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Articles:

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EDITORIAL

As announced in its Strategic Plan, the Autorité des Marchés Financiers (AMF) has this year reactivated the Scientific Advisory Board, formed in 2004. The three specific aims are to contribute to the AMF's regulatory policy, enhance its study and review capability, and promote research into the French financial industry by organising conferences and other academic work.

One of the initiatives for achieving those aims is the launch of a new publication: the Scientific Advisory Board Review, and we are happy to present the first issue. The Review is not confined to work produced by the Board's members; it will promote or publicise original research not previously published elsewhere. Another original feature is that it will endeavour to forge links between authors from different backgrounds, whether in academia or the financial industry. Last but not least, all the articles will focus on newsworthy developments or regulatory issues. In this way, the Review will contribute to the dialogue the AMF wants to foster between authorities, researchers and professionals in order to raise the standard of financial market regulation, investor protection and financial stability.

Naturally, launching a review means wagering on the future. Going forward, we hope the timely, accessible and high-quality analyses published in the Scientific Advisory Board Review will provide answers to the sometimes complex questions on the functioning of financial markets. We also want to clarify the ongoing debate about how the markets can best contribute to financing the real economy.

This first issue of the Review looks at liquidity and the way it is fragmented between markets or between countries. This vitally important question has been highlighted by recent developments in the field of finance. We hope readers will find useful analytical input that they can use to advance their ideas and, more importantly, to continue dialoguing with the AMF. This would be the best possible outcome for everyone.

Gérard Rameix,
Chairman, Scientific Advisory Board
Board

Christian de Boissieu,
Vice-Chairman, Scientific Advisory

The AMF Scientific Advisory Board

The AMF set up a Scientific Advisory Board composed of prominent figures from the academic and financial worlds to expand its research and strategic intelligence capabilities.

he members of the Scientific Advisory Board hold positions in leading universities, business schools and public and private research centres. The board includes foreign researchers of international reputation, which gives it a global perspective. It has a triple remit:

1. provide the AMF with information on ongoing academic research in the financial field,
2. identify developments that may have an impact on the AMF's areas of activity,
3. undertake research projects related to issues of concern to the regulator.

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To help disseminate the Scientific Advisory Board's research, the AMF organises an annual conference that brings together the financial and academic communities to examine a specific topic.

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- Market fragmentation: assessments and prospects?
  Carole Gresse, Université Paris Dauphine ..... p. 23

  This paper provides an overview of the knowledge available to date on market fragmentation and its consequences, with a specific focus on the European experience. Since the implementation of MiFID1 on 1 November 2007, market fragmentation has considerably increased in European stock markets without however reaching the same level as in the U.S. At present, in Europe, three trading platforms have become significant players and their joint market share exceeds 30% of lit trading volumes. Regulated dark pools do not execute more than some 5% of the total trading volumes. In contrast, OTC trading makes a large share of total volumes. The empirical evidence converges to show that fragmentation has generally contributed to improving liquidity with greater benefits for global traders who connect to several platforms and greater liquidity gains on large capitalization stocks. Adverse effects on the depth of small stocks may be observed locally in their primary market but they are more the outcome of algorithmic trading than that of fragmentation. Further, while dark trading in crossing engines is shown to improve liquidity, the impact of OTC trading is mixed and the lack of strong conclusion on this issue leaves room for further research. Finally, price quality does not appear to be significantly affected by market fragmentation in European stock markets.

- France: Is there a real shortage of long-term financing of the economy?
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  It is often agreed that growth in France is endangered by the shortage of long-term financing of the economy, in particular of the corporate sector. We show that, globally, long-term financing is clearly sufficient in France. SMEs in particular have a very important capital. Two concerns remain. The very important role of non-listed equities in the financing of the corporate sector; the underdevelopment of venture capital.

- Towards dynamic measures of liquidity
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  Empirical studies targeting the understanding of orderbook dynamics at high frequency have been conducted on market data for several years. They identified some "stylized facts" that can be found on any dataset, and almost any financial instrument traded via limit orderbooks. Now that very accurate databases are available, with exhaustive labelling (like the type of each market participant, its use of low latency hardware, etc.), it could be valuable to study how these stylized facts are affected by these labels.
  This short paper does not intend to be an extensive review of such stylized facts, but gives a fast overview of the most important of them.
  The shape of the market impact of large metaorders (i.e. the decomposition of market impact among transient impact, temporary impact, decay and permanent impact), and propagation models (the positive autocorrelation of the signs of the trades and the negative autocorrelations of price returns) are stylized facts of importance. Moreover some statistical artefacts like the "signature plot" and the "Epps effect" have to be taken into account when investigating in these directions.
  We can hope accurate studies will be able to answer questions about the persistence of these effects when the orderbook dynamics are conditioned by the nature of market participants (are they intermediaries, institutional investors? do they trade at high frequency? Etc.). It would shed light on the nature of liquidity dynamics emerging from the usual mixes of market participants.

Sudden stop of capital flows to emerging countries and to the countries in the southern eurozone: Irrational decrease in the international mobility of capital or normal consequence of the loss of external solvency?

Patrick Artus, Natixis

Abstract

The crisis has not reduced the international mobility of capital between the large OECD countries (United States, United Kingdom, eurozone, Japan). But one has observed the segmentation of capital markets in the recent years between the North and the southern eurozone and, recently, between OECD countries and emerging countries. In the first case, it is actually an external solvency crisis: South European counties have accumulated a large external debt vis a vis North European countries mostly to accumulate an inefficient capital. In the second case, a brutal stop of capital flows occurred, due to a surge in risk aversion vis a vis emerging countries, without any clear sign of a problem with external solvency.

Résumé

La crise n'a pas réduit la mobilité internationale du capital entre les grandes régions de l'OCDE (Etats-Unis, Royaume-Uni, zone euro, Japon). Mais on observe une segmentation des marchés de capitaux d'une part entre le Nord et le Sud de la zone euro, d'autre part dans la période récente entre les pays de l'OCDE et les pays émergents. Dans le premier cas, il s'agit bien d'une crise de solvabilité externe: les pays du Sud de la zone euro se sont endettés auprès des pays du Nord de la zone euro surtout pour constituer du capital inefficace. Dans le second cas, il s'agit d'un arrêt brutal des flux de capitaux dû à un retour de l'aversion pour le risque émergent sans qu'il y ait de signe clair de problème de solvabilité externe.

An unwarranted collapse in international capital mobility would lead to an obvious loss of well-being. In particular, savings would no longer be allocated efficiently to investment projects in different countries, and the cost of capital would rise abnormally in countries where profitable projects could not find financing. This situation should prompt governments and international institutions to set up international financing mechanisms that can substitute for private capital flows. The European Investment Bank (EIB), the European Financial Stability Facility – European Stability Mechanism (EFSF-ESM) and the eurozone's Target 2 system are all examples of such mechanisms.

When considering the risk of cross-country segmentation of capital markets, the debates around the Feldstein and Horioka tests naturally come to mind. In the following we recall the possible explanations for the Feldstein and Horioka puzzle, which concerns the fact that domestic investment and savings are closely linked despite the removal of barriers to international capital mobility.

Right now, however, we believe that the real question is to determine whether the decline in international capital flows (towards emerging and southern eurozone countries) is due to an abnormal decline in the international mobility of capital, which should be countered, or to investor recognition of reduced external solvency in countries with chronic external deficits likely stemming from the use of external debt to finance unprofitable investments.

Introduction: the Feldstein-Horioka puzzle

Feldstein and Horioka (1980) point to a **significant link between a country's investment rate and its savings rate**. In their initial work, an increase of 1 in savings resulted in an increase of 0.9 in investment. This implies that the current account balance and the **balance on the capital account are very small relative to savings and investment, despite the increased international mobility of capital**. The close link between domestic savings and investment is not due to the correlation of savings and investment with other variables (Feldstein (1983)).
The link is clearer for OECD countries than for emerging countries (Feldstein (2005), Mussa-Goldstein (1993)); before the crisis, the link weakened considerably among eurozone countries (Blanchard-Giavazzi (2002))[1]

Since 1980, the literature has sought explanations for the Feldstein-Horioka puzzle:

- Feldstein-Horioka themselves consider that short-term international financial capital is mobile, **but capital invested in the real economy is not;**
- For Obstfeld-Rogoff (2000), if there are transport costs for goods, current account imbalances imply large variations in the relative prices of domestic and traded goods and hence large variations in real interest rates, which are rejected (see also Frenkel (1986)). In this view, the Feldstein-Horioka puzzle stems from the **imperfect international mobility of goods;**
- Another explanation refers to imperfect international capital mobility owing to a **home bias in financial portfolios,** as savers prefer to hold their own country's securities, for example because of informational asymmetries (Martin-Rey (1999); Portes-Rey (1999));
- The Feldstein-Horioka approach is static; the literature subsequently developed the **intertemporal theory of the current account** (Frenkel-Raszin (1986); Svensson-Razin (1983); Stockman-Svensson (1987); Persson-Svensson (1985)). Intertemporal smoothing of consumption means that temporary (output) shocks lead to changes in the current account balance but that **permanent shocks** are corrected by a change in spending behaviour and do not affect the **current account balance**;

[1] See for example the surveys by Coakley-Kulasi-Smith (1998); Obstfeld (1986); Vamvakidis-Wacziarg (1998).

- Roubini (1988) shows that the Feldstein-Horioka tests **ignore the link between the current account balance and government deficits;** in the presence of taxes, temporary output shocks are not corrected by taxes and have an effect on government and external deficits;
- Some authors reintroduce **general equilibrium mechanisms** (Ventura (2003); Giannone-Lenza (2006)). If global savings increase, the world real interest rate goes down and world investment increases, because savings equal investment at global level. This adjustment has an effect at the level of each country.

The world has just experienced two major balance of payments crises – one in peripheral eurozone countries and one in large emerging countries. In the wake of these crises, a requirement to balance current accounts, i.e. a regulated link between savings and investment, has re-emerged. It is interesting to consider how this might be connected to the Feldstein-Horioka puzzle. Does it reflect a collapse in international capital mobility? Or an abrupt increase in the home bias of financial portfolios?

We find that the **literature on Feldstein-Horioka does not adequately address the question of the external solvency of countries and the solvency of economic agents in countries carrying external debt. What we have observed may not be a resegmentation of capital markets across countries, but a realisation that external solvency has deteriorated in some countries.**

We therefore consider whether **capital has become insufficiently internationally mobile. This generates inefficiencies other than the effects of potential external insolvency, in two cases:**

- emerging countries with a substantial external deficit;
- eurozone countries.

<u>Emerging countries with a substantial external deficit</u>

We look at the situation **of Brazil, India, South Africa, Turkey and Indonesia.** All these countries have built up **large external deficits (Figures 1a-1b)** initially financed by non-resident investors' purchases of their equities and bonds **(Figures 2a-2b-2c-2d-2e). These external deficits started growing considerably from 2010 or 2011.**

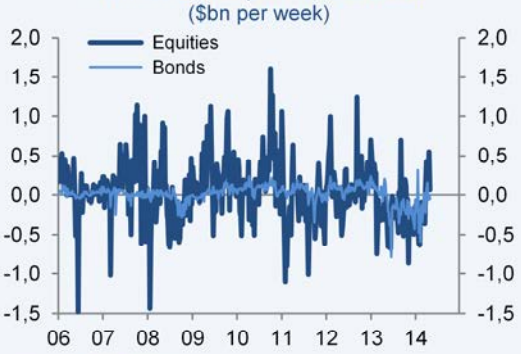
Figure 1a
Current account balance
(% of nominal GDP)

Sources: Datastream, IMF, Natixis

Figure 1b
Current account balance
(% of nominal GDP)

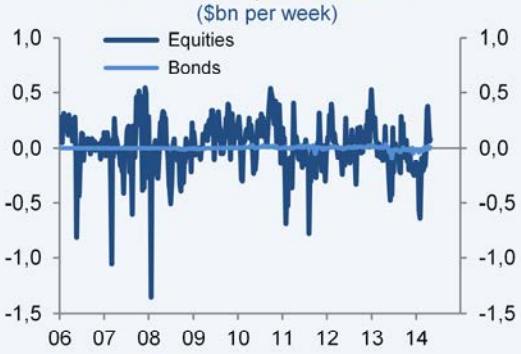
Sources: Datastream, IMF, Natixis

Figure 2a
Non-resident capital flows to Brazil
($bn per week)



Sources: EPFR, Natixis

Figure 2b
Non-resident capital flows to India
($bn per week)



Sources: EPFR, Natixis

Figure 2c
Non-resident capital flows to South Africa
($bn per week)

Sources: EPFR, Natixis

Figure 2d
Non-resident capital flows to Turkey
($bn per week)

Sources: EPFR, Natixis

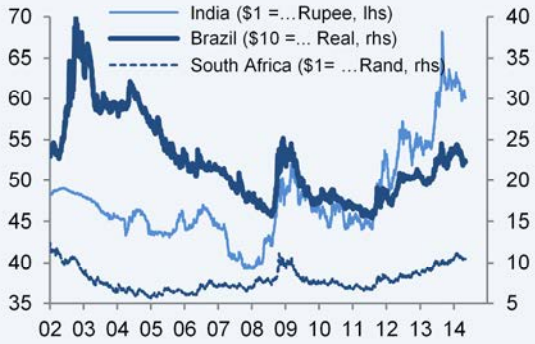
Figure 2e
Non-resident capital flows to Indonesia
($bn per week)

Sources: EPFR, Natixis

Purchases of financial assets by non-resident investors have become far more erratic since the end of 2012, prompting **joint fluctuations in these capital flows, the exchange rates of the**

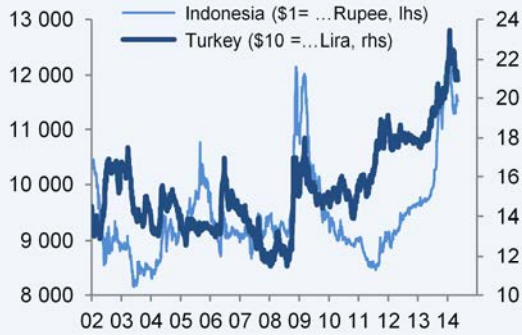
five countries (Figures 3a-3b), CDS spreads (Figures 4a-4b) and stock market indices (Figure 5a-5b), with currencies on a sharp depreciation trend since end-2011. In 2013 and early 2014 capital outflows increased following the US Federal Reserve's announcement that it would begin tapering its asset purchase programme.

Figure 3a
Exchange rate with US$



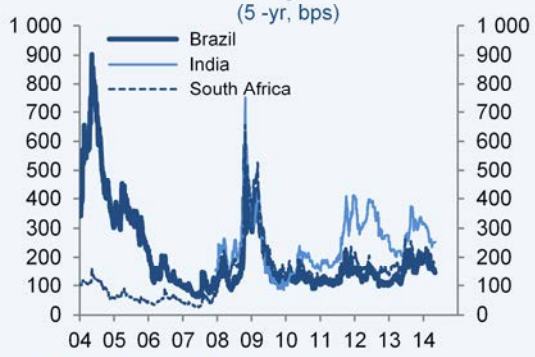
Sources: Datastream, Natixis

Figure 3b
Exchange rate with US$



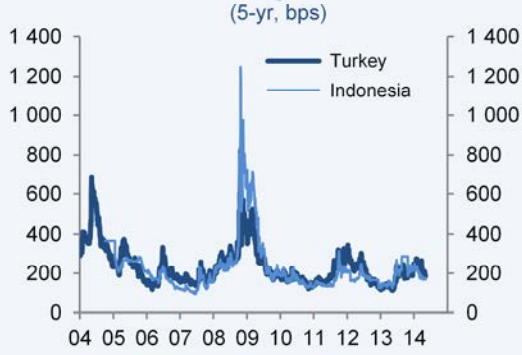
Sources: Datastream, Natixis

Figure 4a
Sovereign CDS
(5 -yr, bps)



Sources: Datastream, Bloomberg, Natixis

Figure 4b
Sovereign CDS
(5-yr, bps)



Sources: Datastream, Bloomberg, Natixis

Figure 5a
Stockmarket indices
(2002:1=100)

Sources: Datastream, Natixis

Figure 5b
Stockmarket indices
(2002:1=100)

Sources: Datastream, Natixis

The question that we are asking is whether the **sudden stop in capital flows to these emerging countries is:**

- **the result of an abnormal decline in international capital mobility,** leading to an abnormal increase in financing costs;
- **the legitimate result of solvency problems in these countries.**

Table 1 shows an econometric analysis of the relationship between savings and investment. We split the period in 2010, which is when capital began flowing back to emerging countries. National savings is made up of the savings of all public and private economic agents.

Table 1
Estimated b coefficient
Investment (% GDP) = a+b
National savings % GDP (quarterly data)

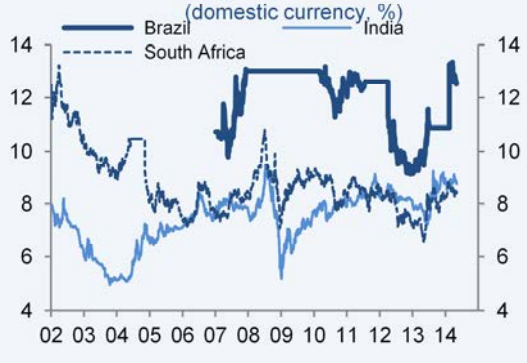
Country	**2002-2009**	**2010-2013**
Brazil	0.56	0.43
India	0.90	0.44
South Africa	0.59	Non-significant (0)
Turkey	0.29	Non-significant (0)
Indonesia	1.00	Non-significant (0)

Source: Natixis

Over the recent period 2010-2013, the link between savings and investment weakened or disappeared, explaining the emergence of external deficits (Figures 1a-1b).

Figures 6a-6b show **that financing costs increased** in 2013**, also reflecting reduced capital mobility.**

Figure 6a
Long-term interest rate
(domestic currency, %)



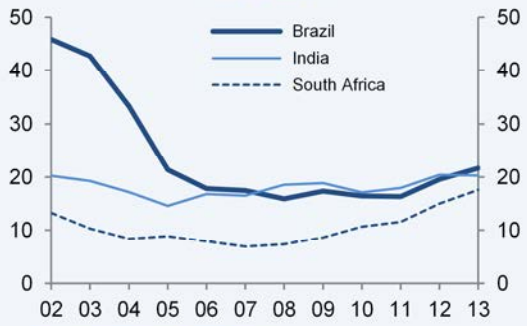
Sources: Datastream, , Bloomberg, Natixis

Figure 6b
Long-term interest rate
(domestic currency, %)

Sources: Datastream, , Bloomberg, Natixis

External debt (Figures 7a-7b) is high only in Turkey. Domestic debt is high in Brazil, India, South Africa and Turkey (Figures 8a-8b). Government debt is sustainable only in India (Figures 8c-8d).

Figure 7a
External debt
(% of GDP)



Sources: Datastream, EIU, Natixis

Figure 7b
External debt
(% of GDP)

Sources: Datastream, EIU, Natixis

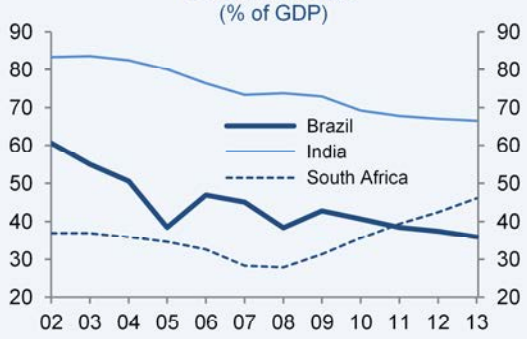
Figure 8a
Credit
(% of nominal GDP)

Sources: Datastream, Natixis

Figure 8b
Credit
(% of nominal GDP)

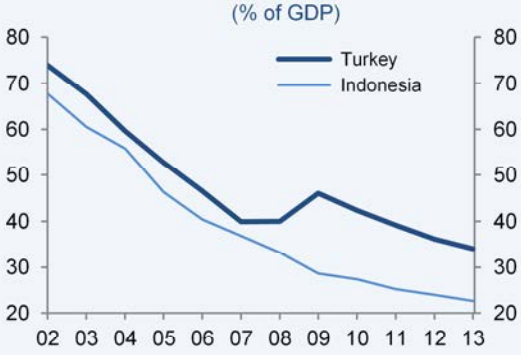
Sources: Datastream, Natixis

Figure 8c
Government debt
(% of GDP)



Sources: Datastream, Natixis

Figure 8d
Government debt
(% of GDP)



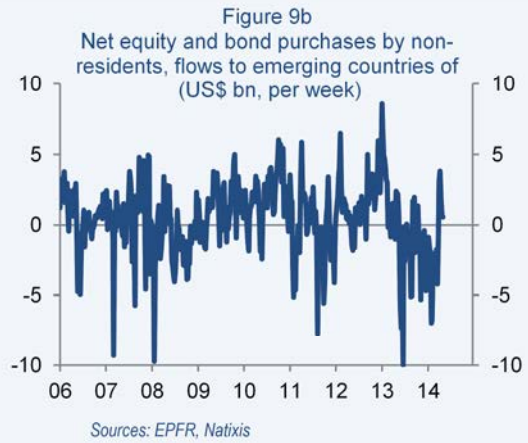
Sources: Datastream, Natixis

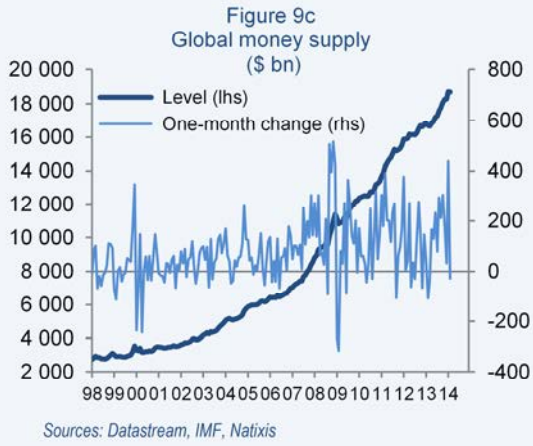
A clear external solvency problem caused by excess domestic debt is apparent only in the case of Turkey, which has seen a sharp increase in credit and, since 2012, in external debt.

Overall, excluding Turkey, the situation reflects a sudden stop in international capital mobility, rather than a severe external solvency crisis.

Many papers have demonstrated the **link between the global financial cycle and the US monetary cycle.**

The period of US monetary expansion between 2009-2012 led to huge capital flows towards emerging countries **(Figures 9a-9b),** and, following the announcement in spring 2013 that the quantitative easing programme would be scaled back in 2014, capital flows into emerging countries resumed, as global liquidity remained plentiful despite US tapering **(Figure 9c).**



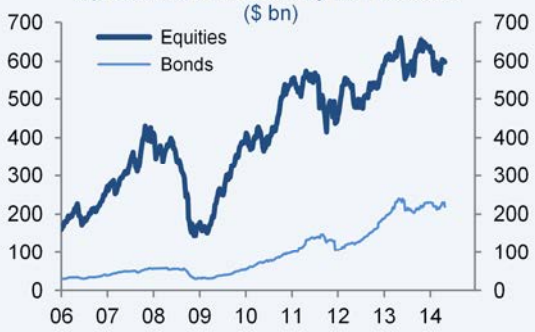


The **nature of international capital flows has also changed**. **Equities make up the bulk** of emerging-country financial assets held by non-residents **(Figure 9d).** International capital flows:

- are thus not linked to global trade;
- are not, as in the 1990s, interbank flows. Accordingly, the sudden stop in these flows has not sparked a crisis, as shown by the continued rapid credit growth in emerging countries **(Figure 9e).**

Today we are seeing **procyclical capital flows into financial assets**. These flows are attracted by the rapid growth of emerging economies **(Figure 9f)** and cause their exchange rates to appreciate.

Figure 9d
All emerging countries: outstanding equities and bonds held by non-residents ($ bn)

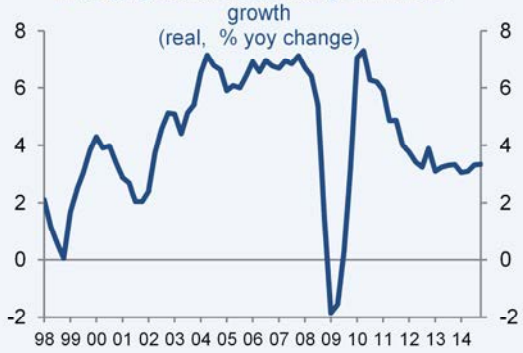


Sources: EPFR, Natixis

Figure 9e
All emerging countries: total credit (% yoy change)

Sources: Datastream, IFM, Natixis

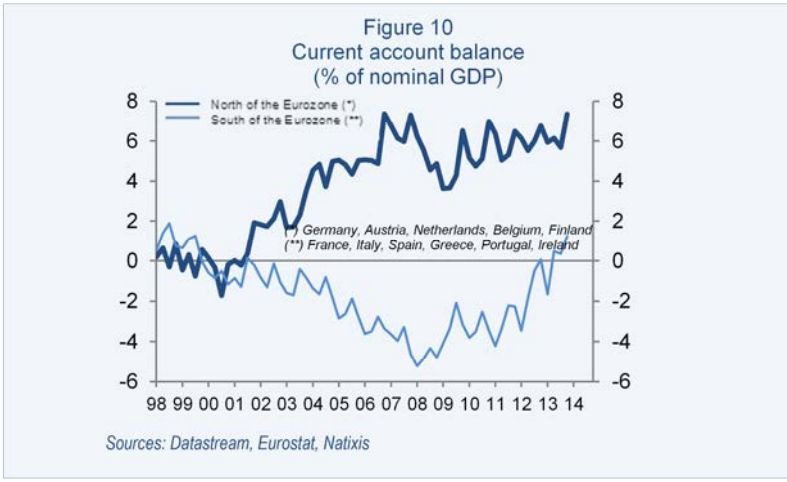
Figure 9f
Emerging countries excluding China: GDP growth (real, % yoy change)



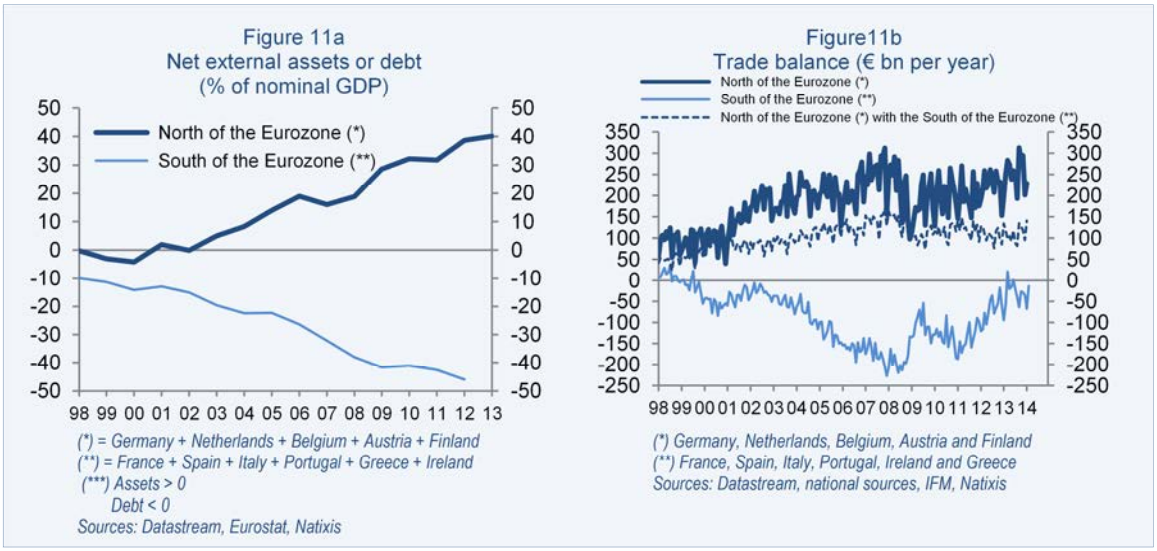
Sources: Datastream, Natixis forecasts

Eurozone countries

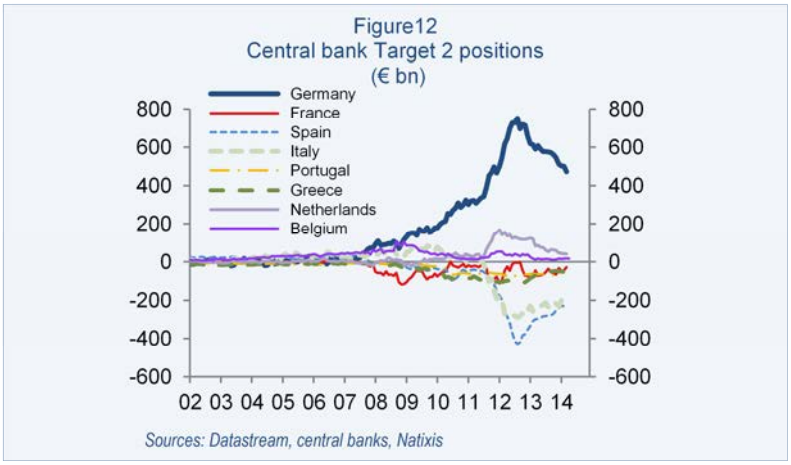
We separate the eurozone into two groups of countries: those with a structural external surplus (the north: Germany, Netherlands, Belgium, Austria and Finland) **and those with a structural external deficit** (the south: Spain, Italy, Portugal, Greece, Ireland and France, **Figure 10**).



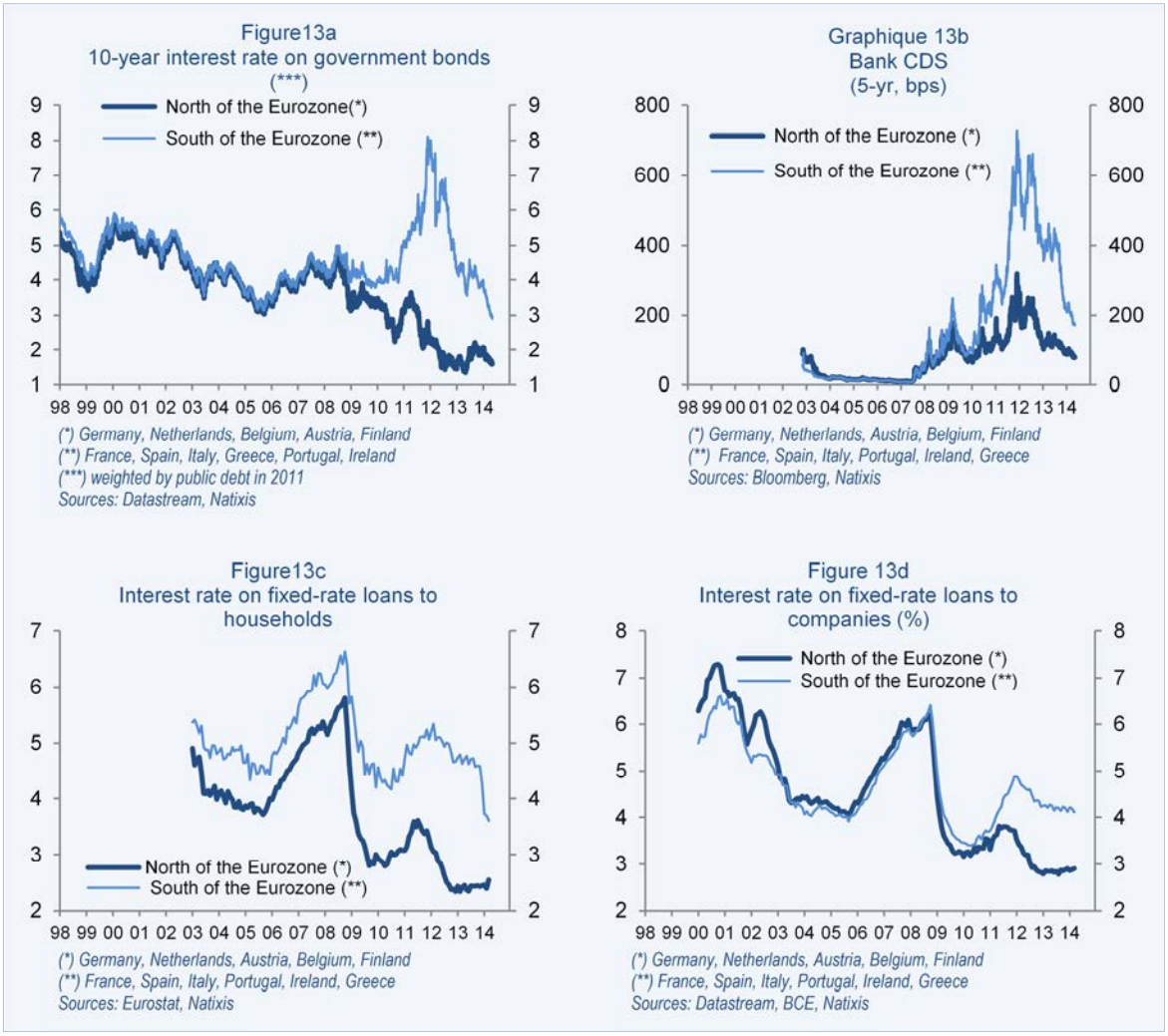
From when the euro was created to 2008, the countries in the northern eurozone used their surplus savings in part to finance the south, with which they had a substantial external surplus **(Figures 11a-11b).**



In 2008, there was a sudden stop as savers in the north stopped financing the south. This forced the southern countries to close their external deficit (Figure 10 above), which in turn forced central banks to take the place of the interbank market in financing southern banks, leading to the opening of **Target 2** positions **(Figure 12).**

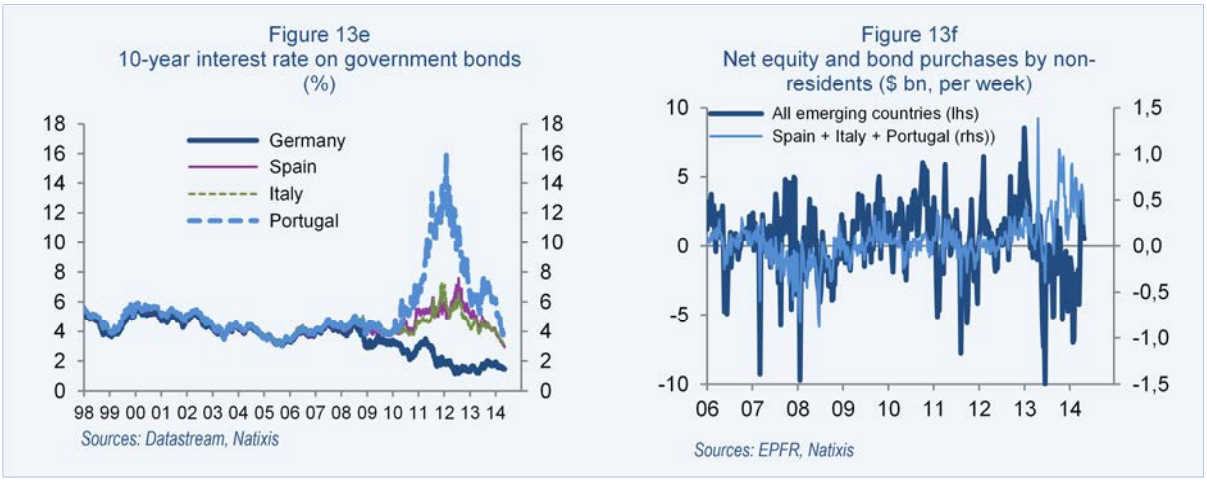


This abrupt halt in capital flows between the northern and southern parts of the eurozone obviously caused a **wide gap between financing costs in the two regions (Figures 13a-13b-13c-13d).** Savers in the north exhibited flight to quality behaviour that saw them come back to their domestic debt.



We include France with the southern countries because of its external deficit. Stripping out France, we see a much wider interest rate gap **(Figure 13e)** between Germany and the southern countries, with a two-stage correction:

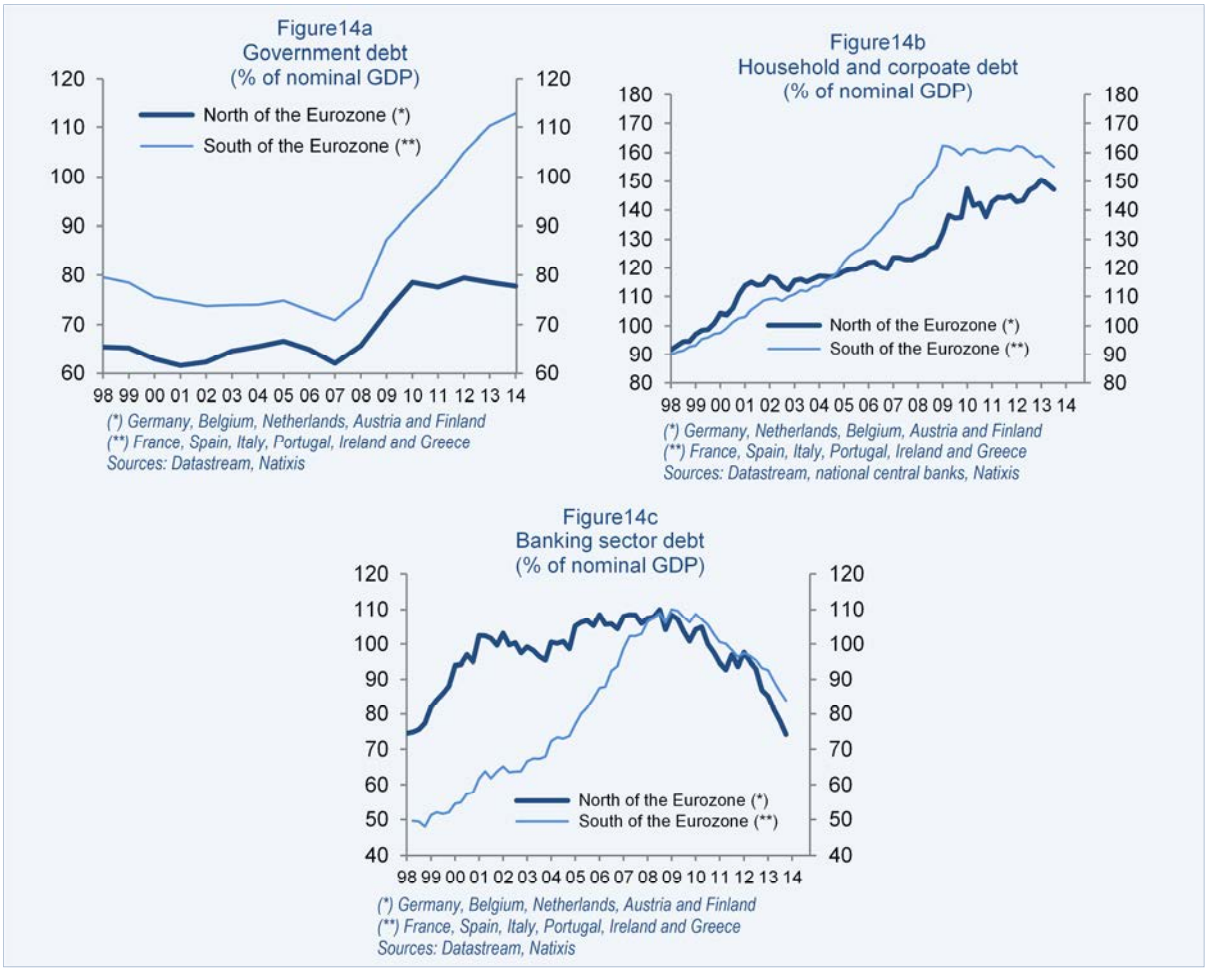
- July 2012 with the ECB's creation of the Outright Monetary Transaction (OMT) programme;
- April 2013, with the announcement of US tapering and the switch in capital from emerging countries to southern eurozone countries **(Figure 13f).**



Does the widening gap in financing costs reflect:

- **the abnormal effects of a sudden reduction in capital mobility within the eurozone;**
- **the normal effects of a loss of solvency among southern borrowers?**

It is therefore necessary to look at whether the **change in the external debt of the southern eurozone until 2008** could have legitimately led to a sudden stop in capital flows from the north. Figure 11a above shows **the south's external debt. Figures 14a-14b-14c show the ratios for government, private sector and bank debt** (debts are shown at book value, as nominal amounts).



The south's external debt stood at almost 50% of GDP in 2012 – a substantial level – and was linked to the surge in private debt. There does indeed seem to have been an external solvency crisis for countries in the southern eurozone.

Table 2 shows the results of Feldstein-Horioka tests for the countries of the northern and southern eurozone.

Table 2
Estimated b coefficient
Investment (% GDP) = a+b
National savings % GDP
Estimated b coefficient (quarterly data)

	1998-2007	2008-2013
Northern eurozone	Non-significant (0)	0.34
Southern eurozone	Non-significant (0)	1.16

Source: Natixis

Capital was highly mobile across all periods in the northern eurozone but became less mobile in the south (increased effect of savings on investment).

Let us return to the **external solvency crisis in southern eurozone countries.**

Before the crisis (before 2008), **these countries were essentially financed by countries in the northern eurozone.**

Table 3 shows **the ownership structure for government debt in eurozone countries.** It is clear that the debt of countries in the southern eurozone is almost entirely held domestically and by other eurozone countries. A substantial portion of the debt of core eurozone countries is, by contrast, held outside the eurozone.

Table 3
Structure of government debt (2013, %)

	Domestic	**Rest of the eurozone**	**Non-residents outside the eurozone**
Austria	17	57	26
Belgium	42	39	19
Finland	9	46	45
France	36	30	34
Germany	38	28	34
Greece	44	48	8
Ireland	40	36	24
Italy	65	27	8
Netherlands	44	32	24
Portugal	46	45	9
Spain	72	21	7

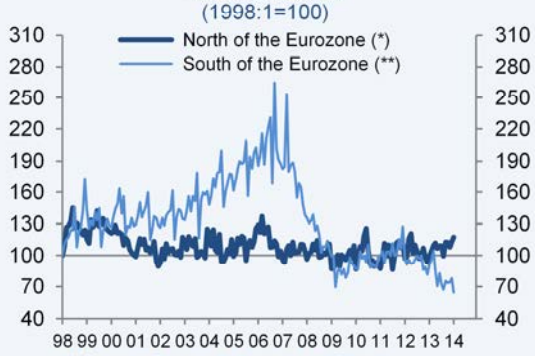
Source: IMF

Between when the euro was created and 2008, countries in the southern eurozone were easily financed by countries from the northern eurozone, perhaps because lenders in the north did not believe in the no bail-out clause and thought that their loans were effectively backed by countries in the northern eurozone. If so, the argument was a very poor one.

In fact, lenders in the northern eurozone financed not government but private debt (Figures 14a-14b-14c above).

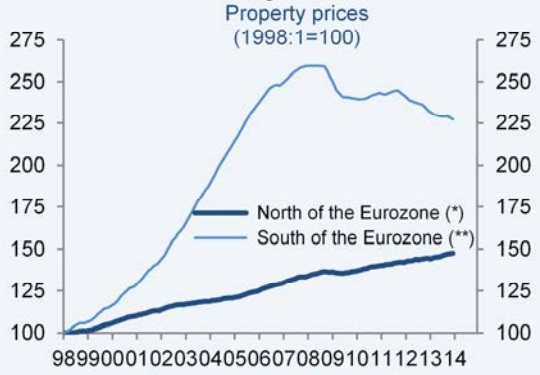
The problem was that the spending financed from 1999 to 2008 by the increase in private debt was essentially unproductive and unprofitable, notably including property loans to households and loans to property developers financing construction needs and promoting a bubble in property prices **(Figure 14d-14e).**

Figure 14d
Building permits
(1998:1=100)



(*) Germany, Belgium, Netherlands and Finland
(**) France, Spain, Portugal, Ireland and Greece
Sources: Datastream, Eurostat, Sources nationales, Natixis

Figure 14e
Property prices
(1998:1=100)



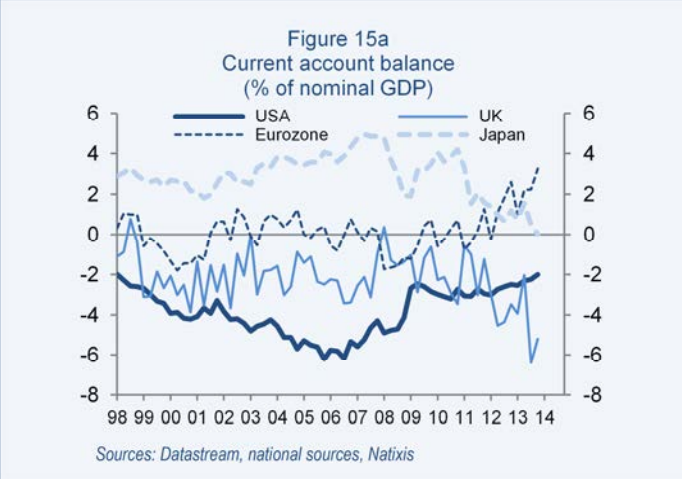
(*) Germany, Belgium, Netherlands, Austria and Finland
(**) France, Spain, Italy, Portugal, Ireland and Greece
Sources: Datastream, BRI, Eurostat, Natixis

Could capital mobility be restored between the northern and southern eurozone in the future?

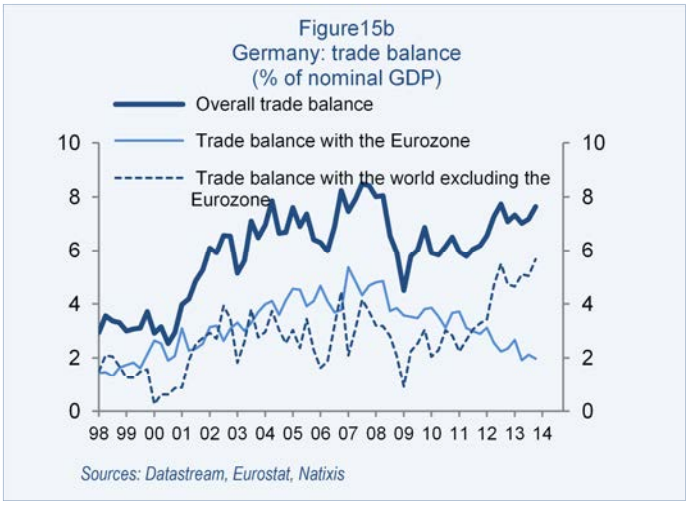
This is a key question: if countries in the southern eurozone have to maintain a balanced current account (Figure 10 above), their growth will be permanently constrained because import growth will be unable to outpace export growth.

- Interest rates are converging today (Figures 13a-13b above), investors are returning to southern eurozone countries (Figure 13f above) and Target 2 positions are being reduced (Figure 12 above), pointing to increased mobility of capital towards countries in the southern eurozone. But it is **hard to know whether this is because of renewed solvency in these countries, which is doubtful** (Figures 14a-14b above), or **excess liquidity and lower interest rates in the north,** which have forced investors in these countries to buy risky assets, **including government debt of southern countries.**

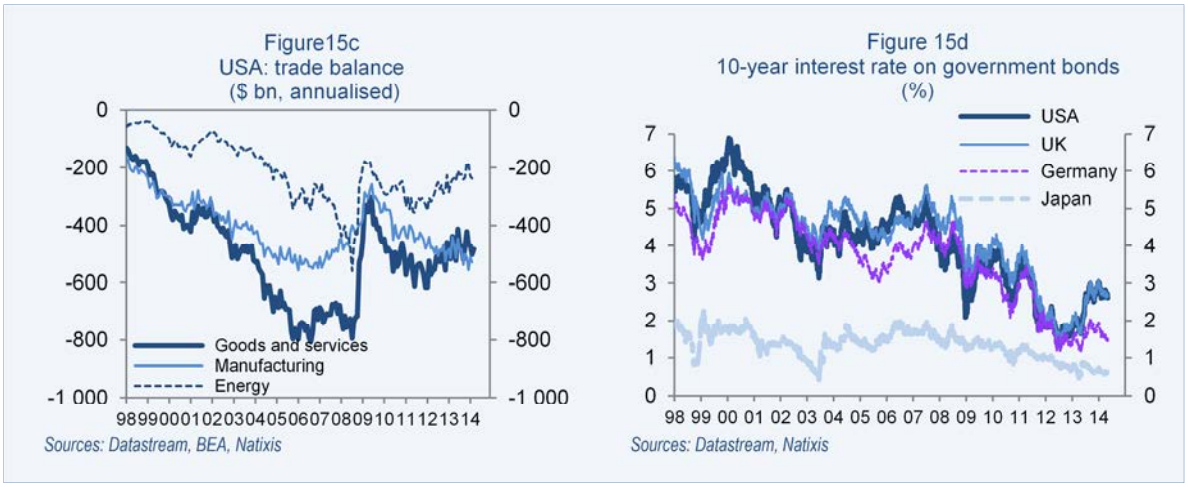
Capital mobility declined considerably between the northern and southern eurozone from 2008-2009. It is reasonable to ask whether this trend was specific to the eurozone or whether capital became less mobile between developed countries (United States, United Kingdom, Japan, eurozone as a whole) linked for example to a growing perception of currency risk or to regulatory developments. **Figure 15a** shows the current account balances of these countries.



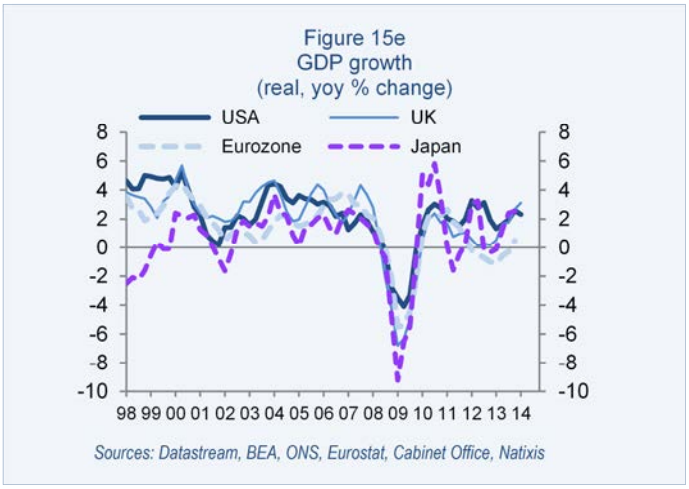
Japan's current account surplus vanishes, but this reflects population ageing and the sharp increase in the energy deficit. The eurozone shifts to an overall external surplus, owing to the disappearance of the south's external deficits and Germany's ability to maintain its external surplus by increasing its exports to the world outside the eurozone **(Figure 15b).**



The US external deficit narrows but solely due to a smaller energy deficit **(Figure 15c).** The UK external deficit widens sharply in the recent period as supply fails to keep up with renewed demand. The changes in current account balances and the crisis that began in 2009 do not appear to have altered the relationship between US, UK, German and Japanese long-term interest rates **(Figure 15d).**



There is no particular evidence of a growing difficulty in financing the external deficits of the USA and UK. The low level of German rates from 2012-2013 is attributable to the cyclical gap between the eurozone and the rest of the world **(Figure 15e)** and monetary policy expectations. In other words, there are no clear signs of reduced capital mobility between the countries.



We carried out Feldstein-Horioka tests for the 1998-2013 period for the USA, the eurozone and Japan **(Table 4).**

Table 4
Total investment % of GDP = a+b National savings
b coefficient

	1998-2013	**1998-2007**
USA	1.10 (12.6)	0.25 (2.8)
UK	0.77 (13.1)	0.70 (5.3)
Eurozone	1.13 (6.4)	0.10 (0.4)
Japan	0.73 (10.2)	1.15 (9.1)

We see that in the UK and Japan, capital mobility as measured by the Feldstein-Horioka tests is not significantly modified by introducing the 2008-2013 period. In the eurozone, we see the effects of the need to restore the external balance of the peripheral countries. In the USA, capital mobility appears to be halted by the crisis; this reveals the weakness of these tests because, as we saw above, the energy sector is solely responsible for the US return to a balanced current account.

Conclusion: abnormal collapse in international capital mobility or collapse in solvency?

More than 30 years ago, Feldstein and Horioka showed that although capital was theoretically becoming much more mobile, the domestic investment of countries remained closely tied to their savings.

But it is necessary to go a step further and distinguish between:

- an abnormal collapse in international capital mobility leading to an abnormal increase in the cost of capital in countries affected by the sudden stop;
- a normal stop to financing for countries where the solvency of debtor economic agents has deteriorated.

We analyse this question for emerging countries with an external deficit, from 2010, and for countries from the southern eurozone, from 2008.

We show that:

- in the case of emerging countries, only Turkey has high external debt, not Brazil, India, South Africa or Indonesia;
- countries in the southern eurozone accumulated large external deficits until 2009 due to unproductive and unprofitable investments.

The evidence thus point to:

- an abnormal decline in international capital mobility for emerging countries other than Turkey;
- an external solvency crisis for countries in the southern eurozone.

Feldstein-Horioka tests:

- explain the increase in the external deficits of emerging countries since 2010 with a marked weakening of the linkage between savings and investment;
- show a much stronger link between savings and investment in the southern eurozone after 2008, when the external constraint reappears.

What are the consequences for regulators?

- emerging countries may experience a sudden stop not linked to an obvious loss of external solvency. Investors could therefore suffer losses that are difficult to predict based on a fundamental analysis of these countries;
- even where external solvency deteriorates, as in the case of countries in the southern eurozone, the balance of payments crisis – and the associated downturn on financial markets – is severe.

Accordingly, investors need appropriate information about solvency, comprising the external solvency of countries (the ability to repay external debt intertemporally) as well as its determinants, i.e. the solvency of domestic economic agents. Between 1999 and 2008, lenders in the northern eurozone clearly did not realise that their savings were ultimately financing unproductive capital, such as housing in Spain. This information is complex because it is not summarised in the ratings awarded to governments, banks or companies, but entails macroeconomic information about the quality of debt usage (productive or unproductive capital, high or low returns).

References

Blanchard O.-Giavazzi F. (2002) – "Current account deficits in the Euro Area: the end of the Feldstein-Horioka puzzle?" – *Brookings Papers on Economic Activity, 22, 147-209.*

Coakley J.-Kulasi F.-Smith R. (1998) – "The Feldstein-Horioka puzzle and capital mobility: A review." *International Journal of Finance and Economics 3: 169-188.*

Feldstein M. (2005) – "Monetary policy in a changing international environment: the role of capital flows" – *Working paper No 11856 – December.*

Feldstein M. (1983) – "Domestic saving and international capital movements in the long run and the short run" – *European Economic review, No21 (1-2), 1983, pp 129-151.*

Feldstein M.-Horioka C. (1980) – "Domestic savings and international capital flows" - *Economic Journal 90 (June): 314-329.*

Frenkel J.-Razin A. (1986) – "Fiscal policies in the world economy", *Journal of Political Economy – 94, June, 564-594.*

Giannone D.-Lenza M. (2009) – "The Fieldstein-Horioka Fact" – *Number working paper 15519 – Novembre.*

Martin P.-Rey H. (1999) – "Financial supermarkets: size matters for asset trade". Journal of International Economics 64 (2004) 335 – 361

McCallum, J. (1995). National borders matter: Canada-US regional trade patterns". *American Economic Review 85 (June): 615-923.*

Mussa M.-Goldstein M. (1993) – "The integration of world capital markets" in *Changing Capital Markets: Implications for Monetary Policy, Kansas City, MO: Federal Reserve Bank of Kansas City, 1993, pp. 245-313.*

Obstfeld-Rogoff (2009) – "The Six Major Puzzles in International Macroeconomics: Is There a Common Cause?" - *NBER Macroeconomics Annual, volume 15, pp 339-412.*

Obstfeld M. (1986) – "Capital mobility in the world economy: theory and measurement" *Carnegie-Rochester conference series on public policy 24 (Spring): 55-103.*

Persson T-Svensson L. (1985) – "Current account dynamics and the terms of trade: Harberger-Laursen-Metzler two generations late" – *Journal of Political Economy, 94, 43-65.*

Portes R.-Rey H. (1999) – "The determinants of cross-border equity flows: The geography of information" – Cambridge, M.A: *National Bureau of Economic Research. NBER working Paper 7336.*

Roubini N. (1988) – "Current account and budget deficits in an intertemporal model of consumption and taxation smoothing. A solution to the Feldstein-Horioka puzzle" – *Working paper No 2773 – November.*

Stockman A-Svensson L. (1987) – "Capital flows, investment and exchange rates" – *Journal of Monetary Economics, vol. 19, No 2, 171-201.*

Svensson L.-Razin A. (1983) – "The terms of trade and the current account: the Harberger-Laursen-Metzler effect" – *Journal of Political Economy, 91, 97-125.*

Vamvakidis A.-Wacziarg R. (1998) – "Developing Countries and the Feldstein-Horioka Puzzle" – *IMF working paper No WP/98/2-January.*

Ventura J. (2003) – "Towards a theory of current accounts" – *World Economy, pp. 483-512.*

Market fragmentation: assessment and prospects

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Abstract

This paper provides an overview of the knowledge available to date on market fragmentation and its consequences, with a specific focus on the European experience. Since the implementation of MiFID1 on 1 November 2007, market fragmentation has considerably increased in European stock markets without however reaching the same level as in the U.S. At present, in Europe, three trading platforms have become significant players and their joint market share exceeds 30% of lit trading volumes. Regulated dark pools do not execute more than some 5% of the total trading volumes. In contrast, OTC trading makes a large share of total volumes. The empirical evidence converges to show that fragmentation has generally contributed to improving liquidity with greater benefits for global traders who connect to several platforms and greater liquidity gains on large capitalization stocks. Adverse effects on the depth of small stocks may be observed locally in their primary market but they are more the outcome of algorithmic trading than that of fragmentation. Further, while dark trading in crossing engines is shown to improve liquidity, the impact of OTC trading is mixed and the lack of strong conclusion on this issue leaves room for further research. Finally, price quality does not appear to be significantly affected by market fragmentation in European stock markets.

Résumé

Cet article présente l'état actuel de la connaissance sur la fragmentation du marché et sur ses conséquences, avec un focus particulier sur l'expérience européenne. Depuis l'application de la directive MIF au 1er novembre 2007, la fragmentation des marchés d'actions européens a considérablement augmenté sans toutefois égaler le niveau de fragmentation observé aux Etats-Unis. A l'heure actuelle, en Europe, trois plateformes d'échange sont devenues des acteurs importants et leur part de marché agrégée excède 30% des volumes traités en bourse. Les dark pools réglementés n'exécutent pas plus de 5% des volumes totaux. En revanche, la part de marché de l'OTC est considérable. Les études empiriques convergent pour montrer que la fragmentation a généralement contribué à améliorer la liquidité, avec des gains plus importants sur les grandes valeurs et pour les négociateurs « globaux » connectés à de multiples marchés. Des effets négatifs sur la profondeur des petites valeurs sont parfois observés localement sur leur bourse primaire mais ces diminutions de profondeur sont davantage liées à la négociation algorithmique qu'à la fragmentation. De plus, alors que l'activité des dark pools semble plutôt favoriser la liquidité, l'impact de la négociation OTC est mitigé, ce qui laisse la place à des recherches futures. Enfin, la qualité des prix n'est pas significativement affectée par la fragmentation sur les marchés européens.

[2] C. Gresse addresses special thanks to IFS (Intelligent Financial Systems) and their managing directors, Sabine and Darren Toulson, for generously providing the data used in Gresse (2014a) and Gresse (2014b) and mentioned in Sections 4 and 5. I am particularly grateful to Mark Holloway, Oliver Speakman, and Sugandha Sharma of IFS for their technical work on the data.

1. Introduction

The stock markets of developed economies are substantially fragmented today, with alternative trading platforms diverting a significant portion of the order flow from primary exchanges. As an illustration of this phenomenon, in Europe, over the months of January and February 2014, the alternative exchange BATS Chi-X executed more than 20% of the regulated volumes in European stocks, and the cumulated market share of BATS Chi-X and Turquoise reached almost 28% over the same period.

Broadly speaking, market fragmentation defines a marketplace in which the same asset is traded at several locations. This may happen because: (1) the stock is cross-listed as a result of the listing strategy chosen by the firm's managers; (2) the main market for the stock has a hybrid structure combining an order book and dealers outside the book; (3) in spite of a single listing on a pure order-driven market, several trading venues compete for the order flow. This article is dedicated to market fragmentation stemming from case (3). Market fragmentation that results from competition between trading venues takes two forms essentially: lit or visible fragmentation which refers to fragmentation between transparent order books, and dark fragmentation or dark trading which designates order execution off-exchange by dealers or crossing engines – also known as dark pools – either under regulation or in the OTC market.

Over the past decade, there has been a vivid debate among regulators, issuers, and asset managers about the pros and cons of lit and dark fragmentation and the effects they may have on market quality. This paper aims to provide an overview of the knowledge available on this topic at the current date, with a specific focus on the European experience. It is organized as follows: Section 2 compares the level of fragmentation in main stock markets around the world. Section 3 reports statistics about the development of fragmentation in Europe and exposes its determinants. Section 4 and Section 5 assess the consequences of fragmentation for liquidity and price quality respectively. Section 6 concludes.

2. Magnitude of fragmentation in stock markets

Market fragmentation stems from alternative trading venues competing with traditional exchanges. Those alternative venues typically are electronic order-driven trading systems designed to offer fast and low-cost execution. In Europe, they are registered as Multilateral Trading Facilities (MTFs) under the Markets in Financial Instruments Directive (MiFID).[3] Many MTFs have entered the European trading industry since MiFID1,[4] some of them run by brokers, others by exchanges, or by investment bank consortiums. Among the 156 MTFs listed by the European Securities and Markets Authority (ESMA) at the end of 2013, only three have become prominent players: Chi-X, Turquoise, and BATS Europe in chronological order of opening. They adopted similar business models based on continuous order-driven trading, high-speed execution, low fees, and liquidity-rewarding rebates. Chi-X was launched by broker Instinet in the third quarter of 2006. Turquoise, created by a consortium of investment banks, started trading in August 2008. Live trading on BATS Europe, a subsidiary of U.S. exchange BATS, began on 31 October 2008. In the course of 2011, BATS took over Chi-X but the two platforms still operates separately under the respective names of BATS Chi-X BXE and BATS Chi-X CXE. The terms BATS Chi-X CXE and Chi-X will be used indifferently in the rest of the article. This also applies to BATS Chi-X BXE and BATS.

Table 1 provides a glimpse of the current level of fragmentation between the three active MTFs and the primary exchanges – also referred to as lit fragmentation or fragmentation of on-exchange volumes – for two European large stock indices. The table puts this level in

3 MiFID recognizes three types of order execution venues: Regulated Markets (RMs), Multilateral Trading Facilities (MTFs), and systematic internalizers. RMs and MTFs are multilateral trading systems with similar functionalities but they differ in that RMs have to be authorized by a competent authority. Both RMs and MTFs may organize primary listings, but securities with a primary listing on a MTF are not considered as regulated instruments. In practice, only RMs organize primary listings.

4 MiFID1 refers to the first version of the directive implemented on 1 November 2007 as opposed to the upcoming revision (MiFID2).

perspective with the level of market fragmentation for two flagship indices in the U.S. The statistics are extracted from the Fidessa's website.[5] They cover one week of trading from 10 March to 14 March 2014. They show that the fragmentation of the lit order flow is substantial for the four indices but that fragmentation is much more pronounced in the U.S. with regard to the market shares of primary exchanges and the number of active markets. For the stocks of the FTSE 100 and the CAC 40, the primary exchange, i.e., the London Stock Exchange (LSE) and Euronext Paris respectively, still captures more than 60% of exchange-traded volumes and the rest more or less distributes between three alternatives platforms, BATS Chi-X CXE, Turquoise, and BATS Chi-X BXE in decreasing order of market share. By contrast, for the S&P 500, none of the primary exchanges – neither the NYSE nor Nasdaq – has a market share exceeding 29%, and for the Nasdaq 100, the market share of Nasdaq is less than 42%. The rest of the lit volumes in S&P 500 and Nasdaq 100 securities trades in more than six other markets.

Table 1

	Market share in trading volumes			
Venue	**FTSE 100**	**CAC 40**	**S&P 500**	**Nasdaq 100**
London Stock Exchange	61.06%			
Euronext Paris		65.21%		
Nasdaq			28.79%	41.55%
NYSE			22.16%	
BATS Chi-X CXE	18.93%	19.78%		
Turquoise	13.71%	10.21%		
BATS Chi-X BXE	6.14%	2.98%		
NYSE Arca			12.52%	15.47%
BATS			11.71%	14.31%
EDGX			9.54%	10.94%
Nasdaq BX			4.78%	5.72%
EDGA			3.85%	4.19%
BATS Y			3.15%	3.23%

Note: This table presents the market shares of the trading venues representing more than 1% of visible volumes for four stock indices over the week of 10-14 March 2014. The figures are extracted from fragmentation.fidessa.com.

2.1. Measuring market fragmentation

In fragmented markets, the degree of fragmentation of exchange-traded volumes can be measured by the reciprocal of the Herfindhal-Hirschman concentration index. This fragmentation index is calculated as one divided by the sum of the squared market shares of all the trading venues considered. The formula writes as follows:

$$Fragmentation\ Index = 1 \Big/ \sum_k \left(\frac{V_k}{\sum_j V_j} \right)^2 \qquad (1)$$

where V_k and V_j denotes the volumes traded on markets k and j respectively, $\sum_j V_j$ represents the total volume traded in all markets under consideration, and $\frac{V_k}{\sum_j V_j}$ is the market share of market k among those markets. If the trading is concentrated on a single platform, this index equals one. If N markets are active with equal market shares, then the index equals N and

[5] Fidessa is a private company which provides trading systems, market data, and connectivity solutions.

increases by one each time an additional market becomes active. This index will serve as the main measure of lit fragmentation in the remainder of the paper.

2.2. An international comparison

The graphs of Figure 1 plot fragmentation index values, as extracted from the Fidessa's website, for several stock indices in four parts of the world – the USA, Canada, Europe, and Japan – over the past two years. The graphs confirm that U.S. markets are characterized by the highest level of fragmentation, with a fragmentation index fluctuating around 4 for the Nasdaq 100 and reaching 5 for the S&P 500 and the Dow Jones. The Japanese stock market is the most concentrated with a fragmentation index ranging from 1.1 to 1.2 and rarely exceeding 1.2. The Canadian and the European stock markets are at an intermediate level with comparable fragmentation degrees: their fragmentation indices vary between 2 and 2.5. Among the European stock indices, the market for the components of the FTSE 100 is slightly more fragmented than the markets for the DAX, the AEX, or the CAC 40 components. Despite some volatility around their average values, those fragmentation levels have remained relatively stable over the two years of observation.

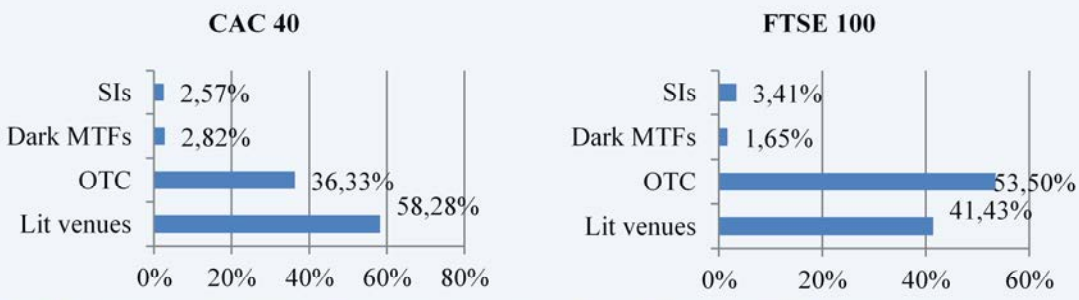
Figure 1. Fragmentation magnitude of lit trading

Note: This figure plots the fragmentation index values for large stock indices in the USA, Europe, Canada, and Japan over two years from 16 March 2012 to 14 March 2014. Source: fragmentation.fidessa.com

2.3. Size of dark trading

Dark trading encompasses any trade for which the matched buying and selling interest are invisible from the market before execution. It may take diverse forms such as bilateral trading with dealers in the OTC market or with systematic internalizers, and multilateral trading in dark pools. Systematic internalizers are defined by MiFID as investment firms which, "on an organized, frequent and systematic basis," execute client orders outside a regulated market or an MTF, either on their principal accounts or against other clients' orders. Although they are imposed pre-trade transparency requirements, they can be classified in the dark trading sphere as the bilateral dealer-to-customer trading process likely allows price flexibility and also because systematic internalizers' pre-trade quotes are not available in the data flow stored by data vendors. Dark pools are trading systems in which buy and sell orders are submitted anonymously and remain undisplayed to the public markets until execution. They divide in three categories (Zhu, 2014). A first category of dark pools passively match buyers and sellers at prices derived from transparent exchanges, such as the mid-quote of the best bid and offer on the primary exchange or a Volume-Weighed Average Price (VWAP). This category includes crossing networks such as ITG Posit or BATS Chi-X dark order books. They are registered as MTFs under MiFID and benefit from pre-trade transparency waivers for non-displayed orders. A second category of dark pools are continuous invisible limit order books that execute orders by price and time priority. Orders are executed inside the bid-ask spread but not necessarily at mid-quote. They are usually owned by broker-dealers and operate as OTC trading venues. A third category of dark pools act as fast electronic inter-dealer brokers that immediately accept or reject incoming orders.

Figure 2. Dark trading vs. lit trading



Note: Those bar charts report the distribution of the total trading volumes between lit venues, OTC trading, dark MTFs, and systematic internalizers for the CAC 40 and the FTSE 100 stocks in 2013. SIs stand for systematic internalizers.

The bar charts of Figure 2 report the size of dark trading relative to lit trading and the relative size of the various forms of dark trading for the stocks of the CAC 40 and the FTSE 100 indices in 2013. Those charts reveal the weight of OTC trading and the thinness of regulated dark trading. Dark MTFs and systematic internalizers do not execute more than a few percent of the total trading volumes. The total number of broker-dealers registered as systematic internalizers is limited[6] and their market share remains around 3%. The total market share of regulated dark pools does not exceed 3%, which is less than what is observed in the U.S. Estimates from Tabb Group and Rosenblatt Securities attribute 12% of U.S. equity trading volume to dark pools as of mid-2011. In contrast, OTC trading represents a sizeable source of liquidity, with more than 36% of the volumes for the CAC 40 and more than 53% for the FTSE 100. Those figures have a significant variance across time and their reliability is questionable since they are based on self-reporting to trade reporting facilities. However the fact remains that to date, OTC trading is the major component of dark trading.

6 No more than 12 investment banks are declared as SIs (cf. http://mifiddatabase.esma.europa.eu/). This number has remained nearly unchanged since the implementation of MiFID1.

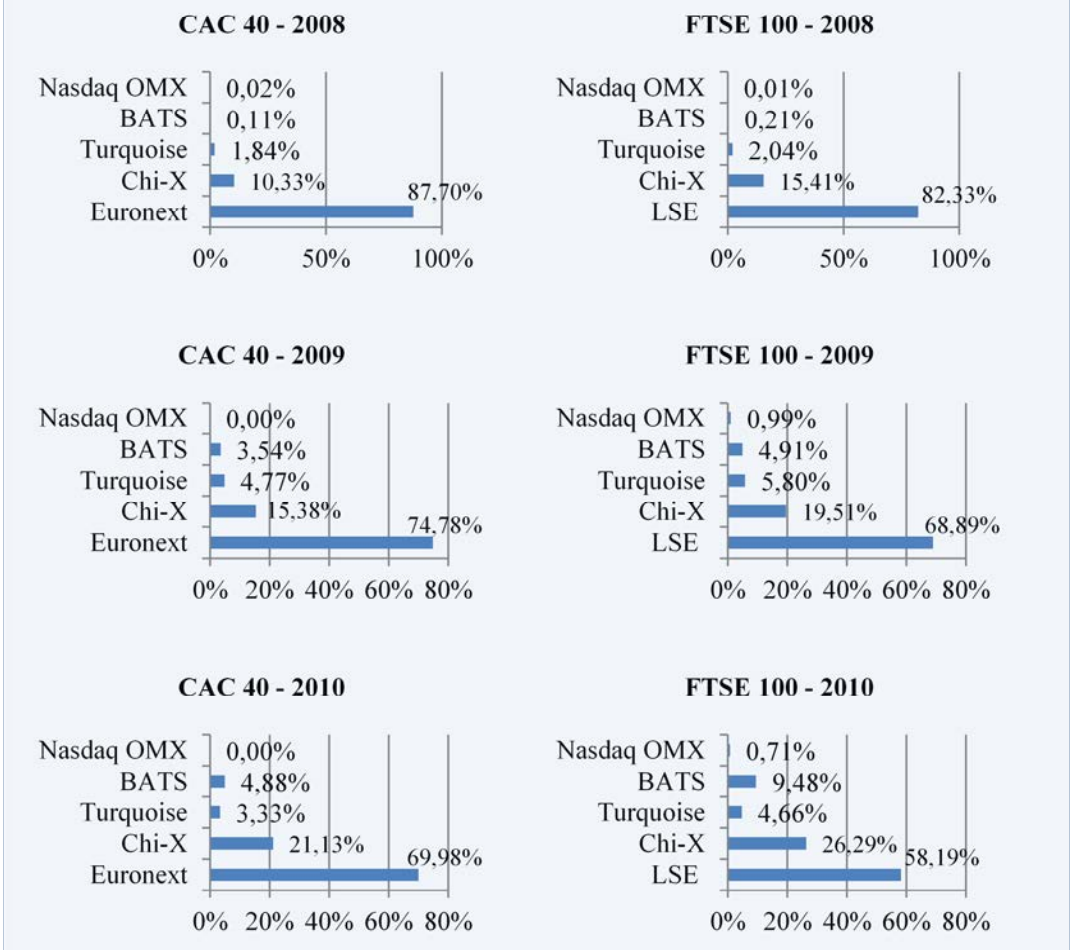
3. Development and determinants of market fragmentation in Europe

While market fragmentation had been observed under various forms in European stock markets prior to MiFID (cf. Jacquillat and Gresse, 1998; Gresse, 2006; Foucault and Menkveld, 2008), it had never reached the magnitude reported at Section 2. It indeed expanded rapidly after MiFID1 implementation, technology being the main driver and regulatory changes serving as a catalyst.

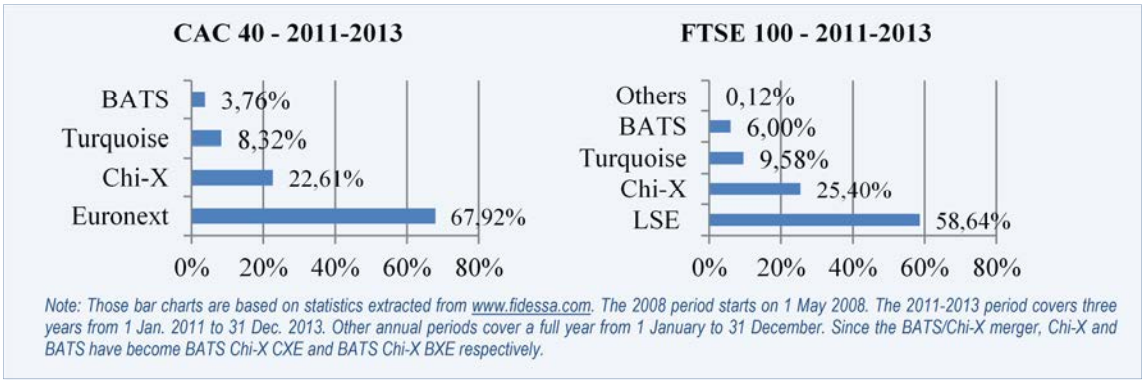
3.1. Development of lit fragmentation in Europe: When did it all happen?

Figure 3 reports the distribution of exchange-traded volumes across active lit trading venues[7] for the CAC 40 and FTSE 100 stocks from 2008 to 2013. Between 2008 and 2013, Euronext Paris lost approximately 22% of market share in its flagship-index stocks, while the LSE market share in FTSE 100 securities fell by 24%. In the meanwhile, Chi-X increased its market share in French large capitalization stocks from 10.33% to 22.61% and its market share in UK large stocks from 15.41% to 25.4%. Turquoise became the second-ranked MTF with market shares of 8.32% and 9.58% in CAC 40 and FTSE 100 stocks respectively over the years 2011-2013, closely followed by BATS with respective market shares of 3.76% and 6%.

Figure 3. The development of lit fragmentation for CAC 40 and FTSE 100 stocks



7 An active trading venue is a venue with more than 1% of market share.



Note: Those bar charts are based on statistics extracted from www.fidessa.com. The 2008 period starts on 1 May 2008. The 2011-2013 period covers three years from 1 Jan. 2011 to 31 Dec. 2013. Other annual periods cover a full year from 1 January to 31 December. Since the BATS/Chi-X merger, Chi-X and BATS have become BATS Chi-X CXE and BATS Chi-X BXE respectively.

The salient fact to be underlined is that most of the rise in fragmentation took place in the course of 2009, with the market shares of new entrants starting to grow at the end of 2008 and reaching their current level in 2010. The rapid success of those MTFs lied in their ability to offer services tailored for computer trading at low cost. Those services include high capacity, super-low latency, the ability to computerize complex decision processes, small tick sizes, and innovative orders. In addition, MTFs charge low fees and offers rebates on liquidity-providing orders. In spite of this fierce rivalry, incumbent exchanges have kept the leadership in the order book trading of their locally-listed stocks, so that the average level of fragmentation has remained far lower than in the U.S. Largest traditional exchanges responded to their new rivals by cutting fees and improving latency. Another reason for their ever-lasting leadership, coined by Menkveld (2013), might be the fragmentation of clearing services which does not allow multi-market traders to net their positions across venues and thus increases the cost of multi-market trading strategies.

3.2. Determinants of fragmentation

In theory, trading should concentrate in the most liquid market (Pagano, 1989), the optimal market structure being the electronic order book (Glosten, 1994). This order flow consolidation would be desirable because the marginal cost of a trade decreases with the quantity of orders executed in the market and because there are network externalities associated with running a market. As a result, the consolidation of the order flow creates economies of scale on the provision of liquidity (Mendelson, 1987). In practice, fragmentation arises when a single market is unable to answer in an appropriate and timely fashion to every client need. Provided that entry costs to the market of markets are not prohibitive and that no regulatory barrier impedes free competition, new trading systems that answer the unsatisfied demand appear and succeed in attracting order flow. With respect to entry costs, technology has considerably lowered the cost of launching new trading systems. It has also provided innovative solutions catering for specific trading needs and it gave birth to a new trading clientele: algorithmic traders and high frequency (HF) traders. MiFID has in turn set up a legal frame permitting what was technologically feasible.

3.2.1. Investor clientele effects

Market fragmentation often arises between trading systems that use different mechanisms, charge different fees, or offer different market access to participant. It thereby contributes to addressing the needs of diverse categories of investors in a more efficient way (Harris, 1993; Hendershott and Mendelson, 2000; Gresse, 2006). The needs of final investors are likely to differ according to trade size, impatience for execution, information quality, and information horizon. Institutional investors, block traders, retail investors, arbitragers, speculators, etc., are as many different clienteles appreciating different trading designs. Large traders generally appreciate anonymity and immediacy. They may accept to pay higher fixed fees to obtain

immediate execution on a large quantity of shares. This makes the success of block markets and OTC trading. Alternatively, they may choose to implement sequential trading strategies by breaking initial parent order into series of small child orders, provided that they remain anonymous. This favors the development of electronic order books guaranteeing anonymity. To what extent investors are impatient to trade is another source of segmentation between investors. Liquidity traders with a long-term perspective or informed traders with long-lived information will accept to bear a non-execution risk to reduce their trading costs and market impact. Dark pools typically address the needs of that type of investors (Hendershott and Mendelson, 2000).

Technological progress gave birth to another clientele segment: HF traders defined by the SEC as "professional traders acting as a proprietary capacity that engage in strategies that generate a large number of trades on a daily basis". Many of them act as multi-venue market makers, providing liquidity in some markets and possibly unwinding inventories in others, so that HF trading is a direct determinant of fragmentation (Menkveld, 2013). Their specific needs are system reliability, execution speed, and low fees. Their trading strategies require highly reliable trading systems which can deal with great quantities of orders and process them very fast at low cost. This explains the flourishing of great-capacity and ultra-low-latency electronic trading platforms with low-fee liquidity-rewarding tariff models.

3.2.2. Technological innovation

Technology has driven the increasing fragmentation of stock markets in several ways. First, technology has made the time and cost of building new electronic multilateral trading platforms extremely low. Second, it has provided the buy-side with tools that enable them to exploit the total range of available trading systems. Most institutions are connected to several international marketplaces through Direct Market Access (DMA) provided by their brokers, the number of those markets in connection depending on the size of the institution. In addition to DMA, other tools such as sweep or pull technologies, Smart Order Routers (SORs), and Execution Management Services (EMSs), help broker-dealers and investment firms optimize execution conditions in multiple markets. Pull technologies connect to diverse institutions' Order Management Systems (OMSs) and scan their trading interests so as to pull orders that can be matched. Initiators of compatible orders are then alerted and have a limited time to respond and agree on a price. SORs are algorithms that scan multiple trading venues, fraction, and distribute orders so as to optimize their price and probability of execution. EMSs are all-in-one broker-neutral trading systems designed to help investors pursue best execution by bringing them access to several liquidity sources and providing them with pre-trade liquidity analysis, automate execution strategies, and transaction cost analysis tools. Those tools participate to fragmenting the order flow across multiple venues on the one hand, but also to re-aggregating the liquidity of those multiple venues on the other hand.

3.2.3. MiFID implementation

Considering that pro-competition regulations in the trading industry, namely Reg NMS in the U.S. and MiFID in Europe, caused fragmentation would be misleading as diverse forms of market fragmentation preceded them. However, they have undeniably contributed to its recent development by allowing the fundamental drivers of fragmentation, i.e., clientele effects and technology, to fully play their role. In Europe, the enforcement of MiFID1 on 1 November 2007 abolished the concentration rule[8] in all countries of the European Economic Area (EEA) and created a competitive environment for trading systems and services in which new trading systems were allowed to compete with incumbent exchanges. It changed the European trading industry in three key ways: it liberalized competition between trading systems by breaking the monopolies of primary exchanges; it offered a regulatory framework for internalization; and it extended post-trade transparency duties to OTC trades in regulated securities and allowed entities other than primary exchanges to report trades, which resulted in a fragmentation of the

[8] A provision in the 1993 Investment Services Directive (ISD) permitted (but did not mandate) individual member states to require orders from investors in that member state to be executed only in regulated markets. This provision was applied in France, Italy, and Spain.

trade reporting activity. Those new game rules combined with the rise of HF trading explain the sudden rise in fragmentation in European stock markets between 2008 and 2010.

4. Market fragmentation and liquidity

The impact of fragmentation on liquidity raised much debate in Europe immediately after MiFID1 enforcement. Some believed that heightened competition had pushed down transaction costs whereas others were convinced that increased fragmentation had widened spreads. Spreads were indeed larger in the immediate post-MiFID1 period but this liquidity drying up was more the consequence of the 2008 subprime crisis than that of fragmentation. More than five years later, clearer conclusions can be drawn.

4.1. Fragmentation of the lit order flow and liquidity

The most common view in academia is that lit fragmentation begets competition gains and promotes order execution quality (Huang, 2002; Stoll, 2003) and that adverse effects remain relatively limited.

4.1.1. Benefits of market competition

Several studies conducted in the U.S. provide empirical evidence that bid-ask spreads narrowed after the opening of new markets for diverse financial instruments (Battalio, 1997; Lee, 2002; Huang, 2002; Boehmer and Boehmer, 2003; Nguyen, Van Ness, and Van Ness, 2007; Mayhew, 2002; Fontnouvelle, Fishe, and Harris, 2003). Foucault and Menkveld (2008) also show that, due to the absence of price priority across markets, consolidated depth is larger after the entry of a new order book.

Regarding the interaction between fragmentation and liquidity, a first attempt to address the issue was made by O'Hara and Ye (2011) who exploited Securities and Exchange Commission (SEC) Rule 605 monthly data for 150 Nasdaq-listed and 112 NYSE-listed stocks over six months of 2008. Their analysis shows that high fragmented stocks have lower transaction costs and faster execution speed than low fragmented stocks, and that this liquidity benefit is more pronounced for small stocks on the Nasdaq and for large stocks on the NYSE.

Time series analyses of the relation between market fragmentation and liquidity have been conducted by Degryse, de Jong, and van Kervel (2014) and Gresse (2014a). Degryse et al. (2014) evaluate the impact of fragmentation on the liquidity of 52 Dutch stocks over a long period from 2006 to 2009. With traditional measures of spreads and depth plus a measure of depth that incorporates not only the quantities available at the best quotes but also those available at further limit prices, they find that fragmentation in visible order books improves cross-market aggregate liquidity. While their main contribution is to provide a long-term time series analysis of the relation between liquidity and fragmentation, their sample is limited to a relatively small sample of stocks. In contrast, in Gresse (2014a), I use shorter observation periods which avoid the extremely illiquid times of 2008 but I exploit a larger sample comprising 152 European stocks listed on the LSE and on Euronext. I find that that lit market fragmentation benefits liquidity or, in the worst-case scenario, does not adversely affect it. A focus on the study is made further in Sub-section 4.1.3.

4.1.2. Limited drawbacks of lit fragmentation

At the same time, a few authors have pointed out some drawbacks of fragmentation. According to Foucault and Menkveld (2008), the absence of price priority between order books makes trade-throughs likely to occur. While trade-throughs are prohibited in the U.S., some studies (Ende, Gomber, and Lutat, 2009; Riordan, Storkenmaier, and Wagener; 2010) report rates of trade-throughs between 6% and 9% in Europe.

Further, the order flow diverted by new markets may lessen the liquidity of the primary market, either by skimming off less informed orders from that market and thereby increasing its adverse selection costs (Chowdry and Nanda, 1991; Easley, Kiefer, and O'Hara, 1996; Bessembinder and Kaufman, (1997), or by simply reducing the quantities available on the incumbent markets. Degryse et al. (2014) find that lit fragmentation deteriorates the liquidity of the primary market for Dutch stocks, the effect being more pronounced for the small ones.

4.1.3. Lit fragmentation, algorithmic trading, and liquidity: the findings of Gresse (2014a)

In Gresse (2014a), my empirical work consists of two parts: a pre/post-MiFID comparison and a post-MiFID time series analysis. Both parts are based on trade and quote data from Euronext, the LSE, Deutsche Boerse, Chi-X, Turquoise, Nasdaq OMX Europe, BATS Europe, PLUS,[9] and BOAT.[10] These high-frequency data were generated and generously provided by Intelligent Financial Systems (IFS) for FTSE 100, CAC 40, and SBF 80 stocks.

In the pre-post MiFID comparison, the pre-MiFID period of October 2007 is compared with the post-MiFID periods of January, June, and September 2009. These three one-month periods were deliberately chosen to avoid the 2008 subprime crisis period. They are characterized by different levels of fragmentation and volatility. Fragmentation progressively increased from January to September 2009. Volatility was extreme in January, owing to the financial crisis, but then decreased and almost fell back to its baseline level of October 2007 in September 2009. The post-MiFID time series analysis covers 63 trading days from 1 September to 30 November 2009. Sampled stocks are those that were continually part of their index from 2007 to 2009. Financial stocks were excluded as very specific factors drove their liquidity and volatility during the observation periods. This screening procedure resulted in a pre/post-MiFID-comparison sample of 140 stocks of which 51 pertained to the FTSE 100, 32 to the CAC 40, and 57 to the SBF 80, and in a post-MiFID time-series-analysis sample of 152 stocks distributed between 64 FTSE-100 components, 32 CAC-40 components, and 56 SBF-80 components.

Lit fragmentation is measured with the index presented at Sub-section 2.1. Liquidity is measured with traditional measures of quoted spreads, effective spreads, and depth displayed at the best quotes, computed at two levels: locally on the primary exchange and globally by aggregating the quotes of all markets. Spreads and depth measured on the primary exchange will be referred to as local spreads and depth. Spreads and depth measured across markets will be referred to as global spreads and depth.

The pre-/post-MiFID comparison

The main test conducted in this part of the study is a two-stage panel regression model that accounts for the co-determination of fragmentation and liquidity. In the first stage, the fragmentation index is regressed on instrumental variables including market size, trading volume, trade size, the number of platforms displaying quotes, the intensity of competition measured by the proportion of markets quoting one of the best prices, and the tick size relative to size. In the second-stage, liquidity measures are regressed on the fragmentation values

9 The PLUS Market is an independent stock exchange based in London and specialized on small and medium sized companies.

10 The BOAT platform of Markit, a financial information provider, was the largest MiFID-compliant trade reporting service for OTC trades and regulated internalization at the time of the study. Markit decided to close it in late 2013. The largest trade reporting service is now offered by BATS Chi-X.

predicted from the first stage after controlling for volatility, market size, volume, price level, and the level of algorithmic trading (AT).[11] Observations are monthly averages by stock.

The results indicate that global and local spreads of CAC 40 and FTSE 100 securities significantly tighten with AT and lit fragmentation, the economic impact of fragmentation being however greater than that of AT. While depth is negatively correlated with AT, it is positively affected by lit fragmentation at both the global and the local level. The magnitude of liquidity benefits is greater for FTSE 100 constituents than for CAC 40 constituents. A possible explanation is that electronic trading was less developed at the LSE than on Euronext before MiFID: indeed stocks with less electronic trading prior to the fragmentation event had their spreads more significantly reduced with market competition.

Comparing the findings for the FTSE 100 and CAC 40 large stocks with those for the SBF 80 medium stocks shows that lit fragmentation is less beneficial to small stocks. Lit fragmentation has a beneficial impact on the effective spreads of SBF 80 stocks but no effect on their quoted spreads, no effect on their global depth, and an adverse effect on their local depth.

The post-MiFID time series analysis

The time series analysis is based on a similar two-stage panel regression methodology but with daily observations. It shows that all measures of spreads decrease with fragmentation for all stocks, except those of the SBF 80 index for which results are insignificant. Both AT and fragmentation contribute to reducing the spreads of blue chip stocks but the effect of fragmentation is greater.

Regarding depth, for FTSE 100 and CAC 40 components, global depth positively correlates with fragmentation and local depth is either positively or not significantly impacted by fragmentation, whereas all measures of depth are negatively impacted by AT. For SBF-80 medium capitalization stocks, fragmentation, when examined without controlling for AT, appears to reduce global and local depth. Nevertheless, when AT is accounted for, this depth reduction proves to be the outcome of AT and not that of fragmentation.

4.2. Dark trading and liquidity

Regarding the impact of dark trading on liquidity, the effects of crossing network trading, that is trading in dark pools matching orders at mid quote, should be distinguished from the effects of internalization, that is off-exchange dealer-to-customer executions. While crossing network trading is found to be associated with greater liquidity (Gresse, 2006; Buti, Rindi, and Werner, 2011; Ye, 2012), the effect of internalization is not so clear. In Gresse (2014a), I examine the link between liquidity and internalization for LSE- and Euronext-listed stocks by using a measure of internalization based on the trades reported to BOAT and the LSE trade reporting service. I find that depth may positively relate to internalization but at the expense of wider quoted spreads. With their sample of Dutch stocks, Degryse et al. (2014) find that dark trading has a detrimental effect on liquidity. Weaver (2011) finds that internalization is related to spread widening for a sample of U.S. stocks in October 2010.

[11] Algorithmic trading, which includes HF trading and other forms of computer-based trading, is measured by the negative of the euro volume in millions divided by the total number of quote changes per minute on both the primary exchange and Chi-X. This measure is a proxy for the "$algo\_trad_{it}$" measure of Hendershott, Jones, and Menkveld (2011), which is the negative of dollar volume per electronic message, measured in hundreds of dollars.

5. Market fragmentation and price quality

It was long believed that primary markets organized price discovery and that competing MTFs freely exploited primary exchange prices to operate without significantly contributing to their formation. Recent academic research by Riordan, Storkenmaier, and Wagener (2010) strongly challenges this view by showing that the contribution of Chi-X to price discovery has exceeded that of the primary exchange for some large capitalization stocks since mid-2008. From a regulatory perspective, if market fragmentation implies that several platforms actually contribute to price discovery, it raises the issue of whether fragmentation deteriorates or improves price quality. This section summarizes the findings of Gresse (2014b) which investigates this issue with two empirical approaches: (1) a comparison of price inefficiency measures based on variance ratios before and after the implementation of MiFID1 and (2) a panel regression approach to test the relation between those price inefficiency measures and fragmentation. Sample, observation periods, and data are those exploited in Sub-section 4.1.3 for the pre-/post-MiFID comparison. With an approach partly similar to (1), O'Hara and Ye (2011) found that high fragmented stocks exhibited better price quality than low fragmented stocks in U.S. markets. My approach is slightly different in that I can consider the implementation of MiFID1 as a natural experiment of markets rapidly shifting from quasi-consolidated markets to fragmented markets. As shown in Section 3.1, in European stock markets, most of the rise in fragmentation took place after MiFID1's enforcement, between the middle of 2008 and the end of 2009. A similar experiment did not happen in the U.S.

5.1. Measuring price quality

Price quality is assessed by price inefficiency coefficients (PICs) based on variance ratios. According to the Fama's weak-form efficiency, efficient prices follow a random walk and are not auto-correlated. The absence of price autocorrelation implies that the variance of long-term returns is proportional to the variance of short-term returns, the scale factor being the ratio of return horizons. Consequently, short-term/long-term return variance ratios can be used to assess price quality as first suggested by Lo and MacKinlay (1988). More precisely, with high-quality prices, i.e., in the absence of auto-correlation, a variance ratio reporting *k* times the variance of returns measured on □-minute intervals to the variance of returns measured on k□-minute intervals should equal one, and the absolute value of one minus this ratio should be zero. This absolute value, further referred to as a price inefficiency coefficient and denoted PIC, is here taken as an inverse measure of price quality, and is calculated as follows:

$$PIC^{\alpha,k} = \left| 1 - k \left(Var^{\alpha \min} \middle/ Var^{k\alpha \min} \right) \right|, \qquad (2)$$

where $Var^{\alpha \min}$ ($Var^{k\alpha \min}$) is the variance of mid-price α-minute returns (respectively kα-minute returns) computed in logarithm. Any increase in the PIC indicates a deterioration of price quality. The deterioration may result from either a positive autocorrelation generated by delayed incorporation of information into prices,[12] or a negative autocorrelation due to noise or overreaction in price movements.[13]

All returns are computed in logarithm on two series of prices: the mid-quotes of the primary exchange and cross-market mid-quotes obtained by consolidating the best limit prices of all markets. For each series, five PICs are computed based on five different variance ratios: the 1-second/5-second variance ratio, the 5-second/1-minute variance ratio, the 1-minute/5-minute variance ratio, the 5-minute/30-minute variance ratio, and the 30-minute/intraday variance ratio.

12 $k \left(Var^{\alpha min} \middle/ Var^{k\alpha min} \right) < 1.$

13 $k \left(Var^{\alpha min} \middle/ Var^{k\alpha min} \right) > 1.$

5.3. Findings

The first approach of Gresse (2014b) consists of testing the changes in PICs between the pre-MiFID period of October 2007 when trading was relatively concentrated on primary exchanges and the post-MiFID period of September 2009 when fragmentation had reached a substantial and stable level. The PIC variations of stocks with highly fragmented order flow in September 2009 are compared with those of stocks with weakly fragmented order flow through a difference-in-differences test on median values. According to the results, PICs of high fragmented stocks do not change in a significantly different way as those of low fragmented stocks for any of the three stock indices. These findings do not provide any statistical evidence of a detrimental effect of lit market fragmentation on price quality. However, no significant beneficial effect is evidenced either for any stock category. This contrasts the finding of O'Hara and Ye (2011) that market fragmentation contributes to improving price efficiency for small stocks in the U.S.

The second approach of Gresse (2014b) consists of running panel regressions of monthly values of PICs on values of the fragmentation index for the four month of October 2007, January 2009, June 2009, and September 2009. According to the estimates, fragmentation does not adversely affect the price quality of FTSE 100 stocks. On the contrary, the efficiency of their cross-market mid-quotes, when measured with 1-second/5-second variance ratios and 1-minute/5-minute variance ratios, improves with fragmentation. For Euronext stocks, cross-market price efficiency measured with 1-second/5-second variance ratios deteriorates with fragmentation but price efficiency on the primary exchange for the same return intervals does not: it improves with fragmentation for CAC 40 components and it is not significantly impacted for SBF 80 components. For return horizons longer than five seconds, price quality is not significantly affected in any way by fragmentation.

6. Conclusion

Since the implementation of MiFID1 on 1 November 2007, market fragmentation has considerably increased in European stock markets without however reaching the same level as in the U.S. The fragmentation of the lit order flow in large equities has constantly increased from 2008 to 2013, with most of the rise happening between the middle of 2008 and the end of 2009. Among the many emerging MTFs, three have become significant players, and at present, their joint market share exceeds 30% of lit trading volumes. In contrast with the growth of lit MTFs, regulated dark pools do not execute more than some 5% of the total trading volumes. Among the diverse forms of dark trading, OTC trading is from far the most prominent one in volume share.

Most academic studies converge to prove that the increased fragmentation of the visible order flow does not harm liquidity. On the contrary, associated competition effects have generally contributed to reducing spreads and to increasing depth, with greater benefits for global traders who connect to several platforms. In Europe, liquidity gains related to lit fragmentation are found to be more significant for large capitalization stocks and for stocks that had less electronic trading before their market fragmented. This contrasts results obtained in the U.S. by O'Hara and Ye (2011) who found that market fragmentation benefits were greater for small stocks than for large stocks on the Nasdaq. Further, adverse effects on the depth of small stocks may be observed locally in their primary market but they are more probably the outcome of algorithmic trading rather than that of fragmentation.

Effects of dark fragmentation are less clear. While dark trading in crossing engines is shown to improve liquidity, the impact of OTC trading is mixed and the lack of strong conclusion on this issue leaves room for further research.
Finally, the price quality of European stocks does not appear to be significantly affected by market fragmentation. This opposes the findings of O'Hara and Ye (2011) who found a positive correlation between price quality and lit fragmentation for U.S. stocks.

References

Battalio, R. H., 1997, "Third Market Broker-Dealers: Cost Competitors or Cream Skimmers?", *Journal of Finance*, 52(1), 341-352.

Bessembinder, H., and Kaufman H. M., 1997, "A Cross-Exchange Comparison of Execution Costs and Information Flow for NYSE-listed Stocks", *Journal of Financial Economics*, 46(3), 296-319.

Boehmer, B., and Boehmer, E., 2003, "Trading Your Neighbor's ETFs: Competition or Fragmentation?", *Journal of Banking and Finance*, 27(9), 1667-1703.

Buti, S., Rindi, B., and Werner, I. M., 2011, "Diving into Dark Pools", Charles A. Dice Center Working Paper No. 2010-10; Fisher College of Business Working Paper No. 2010-03-010, available at SSRN: http://ssrn.com/abstract=1630499.

Chowdry, B., and Nanda V., 1991, "Multimarket Trading and Market Liquidity", *Review of Financial Studies*, 4(3), 483-511.

Degryse H., de Jong, F., and van Kervel, V., 2014, "The Impact of Dark and Visible Fragmentation on Market Quality", *Review of Finance*, forthcoming.

Easley, D., Kiefer N. M., and O'Hara M., 1996, "Cream-Skimming or Profit-Sharing? The Curious Role of Purchased Order Flow", *Journal of Finance*, 51(3), 811-833.

de Fontnouvelle, P., Fishe, R. P. H., and Harris, J. H., 2003, "The Behavior of Bid-Ask Spreads and Volume in Options Markets during the Competition for Listings in 1999", *Journal of Finance*, 58(6), 2437-2468.

Ende, B., Gomber, P., and Lutat, M. (2009) Smart Order Routing Technology in the New European Equity Trading Landscape. Working paper, University of Frankfurt. Available at SSRN: http://ssrn.com/abstract=1476272.

Foucault, T., and Menkveld, A. J., 2008, "Competition for Order Flow and Smart Order Routing Systems", *Journal of Finance*, 63(1), 119-158.

Gresse, C., 2006, "The Effect of Crossing-Network Trading on Dealer Market's Bid-Ask Spreads", *European Financial Management*, 12(2), 143-160.

Gresse, C., 2014a, "Effects of Lit and Dark Market Fragmentation on Liquidity", working paper, Université Paris-Dauphine, available at SSRN: http://ssrn.com/abstract=1918473.

Gresse, C., 2014b, "Market Fragmentation and Market Quality: The European Experience", forthcoming in *Market Microstructure and Nonlinear Dynamics - Keeping Financial Crisis in Context*, edited by G. Dufrénot, F. Jawadi, and W. Louhichi (Eds), Springer-Verlag.

Harris, L., 1993, "Consolidation, Fragmentation, Segmentation, and Regulation", *Financial Markets, Institutions and Instruments*, 2(5),1–28.

Hendershott, T., Jones C. J., and Menkveld A. J., 2010, "Does Algorithmic Trading Improves Liquidity?", *Journal of Finance*, 66(1), 1-33.

Hendershott, T., and Mendelson H., 2000, "Crossing Networks and Dealer Markets: Competition and Performance", *Journal of Finance*, 55(5), 2071-2115.

Huang, R. D., 2002, "The Quality of ECNs and Nasdaq Market Maker Quotes", *Journal of Finance*, 57(3), 1285-1319.

Jacquillat, B., and Gresse C., 1998, "The Diversion of Order Flow on French Stocks from CAC to SEAQ International: A Field Study", *European Financial Management*, 4(2), 121-142.

Lee, R., 2002, "Capital Markets that Benefit Investors. A Survey of the Evidence on Fragmentation, Internalisation, and Market Transparency", Oxford Finance Group.

Lo, A. W., and MacKinlay, C., 1988, "Stock Market Prices Do Not Follow Random Walks: Evidence from a Simple Specification Test", *Review of Financial Studies*, 1, 41-66.

Mayhew, S., 2002, "Competition, Market Structure, and Bid-Ask Spreads in Stock Option Markets", *Journal of Finance*, 57(2), 931-958.

Menkveld, Albert J., 2013, "High Frequency Trading and the New-Market Makers", *Journal of Financial Markets*, 16(4), 712-740.

Nguyen, V., Van Ness, B. F., and Van Ness, R. A., 2007, "Short- and Long-Term Effects of Multimarket Trading", *Financial Review*, 42(3), 349-372.

O'Hara, M., and Ye, M., 2011, "Is Fragmentation Harming Market Quality?", *Journal of Financial Economics*, 100(3), 459-474.

Riordan, R., Storkenmaier A., and Wagener M., 2010, "Do Multilateral Trading Facilities Contribute to Market Quality?", working paper, Karlsruhe Institute of Technology.

Stoll, H., 2003, "Market Microstructure", in Constantinides, G., Harris, M., and Stulz, R. eds., *Handbook of the Economics of Finance*, Volume 1A, Amsterdam: Elsevier.

Weaver, D. G., 2011, "Internalization and Market Quality in a Fragmented Market Structure", working paper, Rutgers Business School, available at SSRN: http://ssrn.com/abstract=1846470.

Ye, M., 2012, "Price Manipulation, Price Discovery and Transaction Costs in the Crossing Network", available at SSRN: http://ssrn.com/abstract=2024057.

Zhu, H., 2014, "Do Dark Pools Harm Price Discovery?", *Review of Financial Studies*, 27(3), 747-789.

France: Is there a real shortage of long-term financing of the economy?

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Abstract

France: Is there a real shortage of long-term financing of the economy?
It is often agreed that growth in France is endangered by the shortage of long-term financing of the economy, in particular of the corporate sector. We show that, globally, long-term financing is clearly sufficient in France. SMEs in particular have a very important capital. Two concerns remain. The very important role of non-listed equities in the financing of the corporate sector; the underdevelopment of venture capital.

Résumé

On avance souvent que la croissance française est handicapée par l'insuffisance de financements à long terme de l'économie, et en particulier des entreprises. Nous montrons que globalement, la France ne manque pas de financements à long terme. Les PME en particulier disposent de fonds propres très importants. Il reste deux sujets d'inquiétude. Le rôle très important des actions non cotées pour financer les entreprises ; l'insuffisance de capital risque.

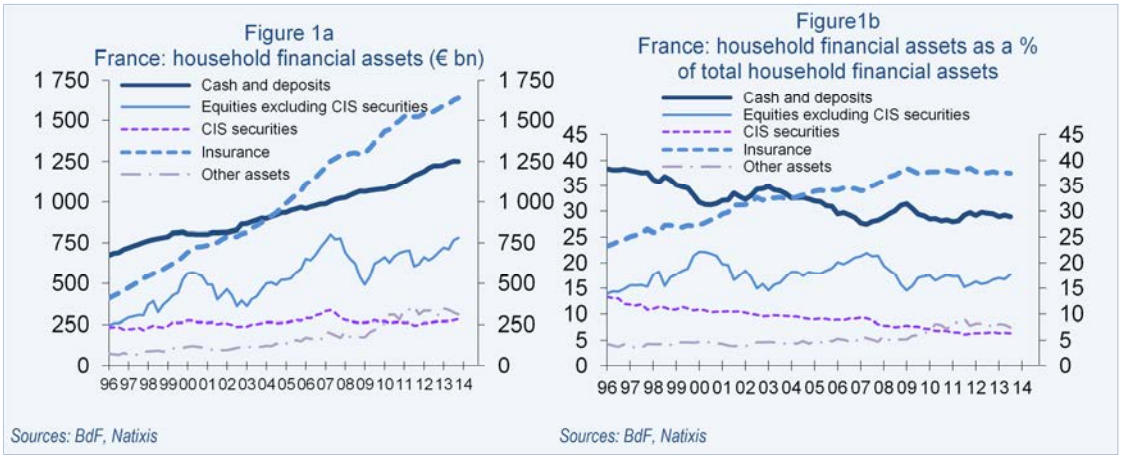
It is often said that there is a major shortage of long-term financing for French companies and that incentives and regulations need to be put in place to channel additional long-term savings to businesses through a variety of forms, including equity, bonds and long-term loans.

We also know that new banking regulations, including the Basel 3 framework, are going to result in greater disintermediation of business financing and that it will be necessary to develop different aspects of the corporate bond market going forward.

Taking this as our starting point, we look at the structure of savings in France and the structure of financing for domestic companies and consider the actual, rather than supposed, deficiencies in business financing.

1- Structure of savings

Figures 1 a/b show **the structure of French households' financial savings**.

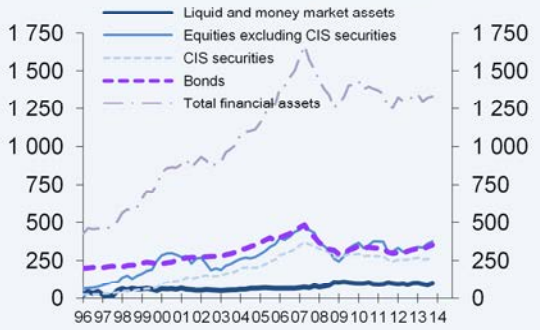


Insurance investments (more than 80% of which comprises life insurance technical reserves) and liquid assets both have substantial shares.

To decompose savings, the next step is to look at the investment structure of collective investment schemes (CIS) **(Figure 2a)**, insurance companies **(Figures 2 b/c)** and **regulated savings passbooks**.

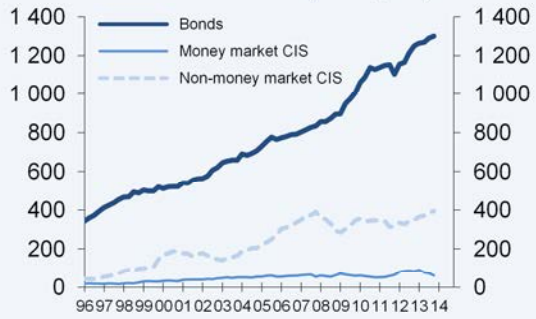
Passbook savings account for more than 15% of households' financial assets **(Figure 2d)**.

Figure 2a
France: assets held by CIS* (€ bn)



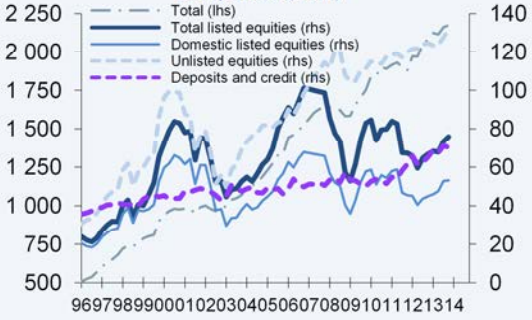
(*) Money market + other CIS
Sources: BdF, Natixis

Figure 2b
France: assets held by CIS* (€ bn)



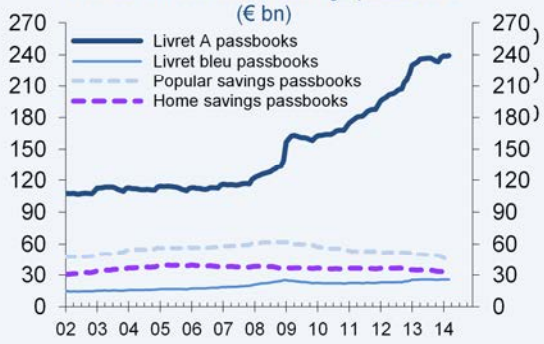
Sources: BdF, Natixis

Figure 2c
France : assets held by insurance companies (€ bn)



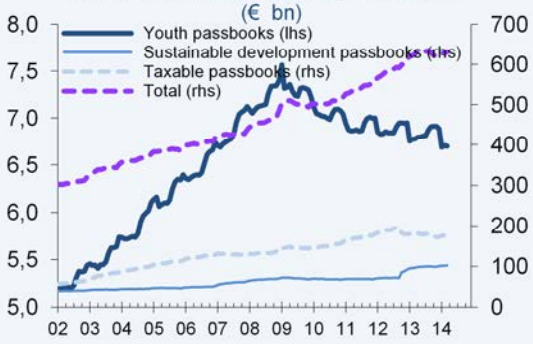
Sources: BdF, Natixis

Figure 2d
France: investment in savings passbooks (€ bn)



Sources: BdF, Natixis

Figure 2e
France: investment in savings passbooks (€ bn)



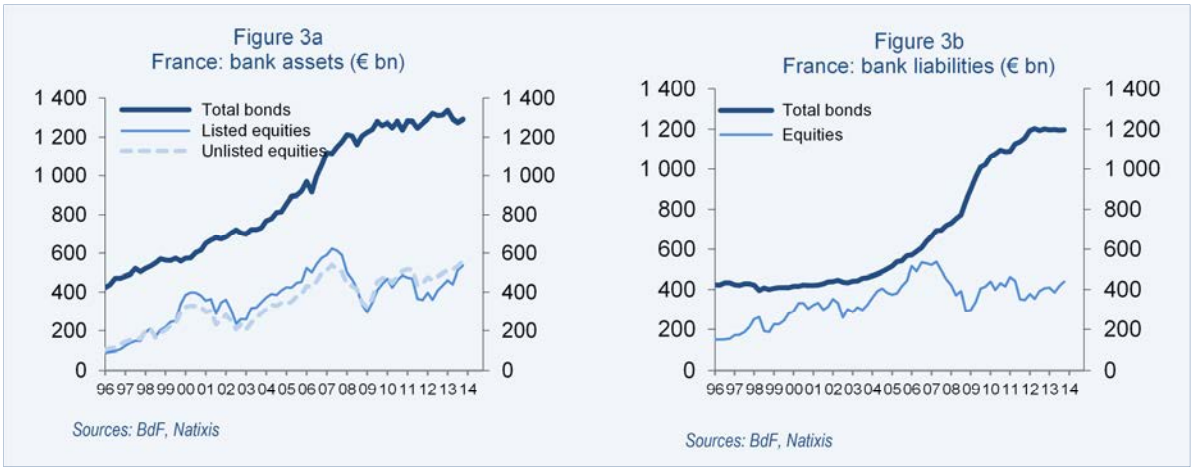
Sources: BdF, Natixis

On average, Caisse des Dépôts savings funds hold 65% of the outstanding assets of Livret A passbooks, 65% of the outstanding assets of sustainable development passbooks and 70% of the outstanding assets of popular savings passbooks.

These funds are used in order to:

- fund social housing and urban development policy (53%);
- provide loans to the local public sector or to refinance housing loans (7%).
- The remainder (40%) is invested in a portfolio of securities that chiefly comprises fixed income products (2/3 sovereign securities), equities and CIS.

We also look at **banks' securities holdings (Figures 3 a/b)**.



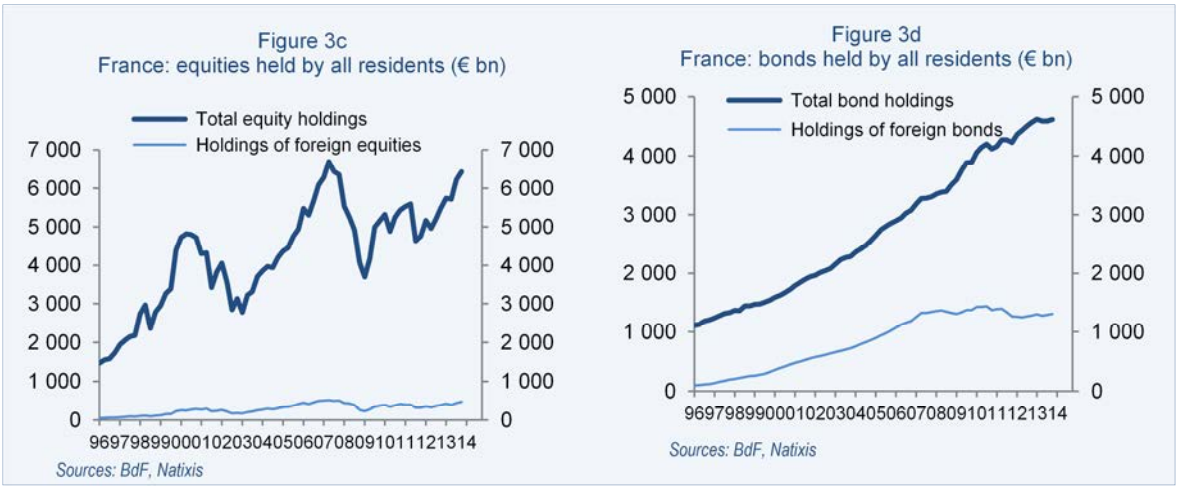
Banks have substantial bond and equity portfolios, holding a net €100 billion in bonds and €530 billion in equities.

When combined, the direct holdings of households, CIS held by households, savings passbooks centralised with the Caisse des Dépôts and insurers amount to total long-term savings of:

- **€1.28 trillion in listed and unlisted equities;**
- **€1.64 trillion in bonds;**

or about 150% of GDP in all.

At this juncture, it is important to acknowledge that **a portion of long-term savings held by French investors does not finance French borrowers but borrowers in the rest of the world. Figure 3c** shows the proportion of listed and unlisted foreign equities held in France, while **Figure 3d** shows the proportion of foreign bonds held in France. Figures 3c and 3d show that the proportion of European securities held in France is low relative to the share of domestic securities.

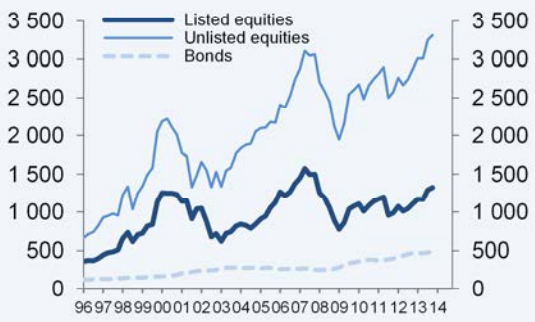


2- Financing structure of French businesses

Let us now consider the **financing structure of French businesses (Figures 4 a/b/c/d)**.

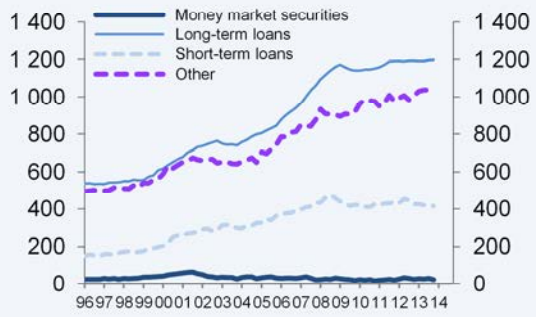
Non-financial companies (NFCs) are primarily financed through unlisted equities (38% of the total), followed by long-term loans (16%), listed equities (14%), and then bonds (7%), making up 75% of their total long-term financing.

Figure 4a
France: NFC liabilities (€ bn)



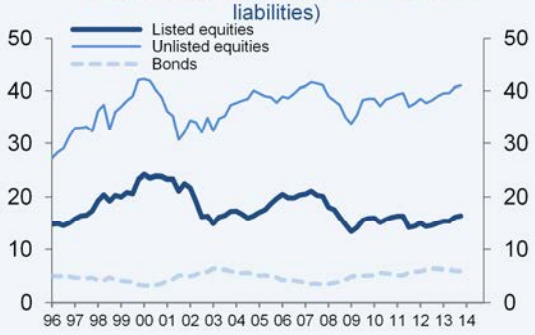
Sources: BdF, Natixis

Figure 4b
France: NFC liabilities (€ bn)



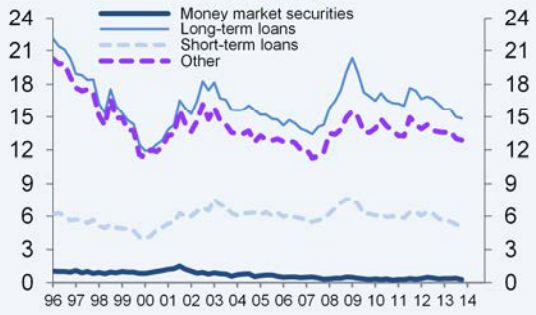
Sources: BdF, Natixis

Figure 4c
France: NFC liabilities (% of total financial liabilities)



Sources: BdF, Natixis

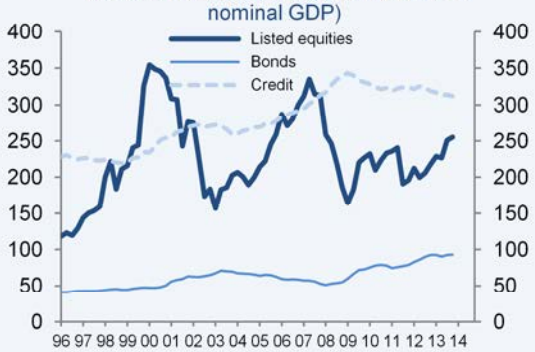
Figure 4d
France: NFC liabilities (% of total financial liabilities)



Sources: BdF, Natixis

French firms have a well-known aversion to market financing. Listed equities and bonds have much lower shares than in the USA, while the share of bank credit is considerably higher **(Figures 4e/f).**

Figure 4e
France: NFC outstanding liabilities (% of nominal GDP)



Sources: Datastream, BdF, Insee, Natixis

Figure 4f
USA: NFC outstanding liabilities (% of nominal GDP)

Sources: Datastream, FoF, Natixis

The long-term financing of French businesses is thus primarily based on unlisted equities and long-term loans.

Table 1 shows that **French small and medium-sized enterprises (SMEs) have a higher proportion of equity than German or Italian firms**, and slightly less than Spanish firms; they also carry more **long-term debt** than German and Italian SMEs.

Table 1
Structure of SME liabilities in 2010 (% of total assets)

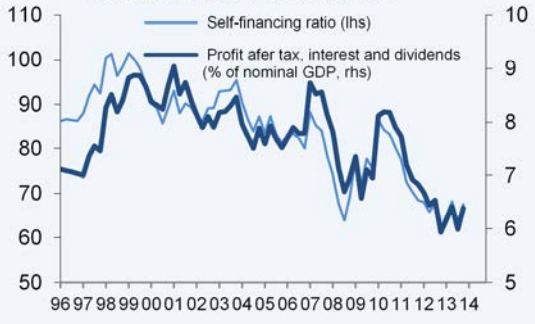
	Equity	Accruals and provisions	Long-term debt (>1 yr)		Short-term debt	
			Credit institutions	Other	Credit institutions	Other
Manufacturing						
France	41.5%	3.6%	10.2%	9.0%	2.9%	32.8%
Germany	38.5%	13.1%	7.9%	3.6%	7.4%	29.5%
Spain	42.1%	4.8%	11.7%	5.7%	8.5%	27.2%
Italy	34.4%	6.6%	9.2%	3.5%	15.3%	31.0%
Construction						
France	29.1%	9.7%	8.7%	7.3%	2.7%	42.5%
Germany	19.1%	11.1%	5.8%	1.8%	7.6%	54.6%
Spain	33.3%	1.9%	22.5%	9.1%	9.7%	23.6%
Italy	22.5%	3.8%	14.3%	4.6%	18.0%	36.7%
Trade						
France	34.8%	1.7%	10.7%	9.3%	3.9%	39.6%
Germany	32.8%	10.1%	5.7%	3.0%	11.5%	37.0%
Spain	40.5%	0.7%	11.0%	4.7%	8.5%	34.7%
Italy	26.9%	5.0%	7.3%	3.2%	18.2%	39.3%

Source: Banque de France, BACH ESD database

The facts therefore give the lie to the notion that there is a shortage of long-term financing for French businesses. However, **we know that while the profitability and self-financing ratio of French firms have declined considerably (Figure 5a) their investment rate did not fall prior to the crisis (Figure 5b).**

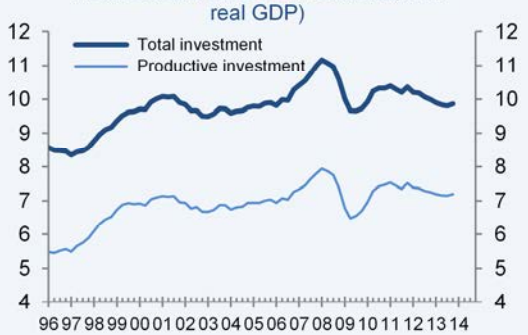
There is no evidence that investment contracted before the crisis because of a squeeze on long-term financing.

Figure 5a
France: profit after tax, interest and dividends and self-financing ratio



Sources: Datastream, Insee, Natixis

Figure 5b
France: real business investment (% of real GDP)



Sources: Datastream, Insee, Natixis

We also know that **whereas large companies have continued to finance themselves on the bond market since the crisis began, small firms have no longer been able to obtain credit (Figure 6)**.

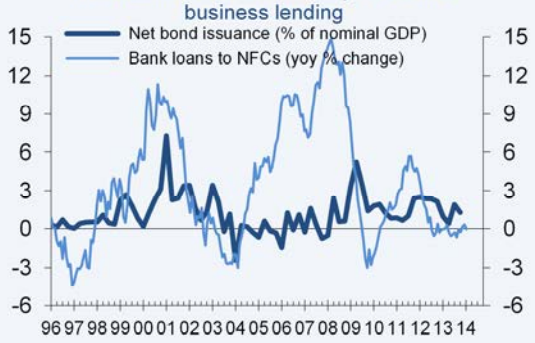
We further know that **issuance of listed equities is fairly small (Figure 7)**.
Accordingly, unlisted equities play an important role.

The "equities and CIS securities" item in the financial accounts of economic agents records financial assets representing ownership rights over companies and quasi-companies. These securities entitle holders to share in the profits and also in the net assets if the company is liquidated.

The equities of unlisted companies are valued using a comparable approach (application of market capitalisation/equity ratio observed for listed companies in the same sector) adjusted using a fixed 25% haircut to reflect the risk associated with lower liquidity.

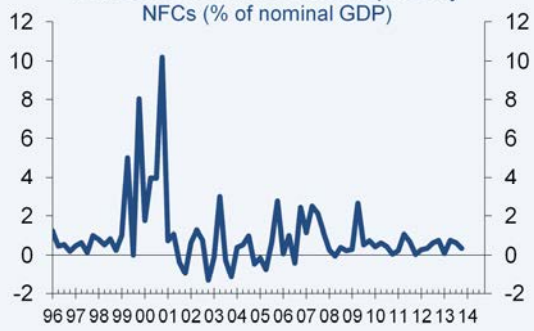
For NFCs, unlisted equities make up a growing and majority share of ownership securities (67% of equities are unlisted) and liabilities (37%), well ahead of listed equities (26% of ownership securities and 14.6% of liabilities), **Figure 8**.

Figure 6
France: net bond issuance by NFCs and business lending



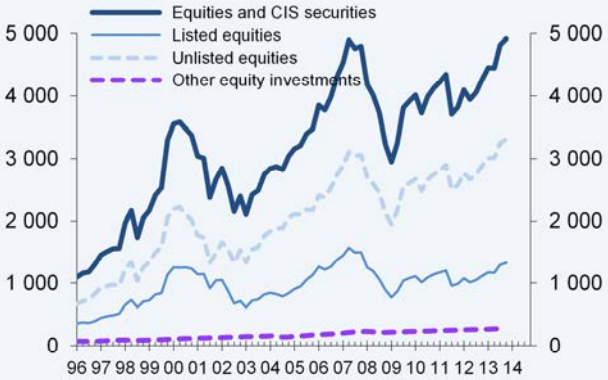
Sources: Datastream, BdF, Natixis

Figure 7
France: net issuance of listed equities by NFCs (% of nominal GDP)



Sources: Datastream, BdF, Natixis

Figure 8
France: NFC financing (equities, € bn)

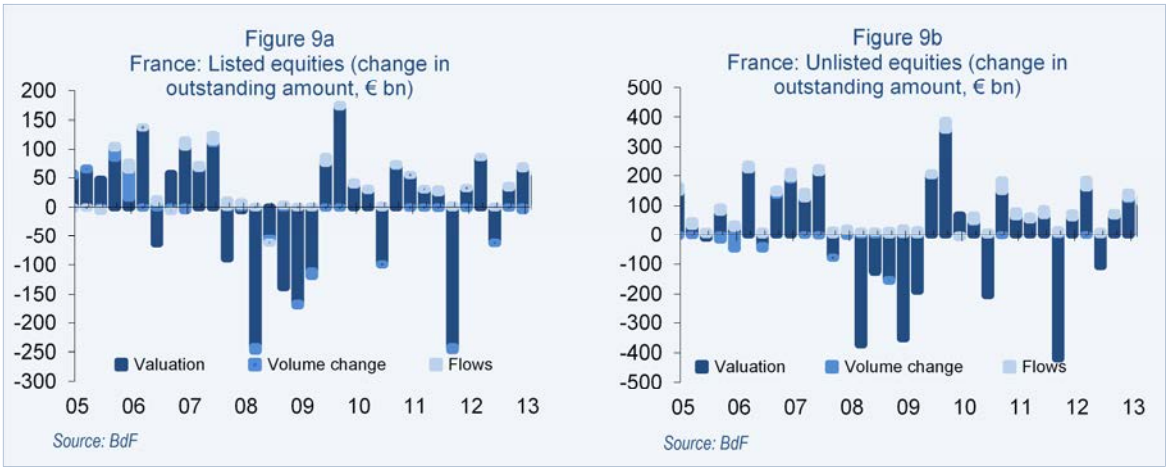


Sources: BdF, Natixis

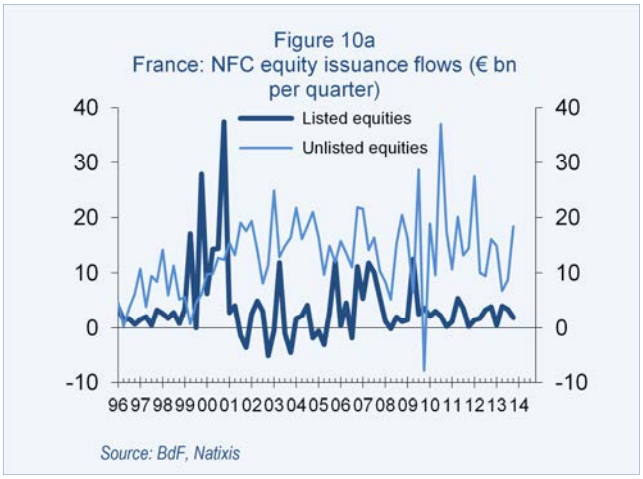
The change in outstanding amounts between two periods reflects three factors:

- valuation effects;
- effects resulting from volume changes owing to reclassifications, creations and withdrawals;
- flows: capital increases.

For listed and unlisted companies alike, valuation effects account for the bulk of changes in outstanding amounts **(Figures 9 a/b)**.



Flows associated with outstanding amounts of unlisted equities have been larger over the long run and more volatile since the onset of the crisis **(Figure 10a)**.



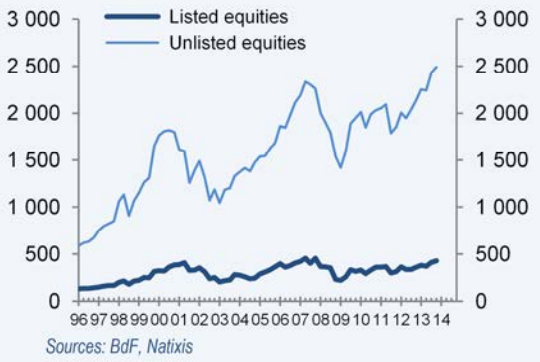
Volume changes mostly reflect the reclassification of unlisted companies as listed ones (see figures above) and, less commonly, listed to unlisted reclassifications, which are also on a smaller scale and mainly occurred between 2001 and 2003, perhaps reflecting the dotcom bubble.

French SMEs thus satisfy their financing needs through equity other than listed equities.

Unlisted equities therefore account for a considerable share of business financing (Figures 8/10a). However, it is important to keep in mind that **so far we have looked at gross financing**. A portion of the listed and unlisted equities **that finance NFCs belongs to other NFCs.**

Consider the **equity financing of NFCs in France**. **Figure 10b** shows the outstanding assets of NFCs, which should be compared against Figure 8, which shows outstanding liabilities. We see that **the bulk of unlisted equities in issuance are held by other companies**. **Figure 10c** provides the same information for flows. Figure 10c shows flows of equity purchases by NFCs; it should be compared against Figure 10a, which shows flows of equity issuance.

Figure 10b
France: NFC assets (€ bn)



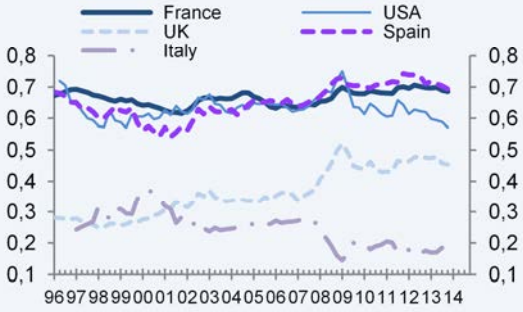
Sources: BdF, Natixis

Figure 10c
France: Change in equities held as assets by NFCs (€ bn)

Sources: BdF, Natixis

We compare the share of unlisted equities in France against other countries.

Figure 10d
Outstanding unlisted equities/total outstanding listed and unlisted equities



Source : Datastream, national sources, Natixis

The share of unlisted equities is high everywhere except Italy.

Why do unlisted equities have such an important role in France? This surely reflects:

- the decision by many companies not to list;
- large-scale purchases by major groups of strong SMEs: 16% of SMEs with more than 250 employees are bought every year by a major group.

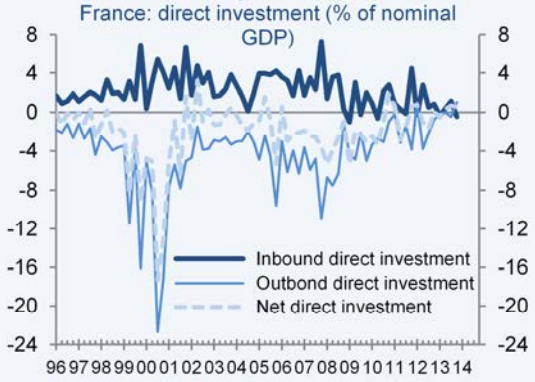
The role of unlisted equities may be cause for concern in terms of:

- the low appeal exerted by the listed equity market;
- the insufficient portfolio diversification of holders of unlisted equities, an issue that has been exacerbated by crowdfunding.

3- The role of non-residents in financing the French economy

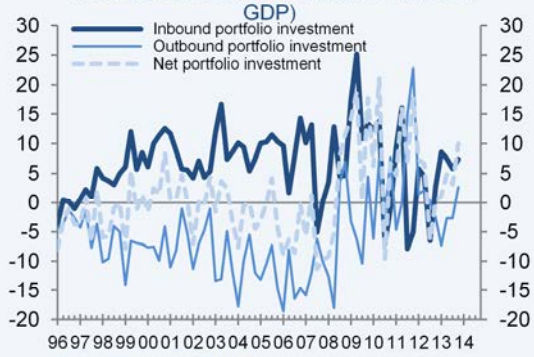
So far, we have compared the savings of French households against the financing requirements of the French economy. What role do non-residents play in this financing? **Figure 11a** shows direct inbound, outbound and net investments; **Figure 11b** shows inbound, outbound and net portfolio investments; **Figure 11c** shows purchases of long-term financial assets by non-residents.

Figure 11a
France: direct investment (% of nominal GDP)



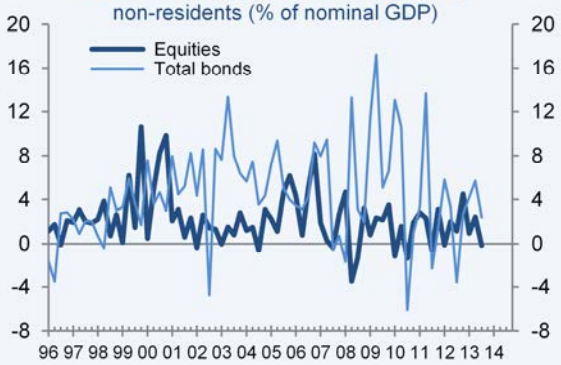
Sources: Datastream, Natixis

Figure 11b
France: portfolio investment (% of nominal GDP)



Sources:Datastream, Natixis

Figure 11c
France: net equity and bond puchases by non-residents (% of nominal GDP)



Sources: Datastream, BdF,Natixis

We see that direct, inbound and outbound investments declined from 2006 and all but disappeared in 2013. Portfolio investments are positive and essentially comprise bond purchases by non-residents.

Careful attention also needs to be paid to direct investments, which are more often acquisitions rather than bona fide investments (Table 2). Total direct investments in Table 2 are equity investments only and exclude financial circulation within companies. If we are looking at the role of foreign direct investment (FDI) in financing the economy, this makes no difference. But it is a very different matter if we are **looking at the role of FDI in building production capacity in France**, which turns out to be very weak.

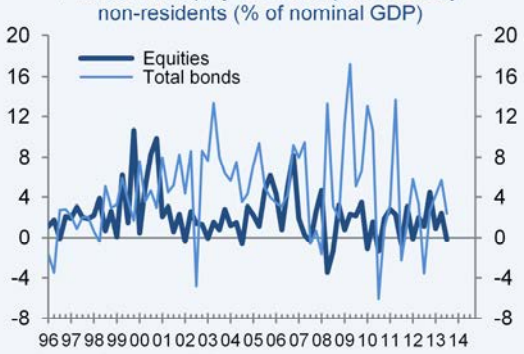
Table 2
France: sector breakdown of FDI flows (€ bn)

		2012
AGRICULTURE, FORESTRY AND FISHERY		**0.07**
MINING AND QUARRYING		**0.26**
of which:	Oil and gas extraction	0.09
MANUFACTURING INDUSTRIES		**1.17**
of which:	Manufacture of agricultural and food products	-0.90
	Manufacture of textiles and wearing apparel	-0.05
	Timber industry, publishing and printing	0.99
	Manufacture of coke and refined petroleum products	-0.86
	Manufacture of chemicals and chemical products	0.34
	Manufacture of basic pharmaceutical products and pharmaceutical preparations	-0.32
	Manufacture of rubber and plastic products	0.03
	Manufacture of basic metals	-0.11
	Manufacture of computer, electronic and optical products	0.45
	Manufacture of machinery and equipment	0.69
	Manufacture of motor vehicles, trailers and semi-trailers	-0.05
	Manufacture of other transport equipment	0.10
ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY		**-0.37**
WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES		**0.06**
of which:	Water collection, treatment and supply	0.03
CONSTRUCTION		**0.06**
WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES		**1.88**
of which:	Wholesale trade	-0.71
	Retail trade	2.14
TRANSPORTATION AND STORAGE		**1.19**
of which:	Land transport and transport via pipelines	0.40
	Water transport	-0.16
	Air transport	0.03
	Warehousing and support activities for transportation	0.91
ACCOMMODATION AND FOOD SERVICE ACTIVITIES		**-0.90**
INFORMATION AND COMMUNICATION		**-0.26**
of which:	Motion picture, video and television programme production	0.35
	Telecommunications	-1.57
FINANCIAL AND INSURANCE ACTIVITIES		**2.31**
of which:	Financial service activities, except insurance and pension funding	2.59
	of which: Holding company activities	2.27
	Insurance	-0.57
REAL ESTATE ACTIVITIES (b)		**9.08**
PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES		**-0.15**
of which:	Legal and accounting activities	0.13
	Activities of head offices; management consultancy activities	0.23
	Architectural and engineering activities; technical testing and analysis	-0.07
	Scientific research and development	-0.05
	Advertising and market research	-0.44
ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES		**3.81**
EDUCATION		**0.03**
HUMAN HEALTH AND SOCIAL WORK ACTIVITIES		**0.03**
ARTS, ENTERTAINMENT AND RECREATION		**0.11**
OTHER SERVICE ACTIVITIES		**0.00**
OTHER AMOUNTS		**0.21**
TOTAL		**18.59**

Source: Banque de France

Figure 11c shows flows of purchases of French financial assets by non-residents. **Figure 11d** shows the corresponding stocks.

Figure 11c
France: net equity and bond purchases by non-residents (% of nominal GDP)



Sources: Datastream, BdF, Natixis

Figure 11d
France: non-resident holdings (% of nominal GDP)

Sources:Datastream, BdF, Insee, Natixis

As we shall see below, non-residents hold a substantial share of France's government debt. Even if French companies are no longer financing themselves with equities (Figure 7), non-residents hold a large portfolio of French shares.

Table 3 shows the increase between 1996 and 2009 in the non-resident share of ownership of government debt and all bonds. In 2010-2011-2012, purchases of bonds by non-residents fell before recovering in 2013. The role of non-residents in financing government debt once again became very important (**Table 3a**).

Table 3
France: percentage held by non-residents

	Equities	Government debt	Bonds
1996	13.9	18.4	13.4
1997	15.0	20.0	16.8
1998	16.1	22.6	16.0
1999	17.9	28.0	19.9
2000	17.2	33.7	24.1
2001	18.5	38.4	27.5
2002	17.0	41.9	29.7
2003	17.8	48.1	34.1
2004	18.7	52.7	36.3
2005	19.8	56.5	36.6
2006	19.3	59.0	35.9
2007	17.5	61.3	34.8
2008	15.9	65.1	35.6
2009	16.0	67.8	37.9
2010	16.0	67.0	39.0
2011	15.8	64.1	39.8
2012	16.6	62.2	40.1
2013	16.8	64.5	40.4

Sources: AFT, BdF, Insee, Natixis

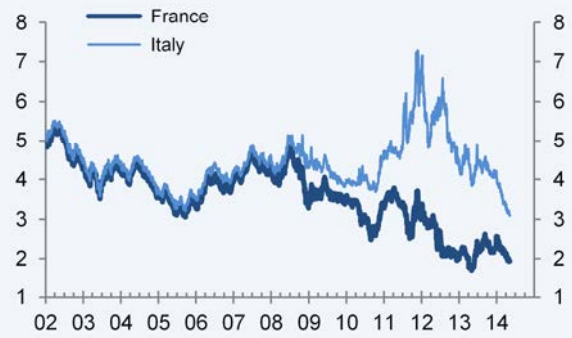
Table 3a
Ownership structure of French government debt, by economic agent (%)

Economic agents	% share
Non-residents	57
Insurers	22
Credit institutions	13
CIS	2
Other	6
Total	100

Source: Agence France Trésor

Is the fact that non-residents hold a substantial share of France's government debt a weakness or an advantage? It is often suggested that non-resident ownership is more volatile than ownership by residents. Is that really true? **Table 3b** shows that Italy has high domestic ownership of government debt, but this did not prevent the country from experiencing debt crises in 2008 and in 2011 **(Figure 12)**.

Figure 12
10-year interest rate on government bonds
(%)



Sources: Datastream, Natixis

However, it is clear that a high proportion of non-resident ownership of government debt crowds resident investors out of the domestic government debt market and pushes them towards riskier assets. **It also leads to a decline in long-term equilibrium interest rates.**

Table 3b
Percentage of government debt held by non-residents (2013)

USA	57.1
UK	28.8
Germany	76.5
France	65.1
Spain	41.0
Italy	39.8
Japan	4.1

Sources: Fed, BoE, BoJ, AFT, Tesoro Publico, Banca d'Italia, Natixis

4 – The specific case of financing for micro-businesses and start-ups: seed phase

Approaches to financing start-ups depend on the project's maturity:

- in the initial phase, capital generally comes from the entrepreneur's funds, a bank loan and/or public R&D grants;
- in the seed phase, additional capital is often provided through debt or equity instruments by business angels, who get involved in the project, supplying networks, experience and strategic expertise;
- next, it is common to see venture capital funds take capital stakes (often minority) in the company for a limited period (three to seven years);
- other mechanisms are in place for the following stages (expansion capital, LBO, turnaround capital), linked in particular to the negative profitability of venture capital in France, unlike in the UK or the USA.

Four problems have been raised[14].

1. The lack of business angels and support **(Table 4)**.

Table 4
Selected data on business angels within and outside networks

	France	UK	EU	USA
Number of BA networks	81	24	334	250
Number of BAs **- within networks** **- total**	 4,000 8,000	 5,500 50,000	 75,000 100,000	 265,400
Total BA investment **- within networks** **- total**	 €62.5 million (€125 million in coinvestments)	 £62.8 million (£123.2 million in coinvestments) £426 million	 €3 or €4 billion	 $20.1 billion
Average amount per BA and per project	€16,000	£77,000 (£10,000 to £500,000)		$76,000 $40,000 (Angel Capital Association)
Number of BAs per project	14	2.5		4.3
Number of businesses financed	280	307		61,900
Stage	75% in first round	50% in first round		41% in first round

Sources: France Angel 2010, British BA Association 2009, European Association 2009, Center for Venture Research 2010

[14] *See Notes du Centre d'Analyse Stratégique No. 237, September 2011; No. 265, February 2012*

2. Investments are concentrated in the least risky phases, not the early phases, with the result that LBO funds dominate **(Table 5)**.

Table 5
Structure of private equity investment in France,
by business development stage (€ billion)

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Venture capital	0.48	0.54	0.68	0.76	0.59	0.61	0.60	0.44	0.64
Expansion capital	0.90	1.06	1.31	1.65	1.80	2.31	2.94	1.95	1.83
Buyout capital	6.29	8.08	10.34	7.40	1.61	3.51	6.02	3.57	3.91
Turnaround capital	0.06	0.10	0.08	0.10	0.08	0.09	0.12	0.12	0.10
Other	0.35	0.40	0.14	0.10	0.03	0.08	0.07	0.00	0.00
Total	**8.07**	**10.16**	**12.55**	**10.01**	**4.10**	**6.60**	**9.74**	**6.07**	**6.48**

Sources: AFIC, Natixis

3. Pre-tax profitability is low in the seed stage **(Tables 6a/6b)**. Investment in this asset class is attractive almost exclusively because of tax incentives.

Table 6a
Internal rate of return (IRR) on private equity in France,
by development stage, measured from inception

	2005	2006	2007	2008	2009	2010	2011	2012
Venture capital	-5.1%	-0.6%	-0.5%	-2.7%	-3.0%	-2.6%	-1.0%	-0.9%
Expansion capital	11.7%	8.7%	8.2%	7.6%	6.9%	6.7%	7.1%	6.0%
LBO	15.5%	20.1%	21.3%	14.5%	14.6%	15.6%	14.1%	14.5%
Total	***10.7%***	***13.4%***	***14.7%***	***8.5%***	***8.4%***	***9.1%***	***8.8%***	***8.6%***

Sources: AFIC, Ernst & Young, Thomson Reuters

Table 6b
IRR on private equity by region and
by development stage from inception to end-2010

	Venture capital	Expansion capital	Buyout	General funds	Total
France	-0.9%	6.0%	14.1%	4.3%	8.6%
UK	3.6%	8.8%	13.4%	9.9%	11.4%
Spain	1.2%	-2.1%	5.5%	0.1%	1.9%
Italy	-2.2%	-7.6%	2.2%	5.5%	0.4%
Germany	-1.7%	-2.7%	8.2%	N.A	3.4%
Europe	0.9%	3.0%	11.6%	9.4%	9.3%
USA	14.3%	13.7%	11.0%	8.8%	11.8%

Sources: AFIC, Natixis

4. Banks and private individuals dominate fund-raising for private equity funds, which the CAE says does not promote larger investments or risk-taking. Pension funds play a fairly marginal role **(Table 7)**.

Table 7
Structure of private equity fund-raising in 2002-2010, Europe

% of fund-raising	France	EU	UK	USA
Industrial investors	2.0	3.0	5.4	2.2
Private individuals	22.0	5.0	7.0	10.0
State bodies	10.0	4.0	9.5	-
Banks	17.0	11.0	11.0	12.5
Pension funds	13.0	21.0	29.0	42.0
Insurance companies	18.0	7.0	9.3	12.6
Universities	-	0.0	3.3	21.0
Funds of funds	14.0	12.0	17.3	-
Other	2.0	20.0	9.6	-

Note: 2005 statistics for the USA
Sources: AFIC, BVCA, EVCA, NVCA

Start-up financing is thus the only area where there is evidence of a shortfall of financing for French businesses. The low level of investment in private equity (Table 5 above) undoubtedly gives a **role to public investors** requiring lower returns.

5 - Overall:

- there is a plentiful supply of long-term savings in France;
- companies are not facing a noticeable long-term financing problem, notably because of the role played by unlisted equities;
- the only obvious financing shortfall involves start-ups, where the lack of business angels and genuine venture capital gives a particular role to public investors;
- non-residents essentially finance the government (deficit), in terms of flows.

The regulator should be concerned about the central role of unlisted equities in financing French companies for two reasons:

- it shows that listed equity markets lack appeal;
- it undoubtedly leads to insufficient diversification of equity portfolios compared with diversified portfolios of listed equities.

Towards dynamic measures of liquidity

Charles-Albert Lehalle[15], Capital Fund Management

Abstract

Empirical studies targeting the understanding of orderbook dynamics at high frequency have been conducted on market data for several years. They identified some "stylised facts" that can be found on any dataset, and almost any financial instrument traded via limit orderbooks. Now that very accurate databases are available, with exhaustive labelling (like the type of each market participant, its use of low latency hardware, etc), it could be valuable to study how these stylised facts are affected by these labels.
This short paper does not intend to be an extensive review of such stylised facts, but gives a fast overview of the most important of them.
The shape of the market impact of large metaorders (i.e. the decomposition of market impact among transient impact, temporary impact, decay and permanent impact), and propagation models (the positive autocorrelation of the signs of the trades and the negative autocorrelations of price returns) are stylised facts of importance. Moreover some statistical artefacts like the "signature plot" and the "Epps effect" have to be taken into account when investigating in these directions.
We can hope accurate studies will be able to answer questions about the persistence of these effects when the orderbook dynamics are conditioned by the nature of market participants (are they intermediaries, institutional investors? do they trade at high frequency? Etc.). It would shed light on the nature of liquidity dynamics emerging from the usual mixes of market participants.

Résumé

Depuis une vingtaine d'années, des études empiriques sur la dynamique de la liquidité à « haute fréquence » se multiplient. Initialement destinées à nourrir les stratégies de « trading optimal » qui sont utilisées par les investisseurs pour découper leurs gros ordres afin de perturber le moins possible la formation des prix, elles nous fournissent des métriques qui mélangent les habitudes des participants et la microstructure des marchés.
Ce court article n'a pas vocation à passer en revue de façon exhaustive tous les "faits stylisés" mis en lumière par ces articles de recherche. Il se contente d'évoquer les plus importants d'entre eux.
Les phases du market impact des gros méta ordres (i.e. sa décomposition en market impact transitoire, temporaire, relaxation, puis permanent), ainsi que les "modèles de propagation" (autocorrélation positive des signes des transactions et autocorrélations négatives des rendements à petite échelle), font partie des effets les plus marqués et quantifiables.
Par ailleurs, des artefacts statistiques connus sous les noms de « signature plot » et « effet de Epps » doivent être pris en compte lorsqu'on mesure des phénomènes à haute fréquence.
Maintenant que des universitaires ont accès à des données très précises (où figure par exemple la nature des participants: intermédiaires, investisseurs institutionnels, etc.), il paraît possible de comprendre en quoi ces phénomènes sont liés à un type d'acteur, de pratique, ou de structure de marché.

15 The author thanks Jean-Philippe Bouchaud for his thoughts on dynamic liquidity measures, which helped in the preparation of this paper.

Market liquidity is hard to define other than qualitatively[16]. A financial instrument is said to be "liquid" if an investor wishing to buy or sell it can easily find a counterparty. When trades are conducted on an electronic marketplace, where investors submit buy and sell instructions (orders) to a server that matches the best sellers with the best buyers in real time, liquidity may seem easy to measure. This can be done, for example, by calculating the average size of a trade and then measuring average bid and ask volumes at each price level, again in average terms[17]. It appears to follow quite naturally that the difference in price between the best offer and the best bid (known as the "bid-ask spread") and the ratio of these two averages can be a reliable two-dimensional indicator of liquidity. For each trade, an investor will, "on average", pay a half-spread plus one tick size multiplied by the ratio of the size of market orders to quantities at the first limit.

The technical difficulty of calculating such ratios, due to the big-data aspect, should not be overlooked: there are approximately 40,000 trades a day in a typical French share, and the number of changes in the bid or ask price is ten times higher still. Nonetheless, it is possible to look further, for example by examining the difference between a ratio of averages and an average of ratios, or even by considering whether bid and ask sizes are sensitive to the size of recent trades. The issue is further complicated by another aspect of the trading process: an investor wishing to buy or sell a large number of shares splits the original order (often called a metaorder) into smaller orders so as to avoid disrupting the price formation process to his disadvantage. Any of the possible metrics would undoubtedly have different values at the beginning, middle and end of a metaorder trade.

The longer the period over which an investor spreads a metaorder to alleviate pressure on price formation, the longer he postpones the moment in time when he will hold the requisite number of shares. He is thus exposed to the risk of the price moving against him during this period. A number of academic studies since the late 1990s have examined how metaorders might be "optimally" split, depending on each investor's definition of optimality[18]. Perfecting optimal order splits relies on very advanced empirical studies of orderbook dynamics. Some of these studies attempt to understand orderbook dynamics at the smallest scale by looking at how order books respond to a single trade[19], while others analyse how order books and prices "digest" metaorders[20]. Such studies are used to implement order splits that enable institutional investors to strike a delicate balance between trading too quickly in order to avoid adverse price movements, and trading too slowly so as not to exhaust the volumes offered by counterparties.

16 See, for example, chapter 1 of "Market Microstructure in Practice", Lehalle and Laruelle, World Scientific 2013.

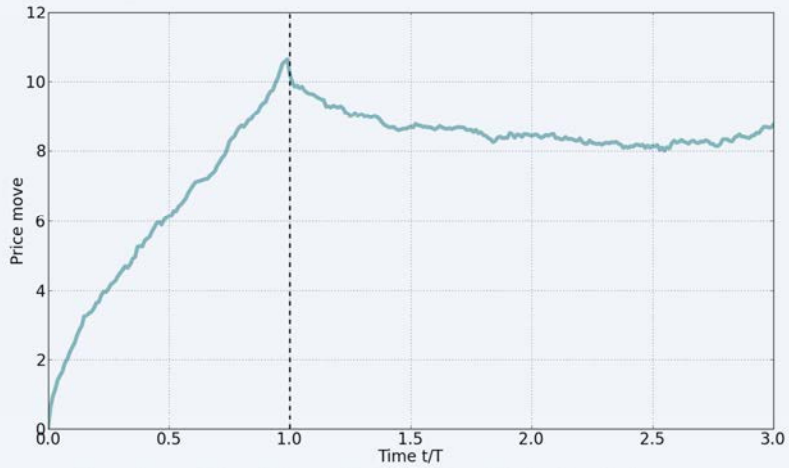
17 In electronic order books, offers and bids are structured by price level or "limit", and the difference between two limits is known as a "tick size", determined by the trading platform. When an investor wants to buy or sell more than the available volume at a given limit, he must accept a price that is one limit higher or lower than his ideal price, and so forth.

18 For a general introduction, see "Market microstructure knowledge to control an intraday trading process", Lehalle, in "Handbook on Systemic Risk", published by Langsham and Fouque, 2013.

19 See Bouchaud, J.-P., Y. Gefen, M. Potters and M. Wyart (April 2004): "Fluctuations and response in financial markets: the subtle nature of 'random' price changes", *Quantitative Finance 4* (2), 176-190.

20 See Farmer, J.D., A. Gerig, F. Lillo and H. Waelbroeck (2013): "How efficiency shapes market impact", *Quantitative Finance 13* (11), 1743-1758.

Figure 1: Change in price averaged across approximately 100,000 metaorders during the trading of a metaorder (where the elapsed time, t/T on the x-axis, is between 0 and 1), followed by the ensuing decay phase (where t/T is between one and three times the duration of the metaorder)



Source: Emmanuel Bacry, Adrian Iuga, Matthieu Lasnier and Charles-Albert Lehalle.

Accordingly, the way in which order books fill up again after a trade and the price response to a long series of buy or sell orders are the main characteristics that determine the "difficulty of finding a counterparty when an investor wishes to buy or sell", to repeat the qualitative definition of liquidity given in the introduction to this paper.

The two essential mechanisms highlighted by empirical research can be summarised as the "decomposition of market impact into three phases" for metaorders and "propagation models" for individual trades. Measures of these two phenomena are used to determine modern metrics, suited to electronic marketplaces, which characterise liquidity as investors understand it. Indeed, through optimal trading, investors are now sensitive to these phenomena when buying or selling large volumes of shares.

The three phases of market impact

Figure 1, taken from the database used by the authors[21] of a detailed study on the market impact of metaorders, clearly illustrates the phenomenon under analysis. When an investor buys or sells a large number of shares which he "optimally" splits into small trades to avoid excessively disrupting price formation to his disadvantage, the price rises concavely (for a buy trade), peaks, then decays towards a level between the initial price and the peak.

Transient impact

The first phase, often called "transient market impact", reflects the fact that the higher prices rise in response to buying pressure, the easier it will be for investors to find counterparties willing to sell to them. The price therefore rises less and less quickly.

21 Emmanuel Bacry, Adrian Iuga, Matthieu Lasnier and Charles-Albert Lehalle; forthcoming study.

Investors are directly sensitive to this first phase: the more concave this segment of the curve, the more the other participants (such as market makers or other investors with symmetrical interests) "resist" the pressure exerted on prices by large volumes. This form of market impact also implies that this resistance is very weak (or even more than linear) for small trading volumes.

Impact decay

Towards the end of the transient phase, the price decays slowly after reaching a peak that is referred to as the "temporary impact" (and is generally proportional to the square root of the number of shares bought). This decay takes place over roughly one-and-a-half times the duration of the metaorder. Strong decay is not good for an investor who has just bought a large number of shares, since it means he paid a price during the transient phase for shares that are now worth slightly less.

Permanent impact

Accordingly, there is still a price difference composed of several effects that are not easy to separate[22]. On the one hand, if an investor makes a buy decision, it is usually because he believes the price will rise; and it is therefore natural to assume that on average, for investors making rational decisions, the decisions they make will depend on future prices. On the other hand, an argument for overall equilibrium suggests that the investor's counterparties, who have sold at an average price of almost two thirds the temporary impact, must not make a structural loss; the price should therefore stabilise at around this level (as shown by Figure 1, this ratio is not always visible in practice). The ratio of temporary to permanent market impact is therefore an empirical measure combining the quality of investors' decisions, the effectiveness of their trading processes, the number of market participants and the efficiency of the price formation process.

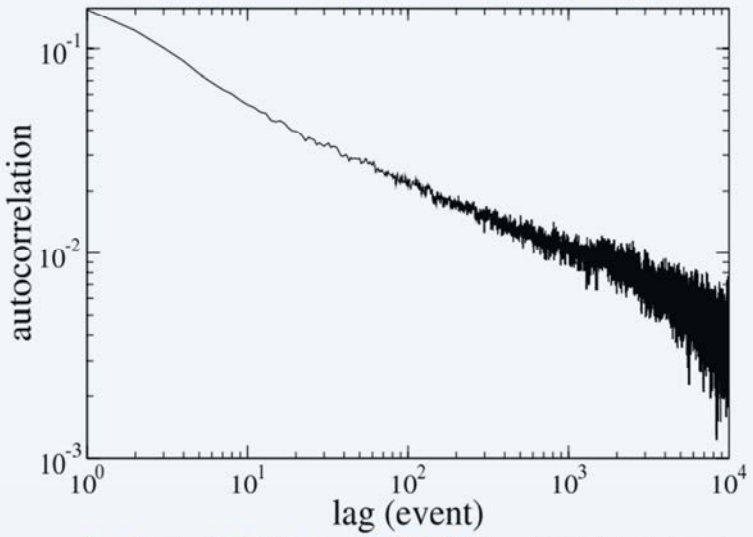
Investors are directly sensitive to measures of the first two phases of market impact, i.e. the transient phase (characterised by the concavity of the rising price curve), the magnitude of the temporary impact and the speed of decay. An investor will consider a share attractive if the temporary impact is weak and similar to the permanent impact. These measures do not replace the usual statistical measures; rather, they complement them. The bid-ask spread remains an important factor in the cost of small metaorders.

Orderbook dynamics: propagation models

Liquidity dynamics are not only characterised at the scale of metaorders placed by institutional investors. While such investors explicitly or implicitly have market impact in mind when commenting on changes in liquidity – their only interaction with liquidity is through large buy and sell orders – this is only the tip of the iceberg. The trading process is at work at a much smaller scale as market and limit orders are placed, changes are made to those orders in response to relative price movements, and liquidity flows from one platform to another. Other mechanisms have been identified over this short timescale, which ranges from a few seconds to a few minutes. These mechanisms are, in principle, more exposed to high frequency phenomena such as collocation. We shall discuss the two main such mechanisms: positive autocorrelation of the signs of trades and negative autocorrelation of price returns.

[22] For a discussion of permanent impact, see Waelbroeck, H. and C. Gomes (July 2013): "Is market impact a measure of the information value of trades? Market response to liquidity vs. informed trades", *Social Science Research Network Working Paper Series*.

Figure 2: Positive autocorrelation of the signs of trades (y-axis) by lag (x-axis). Autocorrelation is strong over short timescales (to the left) and decreases and becomes noisy at lower frequencies (to the right).



Source: Bouchaud, J.-P., D.J. Farmer and F. Lillo (2009): How markets slowly digest changes in supply and demand. Handbook of financial markets: dynamics and evolution, 1, 57.

Positive autocorrelation of the signs of trades

Many empirical studies[23] have revealed that buy trades have a higher probability of following other buy trades rather than sell trades[24] (and vice versa, as illustrated in Figure 2). This autocorrelation is partly explained by large investors' best practice in splitting their metaorders: a metaorder generates individual orders in the same direction (i.e. buy only or sell only) for several hours, and a good proportion of these will result in trades. This simple argument based on a single metaorder might seem enlightening. However, it needs to be qualified because there are usually multiple metaorders in either direction (buy and sell) on any given day and in any given share (placed, for example, by investors with different investment philosophies[25]). Market making itself reduces this autocorrelation: if a market maker provides (for example) buy-side liquidity several times in succession, his stock of trades will become unbalanced, prompting him to make trades in the opposite direction.

This autocorrelation is thus a measure that describes a mixture of practices adopted by the various different participants. As such, it sheds light on one aspect of small-scale liquidity dynamics.

Negative autocorrelation of price returns

Another documented stylised fact[26] that emerges over short timescales is the negative autocorrelation of price returns. Autocorrelation is a linear measure of the time dependence of a series. It is an instance of the classic correlation, the so-called Pearson correlation, between a variable at time t and the same variable at time t-dt for a fixed lag dt. The only parameter for

23 See Bouchaud, J.-P., D.J. Farmer and F. Lillo (2009): How markets slowly digest changes in supply and demand. Handbook of financial markets: dynamics and evolution, 1, 57. Figure 2 is taken from this article.

24 A "buy" trade (or, conversely, a "sell" trade) is defined as a trade initiated by a buyer (or, conversely, a seller). In placing a market order or a limit order at above the best ask price, the buyer is the least patient of the two parties participating in the trade.

25 Such situations might also arise at times of substantial capital inflows or outflows or as a result of trades initiated for risk management purposes, which are, on the face of it, independent of more fundamental decisions.

26 For example, read Cont, R. (February 2001): "Empirical properties of asset returns: stylised facts and statistical issues", *Quantitative Finance 1* (2), 223-236 or B. Zhou (January 1996): "High-frequency data and volatility in foreign-exchange rates", *Journal of Business & Economic Statistics 14* (1), 45-52.

measuring autocorrelation is the lag dt. An oft-used method to cover all possible lags is to plot a correlogram, which is a curve of lag-dependent autocorrelation. The negative autocorrelation of price returns is weaker than the positive autocorrelation of the signs of trades. It also disappears more quickly.

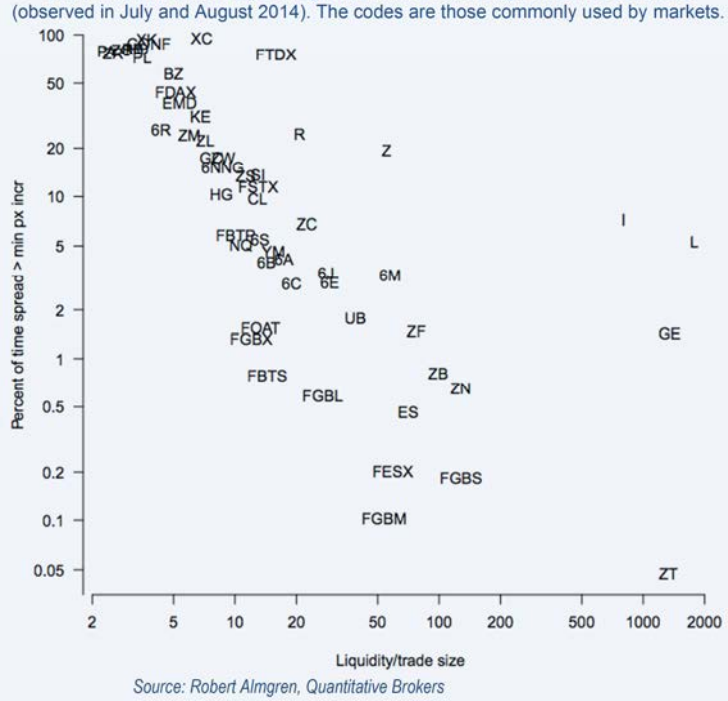
Over timescales of around five minutes for a liquid share, the autocorrelation of price returns is not materially different from zero. Over shorter timescales, however, it is negative.

This property of price returns means than when the price has just risen, it is very likely to fall in the following milliseconds. Of course, this does not mean that a trading strategy consisting in betting on a drop in price as soon as the price rises (and vice versa) would, on average, be a winning strategy. For that to be so, the amount of any gains would have to offset the amount of any losses incurred under this basic strategy, which is not the case.

Qualitatively, this autocorrelation translates into a reversion of the midprice (i.e. the midpoint in the bid-ask spread). Figure 4 shows the relationship between this probability and average best bid and ask volumes, normalised by average trade size. This chart suggests a strong structural relationship between liquidity inflows normalised by reference to liquidity consumption and the negative autocorrelation of price returns.

The measurement of this autocorrelation over short timescales characterises the dynamics of the first limits in the orderbook, and as such reflects a blend of trading practices over timescales of less than five minutes.

Figure 4: Probability of reversion of the midpoint by average size
at the first limit divided by average trade size over a range of futures contracts
(observed in July and August 2014). The codes are those commonly used by markets.



Source: Robert Almgren, Quantitative Brokers

High frequency volatility

Measuring volatility as a function of timescale yields very high values over short timescales. This stylised fact, known as a signature plot, arises less from high frequency trading practices than from a well known statistical artefact[27]. Care should therefore be taken not to interpret an increase in volatility at high frequency as informative.

[27] For example, read Aït-Sahalia, Y. and J. Jacod (2012): "Analyzing the spectrum of asset returns: Jump and volatility components in high frequency data", *Journal of Economic Literature 50* (4), 1007-50.

Another measurement artefact arises when calculating the correlation between two series sampled at very high frequency – the so-called Epps effect. This essentially arises from the fact that nothing is simultaneous at high frequency: there is always a frequency above which two discrete series are no longer correlated in any way28.

These two artefacts make measurement at high frequencies more difficult. However, statisticians have developed methods for working around the problem[29].

Conclusion: new measures for new trading practices

Econometric research intended to shed light on the economic rationale for changes in trading practices on financial markets is currently based mainly on static measures of orderbook dynamics. Recent academic studies, intended in principle to document orderbook dynamics so as to optimise the trading process, have highlighted some sophisticated but easy-to-calculate measures that reflect a blend of trading practices and market architecture.

The more these metrics are included in systematic studies based on huge databases supplied by markets or supervisory authorities, the easier it will be to detect "step changes" in trading practices. Of course, such step changes can sometimes be hard to explain because there is no straightforward economic interpretation of the metrics in question (they reflect a set of practices rather than a single effect and, in particular, they are dynamic in nature). Nevertheless, given that the metrics form part of the range of measures used by high frequency traders and market makers, as well as by automated trading algorithms used by institutional investors, clearly documenting their development will clarify the conclusions of microstructure theory from a different perspective. Furthermore, it would be very interesting to understand whether these effects only emerge when considering the entire process of orderbook dynamics, or whether they persist when analysis is confined to just one type of participant. Among the issues remaining to be addressed are whether the reversion of price returns is stronger or weaker following a trade initiated by a high frequency trader, and whether transient and permanent impacts have changed over the past ten years.

28 Read Tóth, B. and J. Kertész (October 2009): "The Epps effect revisited", *Quantitative Finance 9* (7), 793-802.

29 For example, Hayashi, T. and N. Yoshida (2005): "On covariance estimation of non-synchronously observed diffusion processes", *Bernoulli 11* (2), 359-379.

References

Aït-Sahalia, Y. and J. Jacod (2012). Analyzing the spectrum of asset returns: Jump and volatility components in high frequency data. *Journal of Economic Literature 50* (4), 1007-50.

Bouchaud, J.-P., Y. Gefen, M. Potters, and M. Wyart (2004, April). Fluctuations and response in financial markets: the subtle nature of 'random' price changes. *Quantitative Finance 4* (2), 176-190.

Bouchaud, J.-P., D. J. Farmer, and F. Lillo (2009). How markets slowly digest changes in supply and demand. *Handbook of Financial Markets: Dynamics and Evolution 1*, 57.

Cont, R. (2001, February). Empirical properties of asset returns: stylised facts and statistical issues. *Quantitative Finance 1* (2), 223-236.

Farmer, J. D., A. Gerig, F. Lillo, and H. Waelbroeck (2013). How efficiency shapes market impact. *Quantitative Finance 13* (11), 1743-1758.

Hayashi, T. and N. Yoshida (2005). On covariance estimation of non-synchronously observed diffusion processes. *Bernoulli 11* (2), 359-379.

Lehalle and Laruelle (2013), Market Microstructure in Practice", World Scientific, 2013.

Lehalle, (2013), Market microstructure knowledge to control an intraday trading process", "Handbook on Systemic Risk", Published by Langsham et Fouque.

Tóth, B. and J. Kertész (2009, October). The Epps effect revisited. *Quantitative Finance 9* (7), 793-802.

Waelbroeck, H. and C. Gomes (2013, July). Is market impact a measure of the information value of trades? Market response to liquidity vs. informed trades. *Social Science Research Network Working Paper Series.*

Zhou, B. (1996, January). High-Frequency Data and Volatility in Foreign-Exchange Rates. *Journal of Business & Economic Statistics 14* (1), 45-52.

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