equity, € billion

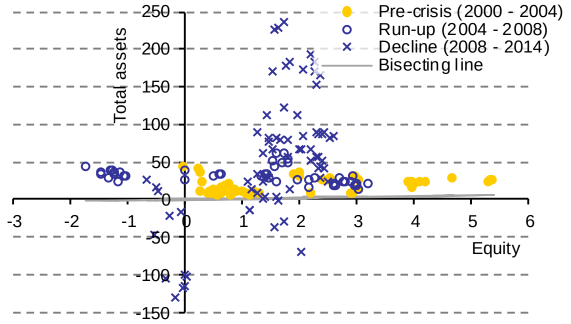
Slovakia



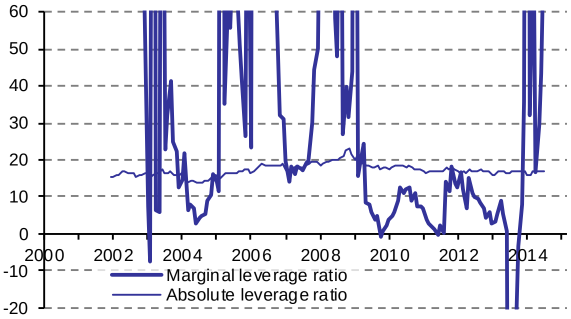


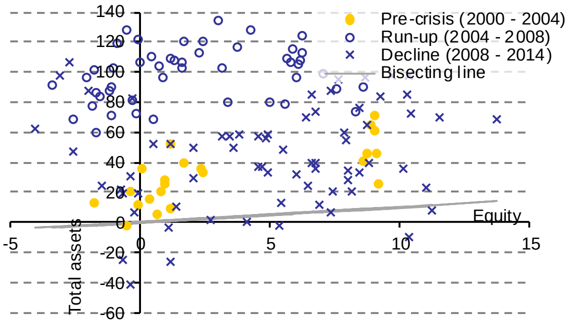
Finland



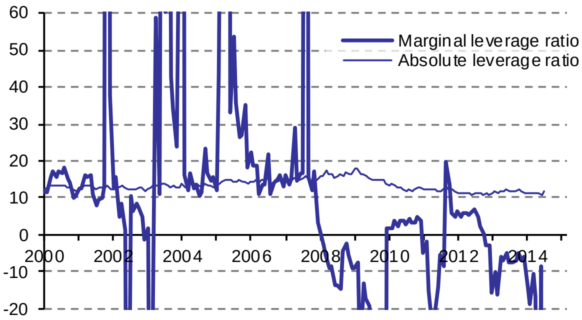


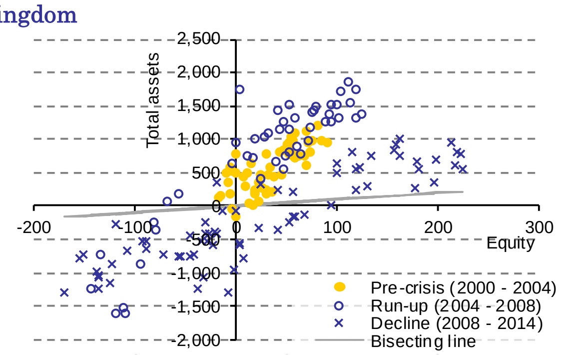
Sweden





United Kingdom





Notes: The absolute leverage ratio is constructed as total assets to total equity. The marginal leverage ratio is computed as annual net flows of total assets to annual net flows of equity. Net flows correspond to annual flows which are computed as the sum of net flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions. For the UK, differences of stocks are used as a proxy for net flows Pre-crisis: Jan-2000 to Sep-2004; Run-up: Oct-2004 to Sep-2008; Decline: Oct-2008 to the last observation.
Source: ECB Statistical Data Warehouse and own calculations.

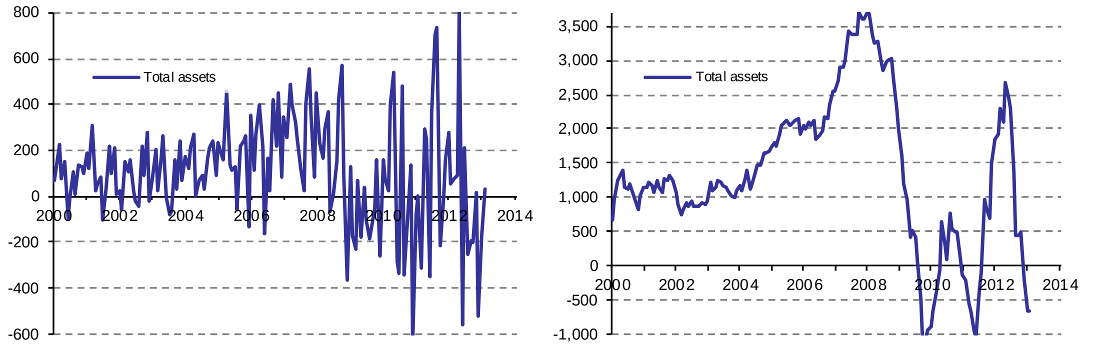
ANNEX B – METHODOLOGICAL NOTE

B.1. COMPUTATION OF ANNUAL FLOWS

The analysis of flow is based on the computation of annual flows from monthly series. High frequency series are embedded with seasonality. Monthly flows can be adjusted for seasonality by computing annual flows as the sum of twelve consecutive months in a rolling window. For instance, the annual net flow for March 2010 is computed as the sum of the monthly flows from April 2009 to March 2010. This is similar to a moving average but without dividing by the number of periods. The result is an absolute annual growth measured in Euros. Charts B1 and B2 show the monthly flows of total assets and equity and the result of the computation of the annual flows.

Chart B1: **Flows of total assets: monthly vs. annual**, Euro area banks, € billion

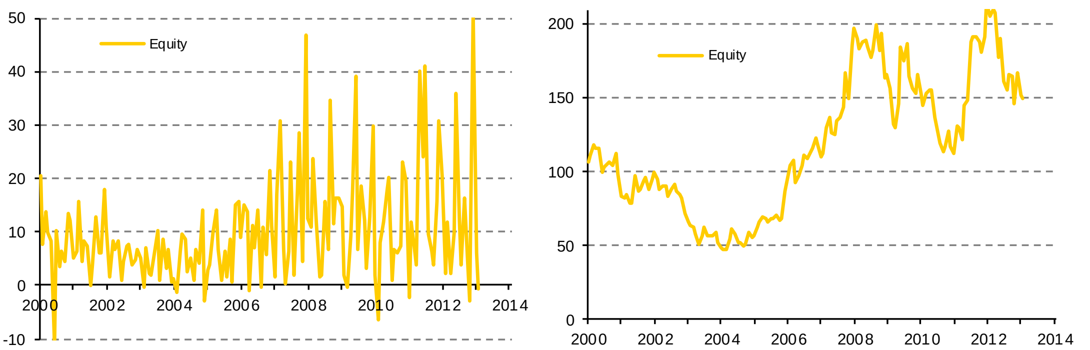
Monthly flows | Annual flows



Notes: Annual flows are constructed as the sum of net flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions.
Source: ECB and own calculations.

Chart B2: **Flows of equity: monthly vs. annual**, Euro area banks, € billion

Monthly flows | Annual flows



Notes: Annual flows are constructed as the sum of net flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions.
Source: ECB and own calculations.

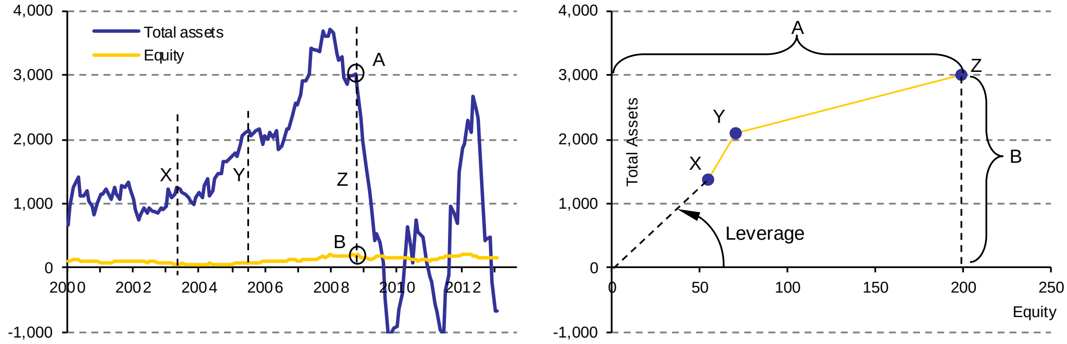
B.2. USE OF SCATTER PLOTS TO REPRESENT LEVERAGE AND ITS COMPONENTS

A scatter plot allows the three main variables of this paper: assets (flows), equity (flows) and (marginal) leverage to be captured in a single chart. Assets and equity are represented on each one of the two axes and the leverage corresponds to the slope of each observation.

Evolution can be represented with a line which joins the observations in a chronological order (for instance, the line going from point X to point Y and then to point Z marks the chronological evolution). However, when a chart includes many observations, adding a chronological line can make the chart unreadable. As an alternative, in this paper, the sample has been divided into three periods (a "pre-crisis" period from January 2000 to September 2004, a "run-up" period from October 2005 to September 2008 and a "decline" period from October 2008 to the last observations), using different colours to represent different periods. The outbreak of the crisis occurred with a certain lag across countries. However, to facilitate comparisons, the same three periods for all countries have been maintained.

Chart B3: **Scatter Plot**, Euro area banks

Evolution of annual flows, € billion | Scatter Plot, € billion



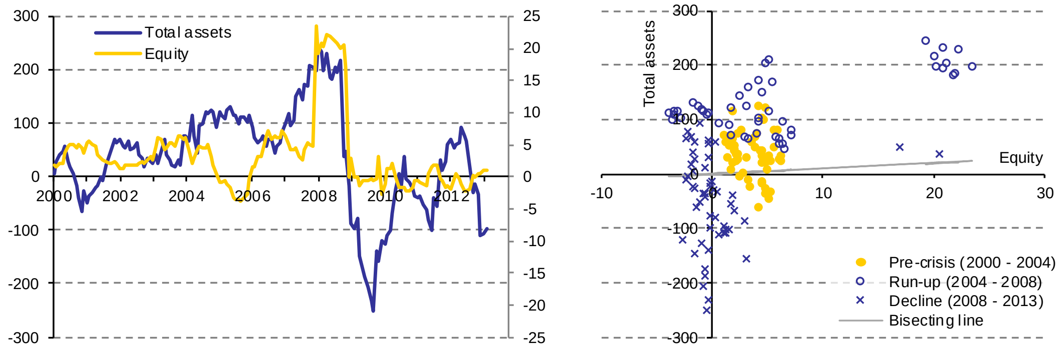
Notes: Annual flows are constructed as the sum of net flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions.
Source: ECB and own calculations.

B.3. Computation of the marginal leverage ratio

The volume of assets and equity is always a positive magnitude, meaning that its representation in a scatter plot will always fall in the first quadrant. However, flows can either be positive (increases) or negative (decreases). As a consequence, observations of flows of assets and equity can appear in any of the four quadrants (Chart B4, right-hand panel).

Chart B4: **Scatter Plot**, Belgian banks

Evolution of annual flows (2 axis), € billion | Scatter Plot, € billion



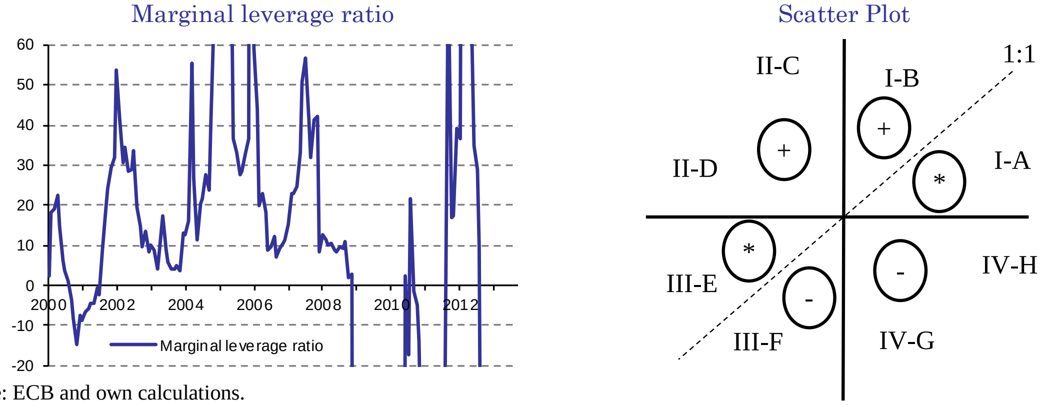
Notes: Annual flows are constructed as the sum of net flows for 12 consecutive months through a rolling window. "Net" refers to new transactions minus redemptions.
Source: ECB and own calculations.

Declines in equity (negative flows) imply an increase in leverage. As a consequence, flows of equity enter the formula of marginal leverage ratio as absolute values (see Equation B1).

$$Marginal\ leverage\ ratio = \frac{Flows\ of\ total\ assets}{ABS(Flows\ of\ equity)} \qquad \text{(Equation B1)}$$

The observations falling in octants B, C and D clearly have a positive marginal leverage ratio while the ones falling in octants F, G and H clearly have a negative marginal leverage ratio. The situation is more ambiguous for the points in octant A as they correspond to observations with leverage below 1-to-1. It could be argued that these points need to switch signs, but I will stick to the outcome of Equation B1. As can be seen from Chart B4, the observations falling in this octant A are quite rare and they only correspond to a transition between positive to negative leverage. Octant E is a similar case.

Chart B5: **Total assets and equity: net flows**, Belgian banks, € billion



Source: ECB and own calculations.

A final remark needs to be made about the meaning of extreme values in the marginal leverage ratio and, in particular, the effect of a small denominator. Chart B4 shows that flows of assets can expand two or three-fold but not much beyond that. At the same time, there are many observations with an equity flow close to zero. Very low values in the denominator make the ratio tend to infinity. In this case, rather than the specific value of the ratio, the information that needs to be retained is that the denominator (equity) has a value close to zero.

This is the reason why marginal ratio charts (e.g. Chart B5, left-hand panel) are capped at 60 to 1 on the positive side and at 20 to 1 on the negative side. Reasonable values for the leverage ratio are the outcome of the interaction between assets and equity flows; however, extreme values signal a very low (zero or close to zero) value of the denominator (equity flows).

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