Europe Economics

The liquidity of gold under proposed EBA liquidity tests

An analysis for the World Gold Council

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1 Executive Summary

The World Gold Council wishes to understand how gold will perform in a variety of liquidity metrics proposed by the European Banking Authority (EBA) to be used in its assessment of assets for the Liquidity Coverage Ratio and the Net Stable Funding Ratio. The World Gold Council commissioned Europe Economics to investigate how gold would perform on the EBA's proposed liquidity metrics, in addition to critiquing the EBA Discussion Paper (DP) that lays out the EBA's proposed methodology and proposing additional liquidity measures for the EBA to consider.

1.1 Concepts of Liquidity

Liquidity is a notoriously difficult concept to pin down. Many discussions on liquidity boil down to transaction costs, which are often measured by the bid-ask spread of an asset. We conceive of liquidity as being composed of three distinct aspects (the first being composed itself of three aspects):

- Convertibility
  - Size of market or scale
  - Diversity of asset holders
  - Correlation of price with the need to sell
- Transactions costs in trading
- Price impact of trading

Many treatments of liquidity focus solely on the "transaction costs in trading" measure, but we feel to focus only on this aspect of liquidity could be dangerous in designing a regulatory capital buffer since different aspects of liquidity could be key in financial crises.

1.2 Critique of the EBA Discussion Paper

We argue that the EBA DP does not capture certain aspects of liquidity. In particular, there are no measures proposed by the EBA that measure the correlation of price with need and diversity of asset holders, which we feel are two crucial aspects of liquidity in times of financial stress. Furthermore, the EBA has indicated that it would like to develop a set of uniform liquidity measures that could be applied across all assets, but we caution against striving for uniformity if that means not capturing all of the aspects of liquidity. Our view is that it is most important that the main dimensions of liquidity be considered, even if the specific measures for each differed across asset classes.

1.3 Gold's Performance on Liquidity Metrics

Out of the five dimensions of liquidity that we identify in this paper, namely scale, diversity, correlation of price with need, transactions costs and price impact, gold performs well in four of these (scale, correlation of price with need, transaction costs, and price impact) under various measures. Although we do not have access to data in order to calculate a measure of diversity of asset holders, our intuition is that gold will perform well on this dimension.

Gold performs well when relative, as opposed to absolute, spread measures are taken into account. This is because the quoted unit of gold (troy ounces) is often much more valuable than the quoted unit of other assets, such as a single stock or bond, rendering inter-asset comparisons using absolute spreads misleading. Gold also typically performs better in times of adverse financial conditions, making it a strong candidate asset for a regulatory capital buffer.

2 What is Banking Liquidity?

This chapter offers our understanding of the concept of liquidity and why liquidity is important for a bank. We begin by discussing three aspects of the concept of liquidity and then offer three reasons for the importance of the liquidity profile of banks in particular.

2.1 The Concept of Liquidity

When economists talk of the "liquidity" of an asset, they mean the ability of the owner to convert the asset into things the owner wants to purchase — the ability, as it were, to "spend" it.

One standard way to make this idea more concrete is to say that the liquidity of an asset is the ability to convert that asset into cash — where cash is, by definition, perfectly liquid. Such a concept is not relevant to all important assets, however. For example, in foreign exchange one might convert one form of cash into another, but the relevant concept of liquidity relates to the ability to convert the asset into the form of cash one requires for purchasing — the ability to "spend" the asset.

So, let us assume that the cash in the currency of the economy where the asset-owner lives ("domestic cash") is, by definition, perfectly liquid. What will be the liquidity of other assets, relative to this perfectly liquid domestic cash? Or, to put the matter another way, in what ways are other assets less liquid than domestic cash?

There are many dimensions in which other assets have lower liquidity than domestic cash. Three particularly important ones are:

- Convertibility
- Transactions costs in trading
- Price impact of trading

We discuss each of these measures in turn below.

2.2 Convertibility

If you hold an asset, are there people willing to buy it and how quickly can they do so? Even if your asset has an acknowledged value, will there be people willing to buy it from you at that price? How does the price of the asset move with your need to sell it? How straightforwardly and quickly can you actually convert market value into domestic cash? The harder it is (e.g. the more time it takes or the more work you have to put in) to find purchasers for an asset or the lower the price of the asset at precisely that moment in which you need to sell it, the lower its liquidity is.

Convertibility is an umbrella concept that covers three related concepts. First is the total number of asset holders in a market. Second, is the diversity of asset holders in a market. A third aspect of convertibility is the correlation of the price of an asset with the holder's need to sell it for liquidity purposes.

2.2.1 Number of asset holders

Being able to convert one asset into another depends the presence of other asset holders that are willing and able to buy your asset. This, in turn, depends on two points: the "depth" of the market –

the sheer number of market players demanding the asset you hold – and the "breadth" of the market – the diversity of the market players demanding your asset. Let us first consider market depth.

Liquid markets are often characterised by high aggregate trade volumes. One factor contributing to these characteristics is the presence of a sufficient number of buyers and sellers of assets in these markets to exchange assets with one another, generating high trade volumes and broad consensus on the market value of an asset via price discovery. If an asset holder wants to keep her asset for liquidity purposes, then she must be confident that when time comes for her to demand liquidity a sufficient number of buyers of the asset will be available.

2.2.2 Diversity of asset holders

In some instances, the pool of buyers of an asset might be very deep but also very homogeneous. If something were to adversely affect this pool of buyers, an asset that typically meets high demand in the market might cease to be sellable. For this reason, it is also important that there is a diversity of holders of an asset to ensure that it is liquid. Holding assets with a diversity of holders might minimise general counterparty risk when trading those assets. That is, conditions that adversely affect one set of asset holders might have little effect on other sets of holders, so some buyers should always be available.

2.2.3 Correlation of price with need

Another key aspect of convertibility is how much cash one will get for one's assets when one needs to sell them.[1] If the price of an asset deteriorates when conditions become such that one needs to sell that asset, then one is at risk of being insolvent given a fixed amount of holdings of that asset. If, on the other hand, an asset actually becomes *more* valuable in adverse financial conditions[2] – perhaps via a "flight to quality" effect – then holding that asset puts one in a better liquidity position in periods of financial stress compared with more normal periods.

The correlation of the price of an asset with the need to sell it has consequences for regulatory capital. Subprime mortgage-backed securities were an investment-grade, generally liquid market where securities commanded a relatively high value. As the financial crisis of 2008 picked up steam, these once liquid assets quickly became illiquid and lost a considerable amount of their market value. Where these assets were held as regulatory capital, the capital buffer began to deteriorate. In these cases, the capital that was built up to ensure solvency had exactly the opposite effect.

2.3 Transaction Costs

One can convert cash into other cash (e.g. a €20 note into two €10 notes) near-costlessly. This allows one to hold different forms of cash with almost no transactions costs. By contrast, trading into and out of other assets may result in costs of trading — the cost of buying even small volumes of an asset may be higher than what one would secure by selling it at the same moment; and the process of purchase may involve brokerage and other such fees.

Independent of brokerage fees, bargaining dynamics between asset suppliers and asset demanders might also influence how much it costs to convert one asset into another. Prices quoted by sellers

[1] This point captures both the "low correlation with risky assets" and"flight to quality" aspects of the HQLA under the Basel III LCR. See http://www.bis.org/publ/bcbs238.pdf, p. 7-8.

[2] One recent phenomenon that highlights this point is the fears stoked by the tax on deposits in Cyprus. Many safe haven assets, such as "core" European bonds and gold, rose in value on the Monday following the announcement of the tax. Riskier assets, such as equities, fell in value. Gold in particular rose 1.7 per cent in euro terms. See: http://www.telegraph.co.uk/finance/personalfinance/investing/gold/9937128/Gold-price-jumps-on-Cyprus-worries.html.

(asks) are often higher than prices quoted by buyers (bids). Often the realised transaction price is somewhere between the ask price and the bid price; buyers pay a higher price than they originally quoted and sellers receive a lower price.[3] Therefore parties on both sides of an asset exchange often incur a cost relative to the price at which one party would like to exchange. Incurring these monetary costs in trading reduces one's ability to convert a notional market value of an asset into the same value of domestic cash, and thus reduces liquidity.

In addition to monetary costs, there are also opportunity costs that might arise in trading. Time needs to be invested in OTC markets to find a counterparty, creating search costs for traders. The delay between making an order and that order being filled can represent an opportunity cost where attractive trade opportunities are missed because of this delay.[4]

2.4 Price Impact

Apart from investors that are governments and central banks, the process of acquiring cash does not itself materially change the value of cash. But the process of acquiring or disposing of other assets might have an impact on the price.[5] This can happen through at least two channels. First, buying or selling asset might signal to the market one's opinion in the current or future value of those assets. Two well-known examples on this point are the way prices of shares change when a takeover bid is announced, and the way the price of a plot of land might change if it were one section of a potential large development (such as a shopping complex).

Another price-impact channel is the size of a trade. Most markets exhibit some price volatility if a large quantity of a product is introduced to or taken off of the market. Some markets are more sensitive to large quantity changes than others. Generally speaking, liquid markets are less sensitive to large trades, as a single large trade in a liquid market is more likely to be a small proportion of overall trading volume as compared with an illiquid market.[6] If markets are liquid, then a large trade might be expected to have a smaller price impact than would be realised in an illiquid market.

Furthermore, liquid markets may feature the ability to execute a large number of small orders rather than a single, large order. Illiquid markets, by contrast, may not enjoy the freedom to discriminate between trade sizes and depend primarily on large trades, due to the smaller number of market participants. It may be the case, then, that prices in illiquid markets are more sensitive to the size of a trade and the market itself dependent on large trades.

In general, either via the signalling channel or the trade size channel, if the process of selling your assets means their price falls significantly, your ability to convert a given market value into cash is diminished and thus the liquidity of the asset is lower.

2.5 Liquidity for a Bank

In principle any firm should care about its liquidity. Nonetheless, the nature of the banking business creates for banks certain concerns that may be absent in other industries – and indeed, it may be precisely these concerns that prompt regulators to care about bank liquidity. In the below discussion we focus on a few concerns that are especially applicable to banks.

[3] This point covers the "width" point in the EBA Discussion Paper on liquidity. See EBA, "Discussion paper: on defining liquid assets in the LCR under the draft CRR", EBA/DP/2013/01, p. 25.
[4] These points cover the "immediacy" point in the EBA Discussion Paper on liquidity. See EBA, "Discussion paper: on defining liquid assets in the LCR under the draft CRR", EBA/DP/2013/01, p. 25.
[5] This point covers the "resiliency" point in the EBA Discussion Paper on liquidity. See EBA, "Discussion paper: on defining liquid assets in the LCR under the draft CRR", EBA/DP/2013/01, p. 25.
[6] It may also be the case that the elasticity of supply and demand is greater in liquid markets.

2.5.1 Assets and liabilities of uncertain duration

Often firms know when their liabilities will come due with some degree of certainty. A retailer, for instance, might know how often he should expect to receive and pay for products from his suppliers, allowing him to allocate his capital with some certainty. Equally, many firms have an idea of the lifetime of and expected returns on their assets. For example, a manufacturer typically knows the rate of depreciation of plant equipment and the rate of return she can expect over the lifetime of the asset. Such knowledge grants a degree of certainty in business planning.

Banks engage in a number of activities that make it more difficult to know with confidence when liabilities will come due. One activity that increases liability uncertainty is taking deposits. A deposit is a loan of capital to the bank. Under fractional reserve banking, a bank pays a rate of interest on deposit capital and invests that capital at a higher rate of interest, the spread between the lending rate and the deposit rate representing profit for the bank. Depositors, however, are often free to request their cash back at any time. By contrast, banks might not be able to recall their investments in a similar matter. There is a risk, then, that a bank may not have sufficient or sufficiently liquid assets to cover their liabilities in the event of large numbers of deposit withdrawals (i.e. during a run on the bank). The uncertainty surrounding when and how much depositors will withdraw from the bank requires a bank to hold a suitable amount of liquid assets to meet depositor demand for their funds, especially in instances of an unforeseen spike in withdrawals.

On the asset side, consider the case of mortgages. When a bank lends money in a mortgage, the mortgage represents an asset to a bank. The return on that asset can be calculated by considering the cash flows of interest plus principal repayment due at regular intervals over the life of the mortgage. Some mortgages are likely to end in default, disrupting the expected cash flows from the asset. Other times, mortgage holders might wish to repay their mortgage early, meaning the bank received the principal value of the mortgage all at once instead of with interest and over time. Both default and early repayment create risks not only for the mortgage originator, but also for holders of securities backed by mortgage cash flows (mortgage-backed securities). In this way, risks generated at the retail market level can also spread to the wholesale market level. In this example, banks would need to hold sufficiently liquid assets if returns on mortgages or mortgage-linked assets do not turn out as expected.

2.5.2 Considerable use of short-term money markets

Banks routinely borrow and lend at maturities of less than one year. In the interbank market, many of these transactions consist of overnight lending. This is often done to manage cash positions, in which surplus cash positions are often lent out to those in cash deficits. Cash positions need to be managed to meet reserve requirement regulation and manage liquidity more generally.

In normal times, money market instruments are highly liquid and treated as cash equivalents. In times of financial unrest, however, the money market can seize up and cease to be liquid. This was the case in the "credit crunch" of late 2008 and early 2009, when short-term lending in major currencies became prohibitively expensive. Many central banks intervened to provide liquidity on a short-term basis to prop up banks unable to secure funds in the interbank market. Banks may be able to avoid future bailouts and financial stresses if interbank funds dry up by holding more or more diverse liquid assets on their balance sheets.

2.5.3 Systemic importance

Banks are systemically important in many senses. As key conduits of the most liquid asset (domestic cash), banks play a critical role both in the financial and social systems.

Financially, banks are involved in ensuring the smooth flow of assets from one holder to another. This can happen through a variety of channels. The traditional role of a bank is to connect those with excess assets (savers) to those with insufficient assets (borrowers). This is the role a bank plays, for instance, when it accepts one client's deposit and loans that deposit out to another client.

Banks are also involved in payments systems in which they do not act as brokers. One example of this is a bank's client paying for goods in a shop with a bank-issued cheque. Here, the bank facilitates the circulation of assets by verifying its client has sufficient funds for the purchase and ensuring that those funds are transferred from its client's account to the shop's account.

For policy makers, banks are a crucial element in the transmission mechanism of monetary policy. When a central bank decides to engage in expansionary monetary policy by lowering its benchmark interest rate, this allows banks to access cash from the central bank at a lower cost compared with the previous benchmark rate. Central bankers might hope that a portion of this cost savings is passed on to consumers via lower lending rates, which would in turn encourage more borrowing and thus increase the money supply. Alternatively, monetary expansion could be encouraged by lowering reserve requirements, freeing up assets on a bank's balance sheet that might be lent out to consumers.

Socially, banks play a role in the public's confidence in the financial system more generally. There are many social functions banks play, so we will use just one to illustrate. If the public believes that a bank is not sound or is about to default on its obligations to them as investors and deposit holders, there will likely be a run on the bank in which investors began to divest of the bank en masse. Bank runs might in turn lead to wider social unrest, such as riots and political upheaval.[7]

[7] This was famously the case in Argentina in the events surrounding its 2001 sovereign default. See Lilico, Andrew, 2010 "Bank creditors, moral hazard, and systemic risk regulation" *Policy Exchange*, http://www.policyexchange.org.uk/images/publications/bank%20creditors%20moral%20hazard%20and%20systemic%20risk%20regulation%20-%20dec%2011.pdf.

3 Policy Background on Liquidity Requirements

This chapter discusses some of the policy background motivating and informing the public discussion on banking liquidity requirements. We start with a history of the first two Basel Accords in order to understand the origins of the EBA Discussion Paper (DP). We then discuss the most recent Basel Accord – Basel III – in more detail, as this is the proposal that European regulation – the CRR and CRD IV – rely on heavily. We then summarise certain aspects of the CRR and CRD IV, highlighting how the European proposals differ on asset inclusion from Basel III. We conclude with a word on the EBA's role in developing the CRR and CRD IV and in particular the motivation behind the DP.

3.1 Basel I and Basel II

The Basel Accords are a series of recommendations on banking measures made by the Basel Committee on Banking Supervision (BCBS) under the auspices of the Bank for International Settlements (BIS) to ensure a stable financial system. As we shall see, two of the three iterations of the Basel Accords have been motivated by the very financial crises they were designed to prevent. In this sense, the Basel Accords are backwards-looking financial regulation, using lessons from the immediate past to design safeguards for the future.

The first Basel Accord, Basel I, was prompted by the collapse and haphazard liquidation of the German bank Herstatt Bank in 1974.[8,9] The BCBS responded to the collapse by drafting Basel I, which was completed in 1988 and adopted internationally in 1992. Building on the lessons learned from the bankruptcy of Herstatt Bank, Basel I laid out requirements and best practices to minimise credit risk and eliminate problems in international settlement, both of which were perceived to have contributed to the downfall of Herstatt Bank. On the credit risk point, Basel I specified that banks should hold sufficiently high quality capital equal to 8 per cent of their total risk-weighted asset holdings. Furthermore, there were two tiers of capital that could be used in the 8 per cent capital requirement: equity capital and retained earnings (Tier I) and additional resources available to the bank (Tier II). More than half of the assets in the capital buffer had to be held in Tier I capital.

The next Basel Accord was drafted in the context of a wave of financial innovation. Products such as credit default swaps, mortgage-backed securities, and a host of other derivatives either did not exist or were a relatively small proportion of the financial market when Basel I was drafted and enacted. "The New Basel Capital Accord", also called Basel II, recognised that the financial world had changed markedly since Basel I. Basel II responded to these changes in a number of ways. On capital requirements, Basel II changed the number and composition of capital tiers in the capital buffer. Tier I remained equity capital and other reserves (i.e. retained earnings) and Tier II included some debt instruments and hybrid products that had become more prominent since Basel I. The new tier, Tier III, allowed for short-term debt meeting certain conditions to make up a part of the capital buffer. The capital buffer limit was held at 8 per cent of total risk-weighted assets.

[8] http://www.economist.com/node/6908488
[9] http://www.bis.org/bcbs/history.pdf

3.2 Basel III and the Financial Crisis

The financial crisis beginning in 2007 prompted the BCBS to reconsider the recommendations made in Basel II. Basel III is intended to address what the BCBS perceives as regulatory shortcomings that allowed the financial crisis to happen.[10]

Basel III represents a substantial overhaul to the Basel Accords. Changes to capital requirements recommendations have altered the existing capital requirements rules under Basel II and introduced new concepts – the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR) – to address the liquidity of those assets. This is in part a response to the fact that many assets that were rated investment grade were suddenly and sharply downgraded as the crisis unfolded. It is also a response to the fact that markets which were liquid under normal financial conditions seized up quickly at the onset of the crisis (i.e. during the "credit crunch"). At the time of writing, Basel III recommendations are to be implemented in steps up to 2019, when they will be implemented in full.

Regarding capital requirements, Tier III of the capital buffer was eliminated. As it stands, there will be an increased focus on common equity; the capital buffer composed of common equity will be no less than 7 per cent of total risk-weighted assets. Furthermore, there will be a countercyclical buffer that moves between 0 and 2.5 per cent of common equity. The level of the countercyclical buffer will be related to the level of credit growth with the aim of discouraging the build-up of excessive leverage.

3.2.1 The Liquidity Coverage Ratio and Net Stable Funding Ratio

The LCR and the NSFR represent the first instance in the Basel Accords in which the ability of the assets in the capital buffer to serve their purpose – that is, how well the assets can keep their holder solvent – is considered alongside the presence of the assets as such. The LCR and the NSFR are short-term and long-term liquidity buffers, respectively, that are meant to address different aspects of adverse financial conditions.

The LCR is a short-term liquidity buffer. The LCR aims to ensure that a bank holds sufficient unencumbered High Quality Liquid Assets (HQLA) that can be converted with little cost and at short notice into cash in the public markets to cover the bank's funding requirements over the next 30 calendar days. HQLA are composed of Level 1 assets, which include cash and marketable government-backed assets, and Level 2 assets, such as certain classes of bonds and select equities. The LCR is the ratio of HQLA to total net cash outflows over the next 30 days and is required to be at least 100 per cent in normal times. This appears to be a response to the credit crunch in which money market lending ground to a halt and short-term lending rates spiked, effectively shutting down a channel banks were accustomed to using for access to short-term debt (a failure of convertibility according to our taxonomy in Section 2.

On January 6th, 2013 the BCSB officially adopted changes to the LCR, which include expanding the list of assets available in the HQLA to include riskier debt and equity securities[11] and securities posted as collateral in derivatives trades (e.g. reverse repos).[12] Furthermore, the liquidity of an asset is to be tested on the basis of historical data and a diversity of assets held in the liquidity buffer is to be encouraged so that firms are not over-reliant on any one asset class or issuer.

[10] More details on the BCBS's view of the financial crisis and how it has shaped their thinking on Basel III can be found here: http://www.bis.org/bcbs/fincriscomp.htm.
[11] http://www.bis.org/press/p130106b.pdf
[12] http://www.ey.com/GL/en/Industries/Financial-Services/Banking---Capital-Markets/Basel-III-liquidity-requirements-and-implications---Key-liquidity-changes-in-Basel-III

The NSFR[13] is a longer-term liquidity buffer and seeks to guarantee that banks could survive a prolonged closure of wholesale financial markets. The NSFR is the ratio of assets a bank holds that could be converted into cash relatively quickly and at little cost over a longer time period to bank assets that cannot be converted into cash so easily over that same time period. The NSFR has specific weights allocated to both sets off assets. From a gold perspective, we note that gold is not listed in the set of assets that can be used for liquidity (called "available stable funding") but is included in the list of assets that would require some liquidity coverage (called "required stable funding"). Gold is listed with "unencumbered listed equity securities or non-financial senior unsecured corporate bonds (or covered bonds) rated from A+ to A-, maturity ≥ 1 year" and "loans to non-financial corporate clients, sovereigns, central banks, and PSEs with a maturity < 1 year" as needing approximate 50 per cent of its value covered by assets in the "available stable funding" basket.[14] This also means that gold is considered approximately as liquid as those assets in Basel III.[15]

3.3 Capital Requirements Directive and Capital Requirements Regulation

The Capital Requirements Directive (CRD) is a directive of the European Union that seeks to codify recommendations from the Basel Accords into European law and harmonise a variety of banking standards across the EU. The four iterations of the CRD are broken up into "packages" of legislation. The CRD packages all look to set explicit capital requirements with the goal of assuring the soundness and stability of European banks and their balance sheets. Given that the CRD packages are based on largely on the Basel Accords, they can also be considered as backwards-looking regulation.

The most recent CRD package is CRD IV. The Capital Requirements Regulation (CRR) forms part of CRD IV. The CRR and CRD IV more generally look to integrate the Basel III recommendations into European law. Thus, the discussion of Basel III above can be taken to apply to the European context via CRR and CRD IV.

However, the CRR and CRD IV also endeavour to account for European specificities when transposing Basel III. For capital and liquidity purposes, assets other than those identified by Basel III, such as gold, are currently being considered as candidates for the LCR and NSFR. The European Banking Authority (EBA) is to finalise the list of eligible assets for the EU versions of the LCR and NSFR in 2015.

3.4 EBA Assessment of Bank Liquidity

As the authority responsible for determining assets eligible for the LCR and NSFR, the EBA must consider:

- "Cash
- Debt securities issued by governments or central banks
- Debt securities issued by institutions with a credit assessment by an eligible External Credit Assessment Institution (ECAI)
- Debt securities issued by other entities with a credit assessment by an eligible ECAI
- Debt securities with a short-term credit assessment from an eligible ECAI
- Equities or convertible bonds
- Gold

[13] We note that there have been recent reports that the NSFR could be heavily revised or even dropped. See http://www.ft.com/cms/s/2/fcb4fe7c-64c6-11e2-ac53-00144feab49a.html#axzz2NWapCREw for one example.
[14] http://www.bis.org/publ/bcbs188.pdf, p 52.
[15] http://www.bis.org/publ/bcbs188.pdf, p 28.

- Securitisation positions that are not re-securitisation positions, which have an external credit assessment by an eligible ECAI."[16]

As part of this consideration, and in response to the January changes to Basel III specifying that liquidity of assets should be determined on the basis of calculations using historical data, the EBA will attempt to quantify the liquidity of various assets and asset classes. The results of this exercise will inform decisions made on the inclusion and ranking of assets for the LCR and NSFR.

[16]http://hb.betterregulation.com/external/Capital%20Requirements%20Directive%20IV%20%20-%20A%20Cicero%20Consulting%20Special%20Report.pdf

4 A Critique of the EBA Discussion Paper

The EBA Discussion Paper (DP) seeks comments on its analysis of appropriate uniform definitions of high and extremely high liquidity and credit quality of transferable assets and appropriate haircuts for the purpose of the LCR requirements as specified by the draft CRR.

4.1 Dimensions of Liquidity

We agree with the EBA that in the broadest terms, a liquid asset is one which can be converted into cash rapidly with little or no loss of value. We believe that there are a number of dimensions to this definition, as set out in our discussion above. In our view, the discussion on liquidity definitions presented by the EBA, and the range of measures proposed, do not adequately reflect all the relevant dimensions.

The EBA notes that liquidity needs to be assessed across different dimensions simultaneously, and refers to the classifications in Harris (1991) as a useful guide for proposing a set of measures that covers the most important aspects of liquidity. These are (p 25):

- Width – reflects the cost of demanding liquidity, typically captured by the size of the bid ask spread. The EBA includes some measures to this dimension in addition to those proposed in the CRR[17] that take account of data availability limitations.
- Depth – refers to the quality of liquidity supplied, typically measured by the volume offered at the bid ask quotes. The EBA also includes additional measures to those proposed in the CRR to take account of data limitations, particularly the need for intraday order level data.
- Immediacy – refers to how quickly a large trading need can be accomplished.
- Resiliency – refers to the time it takes for the price to return to the pre-trade equilibrium level after a large (uninformed) order consumes liquidity.

Whilst we agree with these dimensions and can reconcile them with our dimensions discussed above, we note that the EBA does not consider two important dimensions of liquidity, namely the correlation of price with need and the diversity of holders of the asset.

- Correlation of price with need – The EBA notes in the DP that the drying up of many funding markets in 2007-08 demonstrated how quickly liquidity can evaporate (p 6), and that there are certain asset classes that are more likely to generate funds without incurring large discounts in outright sale or repo markets (p 8). This highlights the importance of our 'convertibility' dimension of liquidity that captures the correlation of price with need. The dimensions cited by the EBA, and the corresponding measures, do not provide the means of assessing the linkages between the price of an asset and the conditions under which this asset would need to be sold. We have developed four measures of this dimension, and discuss these in the following chapter.
- Diversity of holders – An important dimension of liquidity is the quantity able to be supplied at certain prices; this is captured by the 'depth' dimension cited by the EBA. However, comprehensive depth is represented not just by the number of potential buyers/sellers and

[17] See page 13 of the Discussion Paper for these measures

volumes supplied, but also by the diversity of such buyers. The measures considered by the EBA do not include any that attempt to measure this diversity concept.

Omitting liquidity dimensions where different asset classes are likely to perform differently would result in the overall assessment of liquidity being unduly biased (it matters less if dimensions are omitted such that all assets are equally affected).

4.2 Choice of Measures

Annex 5 of the DP presents 24 measures that the EBA considers relevant in measuring the different dimensions of liquidity. In addition to oversights on the dimensions of liquidity, in our view some of the specific measures proposed by the EBA do not adequately capture the dimensions they purport to represent. In particular, we consider the measures identified as representing price impact (20, 21, and 22) to more accurately represent transactions costs. The measures we do consider most reflective of price impact are imperfect.

Our overall classification of the EBA measures according to our dimensions is as follows:

- Scale: 8 measures (1, 2, 3, 4, 5, 6, 7, 19)
- Diversity of asset holders: 0 measures
- Correlation of need with price: 0 measures
- Transactions cost: 12 measures (8, 9, 10, 11, 12, 13, 14, 15, 20, 21, 22, 23)
- Price impact (16, 17, 18) – all imperfect as they do not explicitly measure the impact on prices of large trades (given the absence of order-level trade data).

Measure 24 is a blended combination of scale, transactions costs and price impact.

We therefore propose a number of measures to be considered in addition to those set out in Annex 5 of the DP:

- 4 measures to reflect correlation of price with need
- 1 additional measures of price impact

In addition to these, we also outline how a regulator should be able to calculate a measure of the diversity of asset holders. These are discussed in more detail in the next chapter.

4.3 Weighting of Measures for the Ranking

The EBA proposes to establish an ordinal ranking of asset classes in terms of liquidity, but no detail is given as to how this ranking would be established, other than the analysis of 'combinations' of liquidity metrics (page 17). The EBA must consider that different asset classes will perform differently under the various dimensions of liquidity. The ranking of asset classes raised two questions:

- Which liquidity measures will be chosen of the 24+ proposed by the EBA?
- How will these measures be weighted to allow a ranking?

With respect to the first question, clearly at least one measure from each liquidity dimension must be chosen to arrive at a 'basket' of measures that represent the overall liquidity of an asset class. In our view, this is five (the first three being part of the wider 'convertibility' measure'):

- Scale
- Diversity

- Correlation of need with price
- Transactions cost
- Price impact

The relative performance of asset classes under different liquidity measures is likely to differ, such that some weighting of the measures in the overall basket will be necessary. This could be done in a number of ways:

- Equal weight for all measures may well produce the best result in terms of the overall liquidity of an asset class. This would also be a straightforward and transparent approach.
- Measures could be weighted according to performance against certain criteria, such as the data required to calculate the measure.
- A minimum weighting basis could be used, whereby the overall liquidity of an asset class is represented by the lowest score achieved on the measures.
- A scenario basis could be used, whereby different baskets had differently weighted measures according to the type of crisis. For example, in some crises, the diversity of holders measure may be a far more important variable than, say, transactions costs.
- Qualitative judgement (although it may be difficult to have objectivity if different measures favour different asset classes).

The overall assessment of measures could be constructed on an additive or multiplicative basis. One example of an additive assessment might be using some sort of sum to construct a single "liquidity coefficient" for each asset class and then rank the asset classes according to their liquidity coefficients. A multiplicative assessment might include taking the natural logarithm of measures and multiplying them together to obtain the liquidity coefficient. In practice, there are a number of ways the assessment of measures could be performed.

The weightings for the overall measure of liquidity (both the method of weighting and the weights themselves) would most likely evolve over time as more information becomes available or scenarios change.

Where more than one measure exists or is suitable for each dimension, those could be weighted within the dimensions, or different measures used for different asset classes according to data availability (provided each asset class had at least one measure to represent each dimension). Ordering a set of uniform standards might bias the liquidity buffer to a particular asset class, making such a buffer redundant if in a crisis that asset class was particularly negatively affected. There may be a trade-off between the recognition of the need for a diversity of assets to be included in the liquidity buffers and the uniformity of liquidity measures. **Our view is that it is most important that the main *dimensions* of liquidity be considered, even if the specific measures for each differed across asset classes.**

5 Proposed EBA Liquidity Measures and Alternatives

This chapter covers some technical aspects of the quantitative liquidity measures proposed by the EBA and potential alternatives. As the purpose of this paper is to assess gold's performance relative to other asset classes for a variety of liquidity measures, we concentrate here only on those measures calculable given the available data on gold. Furthermore, we have tried to focus on indicators that are more directly comparable with other asset classes, so as not to bias the analysis towards gold.

We open with a discussion of the liquidity measures the EBA proposes in its Discussion Paper, building on the theory of liquidity laid out in Chapter 2. We then present a series of alternative liquidity measures that the EBA did not consider but that are relevant in light of our thinking on the concept of liquidity. A full list of the measures discussed here can be found in Table 5.1 at the end of this chapter.

5.1 Liquidity Measures Proposed by the EBA

The first 9 measures in Table 5.1 come from the EBA DP. As discussed in the previous chapter, the EBA is provisionally considering at least 24 individual measures of liquidity for its assessment.

Our presentation excludes some measures where data is not equally robust across banks, asset classes, or where there was some duplication in the measure. For instance, we examine the performance of various asset classes on the turnover measure of liquidity, which is intended to capture the "scale" aspect of convertibility. By definition, trading volume could be calculated by dividing turnover by the asset's price. Likewise, detailed holdings information on gold, for example, is generally not publicly available. This does not mean, however, that a financial regulator could not obtain this data from brokers or other non-public sources.

The EBA measures we calculate for gold and other asset classes fall into two dimensions: the "scale" or "size of market" dimension and the "transactions cost" dimension. Furthermore, of the 9 measures considered, eight are measures of transaction costs. Only one measure each is calculated for scale.

5.2 Alternative Liquidity Measures

The EBA DP does not include any measures that cover our concept of the correlation of price with need and the diversity of asset holders. Furthermore, it only offers one measure of price impact and that measure is, in our view, an imperfect approximation of the concept. To address this we have proposed and calculated some liquidity measures that are not included in the EBA DP.

In particular, we have calculated an additional measure of price impact (which is also imperfect), and proposed and calculated four measures of the correlation of the price of an asset with the need to sell it. This latter category is comprised of two measures for equity markets and two measures for debt markets. Finally, we were not able to calculate a strong measure of the diversity of asset holders due to publicly-available data limitations, but we do offer a discussion of how a regulator might be able to calculate such a measure.

5.2.1 Market Efficiency Coefficient

Another measure of the price impact notion in liquidity is the Market Efficiency Coefficient (MEC).[18] The MEC measures the ratio of long- to short-term volatility, which can be considered a proxy for market resilience. This is an imperfect price impact measure. Our concept of price impact considers what happens to the price when one executes a large trade. The MEC can be thought of as examining how returns – in part via prices – change from period-to-period, regardless of the size of the trade. Stated differently, our concept of price impact considers how the price changes when a large trade is executed, while the MEC attempts to capture how long it takes for an asset to return to its fair value after a trade is executed. The MEC is calculated as:

$$MEC = \frac{Var(R_t)}{T * Var(r_t)}$$

where R_t is the log return of an asset over some time period (say, one month), r_t is the log return of an asset over some subdivision of the time period (say, the number of trading days in one month), T is the number of subdivisions, and *Var()* is the variance operator. In resilient, liquid markets, this ratio is expected to be near one. The idea is that liquid markets display less short-term volatility than illiquid markets. Therefore, the closer the MEC is to one, the more liquid the market is.

5.2.2 Correlation of price with need to sell

As the EBA DP did not include any measures of the price of an asset with one's need to sell it, we have considered a few measures that might approximate this aspect of liquidity. Given that the purpose of the capital buffer is to ensure that bank balance sheets are sufficiently robust to withstand a period of financial stress, it would make sense to measure how items in the balance sheet perform in times of financial stress.

We sought to identify standard measures of financial stress or instability assets that banks typically hold in their balance sheets. The universe of assets banks hold may be quite large, but we have decided to focus on two classes: equity and debt. To this end, we have measured the correlation[19] of an asset price with general and bank-specific measures of equity and debt.

General measures of equity and debt

- Level of the local equity index – Equities is one asset class that banks hold on their balance sheets. All else held constant, if the value of a bank's equity holdings begins to fall, then the bank itself is less valuable and has less assets to cover a fixed level of liabilities. If this were to happen, then a bank may be at risk of becoming insolvent. Assets held in a regulatory capital buffer should protect banks against such a situation, becoming more value precisely when banks need liquidity the most. Thus, we would expect to find liquid assets to be negatively correlated with the value of equities (or, at least, the value when equity prices are falling).
- Spread on sovereign bond yields – In recent years the spread between different sovereign bonds has come to be seen as a crucial measure of stress in sovereign fixed income markets. In general, one might wish to compare the bonds of a distressed entity – be it a sovereign country or some sub-national geopolitical unit – with the benchmark bond for a larger unit of which that entity is a part. In the European context, the spread of "core" European bonds, such as German bunds, over "peripheral" European bonds, such as Greece or Spain, has become a thermometer measuring

[18] See Sarr, Abdourahmane and Lybeck, Tonny 2002 "Measuring liquidity in financial markets". *IMF Working Paper WP/02/232*, p. 15-17.
[19] For this exercise we considered correlations, but covariances might also be appropriate.

market sentiment on the European economy as a whole.[20] A wider spread represents a higher level of financial stress, and thus we would expect the price of liquid assets to be positively correlated to widening spreads.

Bank-specific measures of equity and debt

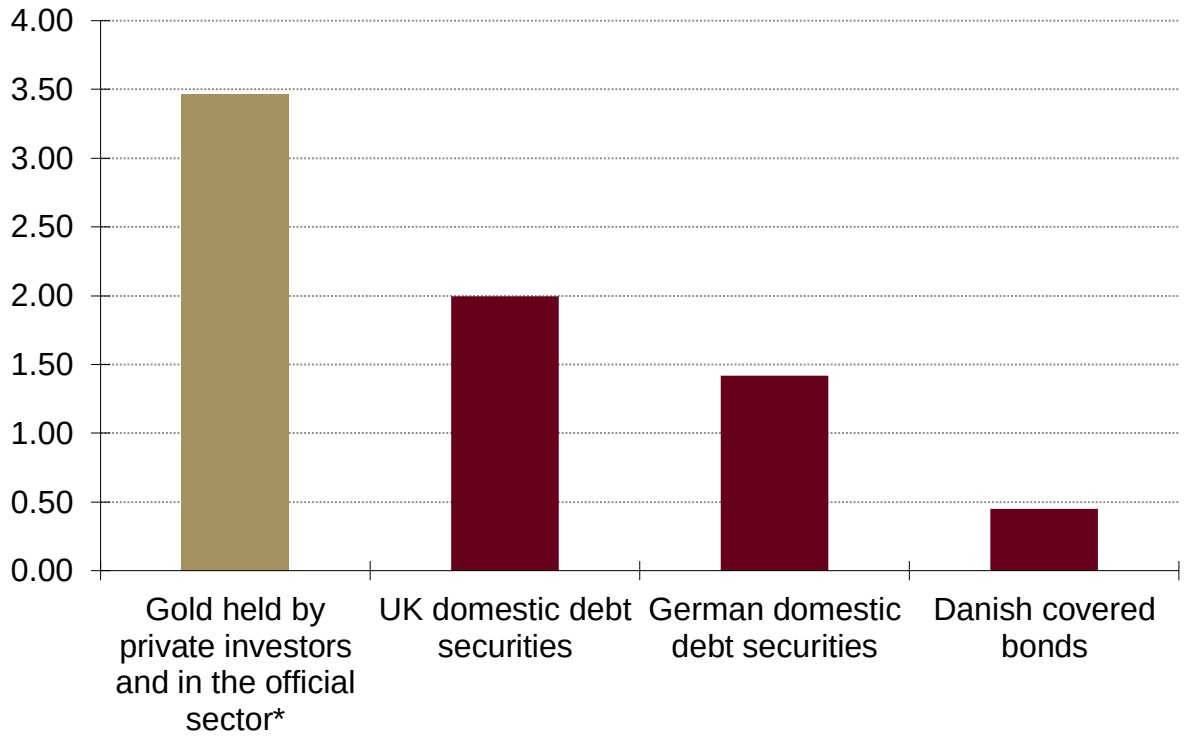
- Level of bank equities – The level of bank equities in a given country or region could be considered an indication of bank stress. If banks become or are anticipated to become distressed, investors might divest of their holdings in the bank. This might result in a fall in the equity price, especially where those divestments come via sales of stock in the bank. For liquid assets used as bank regulatory capital, it would be preferred that the value of the asset increased when financial sector stress increased, thereby providing a greater amount of liquidity for a troubled bank. We expect, then, to find liquid assets negatively correlated with the level of bank equity prices.
- EURIBOR-EUREPO spread – The EURIBOR-EUREPO spread represents the additional rate of interest a firm – typically a bank – would have to pay for unsecured lending versus secured lending in euro-denominated money markets (EURIBOR being the unsecured rate, EUREPO being the secured rate). It is a measure of stress in the interbank debt market. In normal times, short-term lenders are typically confident that short-term borrowers will be able to pay back the principal and interest on a loan, and thus the additional cost paid to borrow without backing the debt with assets is minimal. By contrast, during the credit crunch of late 2008 and early 2009, the spread on unsecured versus secured short-term lending rose to unprecedented levels as lenders' confidence in borrowers' ability to repay eroded. A high EURIBOR-EUREPO spread indicates money market stress and we would expect the price of a liquid asset to be positively correlated with the spread.

5.2.3 Measures of the diversity of asset holders

In order to understand the composition and thus diversity of holders of an asset, one requires information on who holds or what type of entities hold the asset at a given point in time. Information on who holds assets traded in OTC markets may be difficult to obtain. This matter is even more complicated for gold, given its diverse uses ranging from investment to jewellery to industrial applications. This is a problem not faced by assets such as equities or bonds as these are held strictly as investments.

[20] We note that this is a context-specific comparison. We might imagine that in the future Belgian bonds could be considered stressed and Portuguese bonds the benchmark European bond. In such a situation the relevant spread would be the Belgian sovereign bond over the Portuguese sovereign bond.

Figure 5.1: Market value of gold versus select European bonds in 2012



Source: GFMS, German Finance Agency, UK DMO, European Covered Bond Council, World Gold Council
Notes: Based on 2012 estimates of total above ground gold stocks held by private investors and in the official sector, converted at the 2012 average annual gold price.

According to calculations by the World Gold Council, the market value of the investment gold market is roughly as big is the UK gilt and German bund markets combined. Given that gold has uses other than investment purposes only, we infer that the diversity of gold holders for all purposes is very probably greater than that of the debt securities in Figure 5.1, which only have investment uses. Thus, it appears that the gold market is both larger in market value than some major European debt markets and probably wider in terms of asset holders.

If the situations motivating the LCR – a 30-day closure of short-term funding markets – and the NSFR – a prolonged closure of medium- to long-term liquidity markets funding markets – are systemic, then it will be to the banking sector's advantage to have demand for their assets outside of the sector, since most participants in the sector will likely be affected by the adverse conditions to some degree. Even if only one bank were affected in a future crisis, if the banking sector in general is saturated with a particular asset, the affected bank may find it difficult to find buyers for that asset. In other words, the EBA might wish to know where institutional demand could originate from outside of the banking sector. One proxy for this could be the proportion of the total market value of an asset is held within the banking sector.

We attempted to get an idea of bank holdings as a proportion of total outstanding value for a variety of securities. Unfortunately, balance sheet information on banks (or monetary financial institutions more broadly) from sources such as the European Central Bank and the Bank of England do not list gold holdings separately from other assets. Where information on gold is available, it is typically aggregated with other commodity holdings and fixed assets into an "other assets" category. For this reason, we were not able to calculate this measure of the diversity of institutional asset holders.

We expect, however, a regulator to be able to obtain detailed information on bank asset holdings. Since banks are regulated entities, regulators would have access to information on their holdings of

different kinds of assets – bonds, equities, gold, etc. Assuming there are also reasonably accurate estimates of the total outstanding stock of assets of various sorts (e.g. the regulator would know how many U.S. 5-year Treasuries are outstanding). The regulator could then calculate the proportion of the total outstanding stock that is held in the banking sector. The lower that proportion the more "diverse" are the holders of the asset.

Table 5.1: Liquidity measures calculable with available gold data

Measure	Data requirements	Frequency for gold	Liquidity concept	Source
Turnover	Volumes	Yearly	Scale	EBA DP
Bid-ask spread	Prices	Daily	Transaction costs	EBA DP
Log bid-ask spread	Prices	Daily	Transaction costs	EBA DP
Relative spread with mid price	Prices	Daily	Transaction costs	EBA DP
Relative spread with last prices	Prices	Daily	Transaction costs	EBA DP
Relative spread of log prices	Prices	Daily	Transaction costs	EBA DP
Effective spread	Prices	Daily	Transaction costs	EBA DP
Relative effective spread with mid price	Prices	Daily	Transaction costs	EBA DP
Relative effective spread with last price	Prices	Daily	Transaction costs	EBA DP
Market Efficiency Coefficient	Returns	Daily	Price impact (imperfect)	IMF 2002
Correlation/covariance of asset price with equity index	Prices	Daily	Correlation of need with price	Europe Economics
Correlation/covariance of asset price with financials stock index index	Prices	Daily	Correlation of need with price	Europe Economics
Correlation/covariance of asset price with spread in sovereign bond yields	Prices	Daily	Correlation of need with price	Europe Economics
Correlation/covariance of asset price with EURIBOR-EUREPO spread	Prices	Daily	Correlation of need with price	Europe Economics

6 The Liquidity of Gold and Other Assets

This chapter compares the liquidity of gold under various measures with the liquidity of other assets. In particular we compare gold with:

- Equities from the FTSE 100, CAC 40 and DAX indices.
- Corporate bonds issued by companies in the FTSE 100, CAC 40 and DAX indices.
- Sovereign bonds issued by the UK, Germany and France.

As set out previously, liquidity metrics assess three separate dimensions of liquidity:

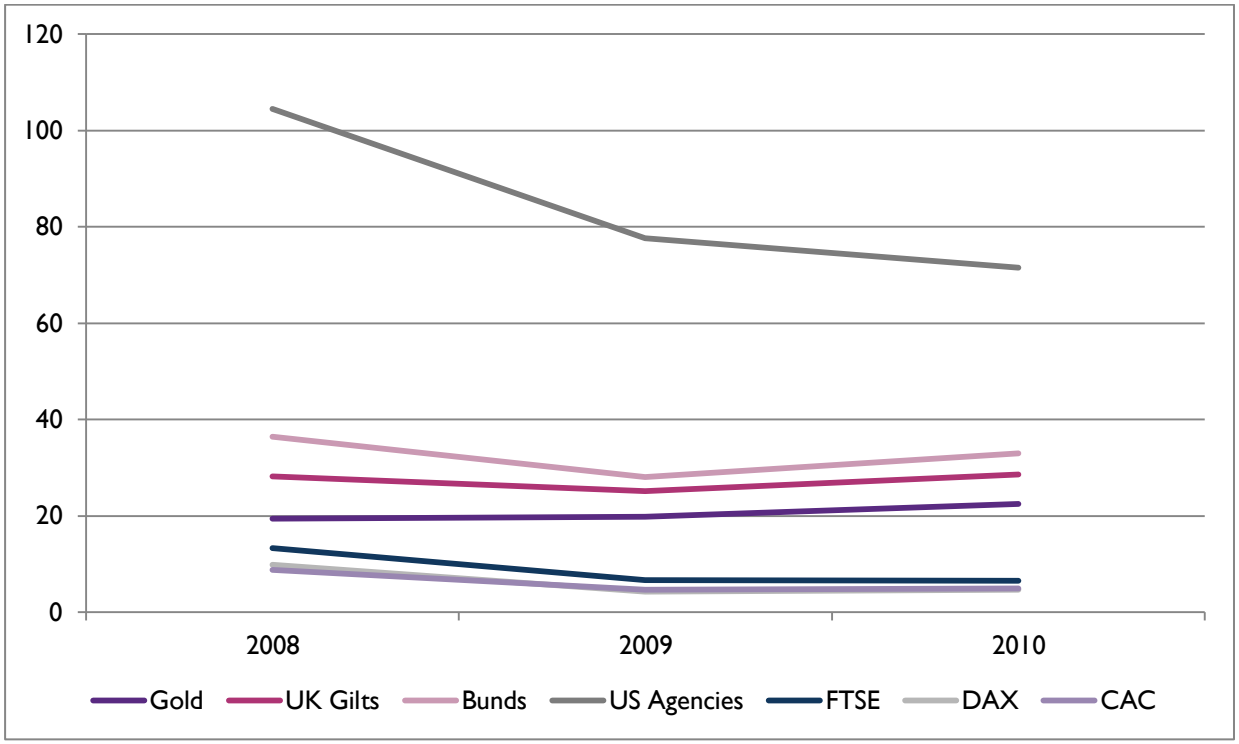
- Convertibility – comprising scale, diversity and correlation of need with price.
- Price impact
- Transactions costs

With the available data, we are able to calculate liquidity measures for all of these, with the exception of the diversity aspect of convertibility.

6.1 Scale Measure

To compare the scale of trade in different assets, we analysed the per-day trading turnover for the asset classes in question. This is roughly equivalent to metric 2 in the EBA's list. The chart below shows gold clearing turnover on the London Bullion Market and trading volumes for gilts, bunds, and equities in the FTSE 100, DAX and CAC 40 indices. For gold, data was only available on cleared volumes. According to the World Gold Council, clearing numbers are typically multiplied by a factor of 10 or, conservatively, 5 to indicate gross trade volumes. However, to be extremely conservative we do not perform such a multiplication, so the gold series shown below should be considered as an absolute lower bound.

Figure 6.1: London Bullion Market gold clearing turnover and daily trade volumes for other securities and exchanges, billions of USD 2008-2010



Source: Bloomberg, LBMA, UK Debt Office, German Finance Agency, SIFMA, and World Gold Council

Trading volumes in US debt are significantly larger than all other asset types, while volumes in UK gilts and German bunds are at a similar level. The lower bound for gold clearings comes in below volumes for gilts and bunds, but it is also in excess of volumes for members of the equity indices. In reality, the trade volume of gold is therefore almost certain to exceed the volumes for gilts and bunds. With respect to scale, the gold market is therefore comparable to markets for other asset classes.

6.2 Correlation of Need with Price Measures

None of the measures of the correlation of need with price that we selected were detailed in the EBA paper. To calculate these measures we used daily data taken from Bloomberg on asset prices and data on the indicators of need set out above:

- For general measures of equity and debt, we used the FTSE 100 index to analyse correlation with need arising due to general equity risk and the correlation with the spread on Spanish over German bond yields to account for need arising due to sovereign bond risk
- For bank-specific measures of equity and debt, we used the MSCI Europe Financials index to analyse correlation with need occurring due to bank stress and the EURIBOR-EUREPO spread to account for need arising due to risk in bank debt.

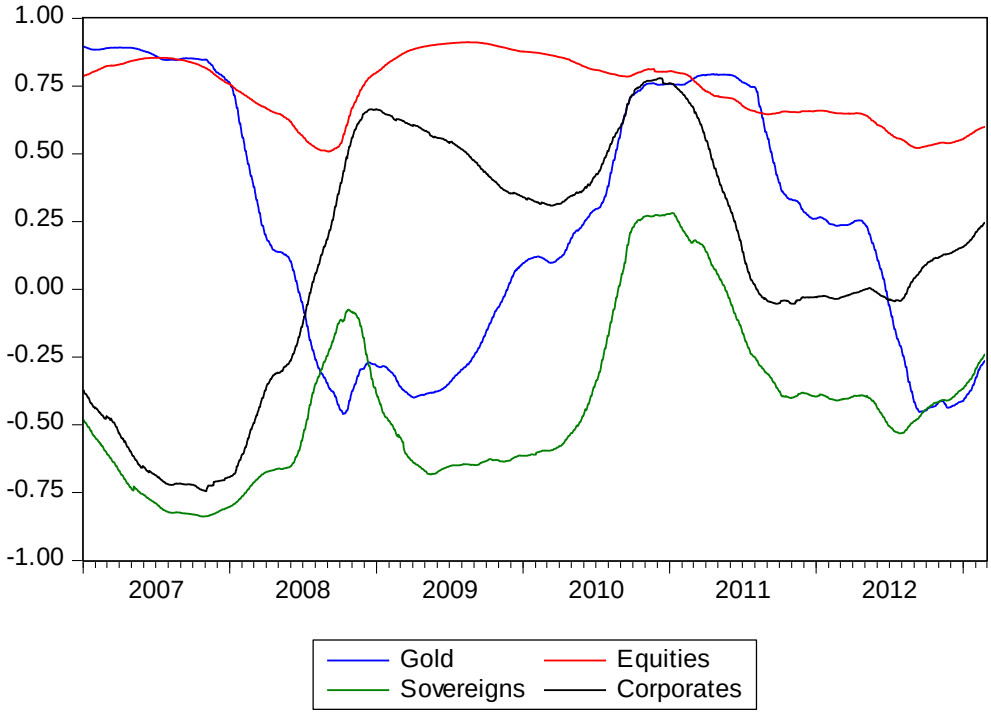
For each asset we calculated the correlation of price with the above indicators using two-year rolling windows. We also calculated whole-sample correlations. For sovereigns, equities and corporates, we then calculated the mean correlation across the asset class.

6.2.1 Correlation with equity price index

Recall that the correlations shown below are calculated on the basis of two-year backward-looking rolling windows. Thus the effect of the credit crunch in late 2008, for example, would have an effect

starting in late 2008 and ending in late 2010. Recall also that liquid assets are expected to have a negative correlation with equity prices – as equity prices fall, the prices of liquid assets rise. The chart below shows the assets' (mean) correlation with the FTSE 100 index.

Figure 6.2: Mean correlation with FTSE 100 index, 2007-2013



Source: Bloomberg and Europe Economics calculations

The table below shows whole sample correlations for the assets with the FTSE 100 index.

Table 6.1: Assets' whole-sample correlation with FTSE 100 index, 2005-2013

Asset	Sample Correlation with FTSE 100
Gold	-0.316004274
Equities	0.531550442
Corporates	0.233377517
Sovereigns	-0.245749892

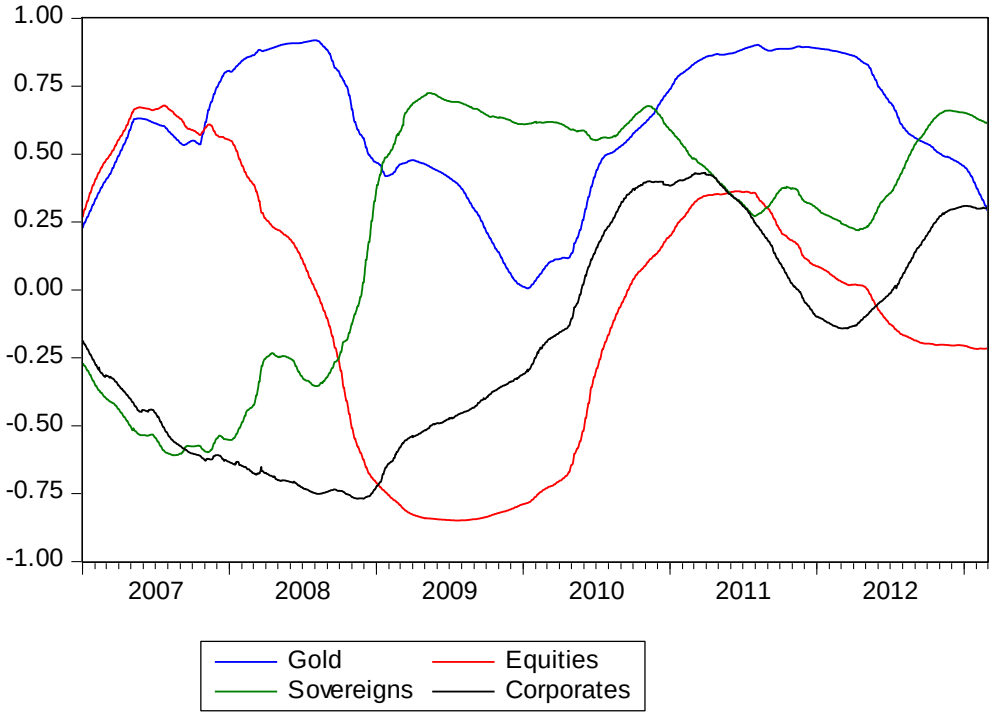
Source: Bloomberg and Europe Economics calculations

As can be seen, gold has the most negative correlation (i.e. performs best on this measure of liquidity) across the whole sample, while sovereigns are also negatively correlated with the equity index,

6.2.2 Correlation with spreads in sovereign bond markets

The chart below shows assets' (mean) correlation with spreads in sovereign bond markets, represented by the spread between Spanish and German bonds. Gold's correlation is consistently high and positive. Sovereigns' mean correlation is negative to 2008 but then turns positive and is consistently higher from 2009 to 2013. Corporates' mean correlation begins the period negative, but turns positive by 2010. Equities' correlation is not consistent across the period, going from positive in 2007-2008 to negative in 2008-2010 and then negative again in 2012.

Figure 6.3: Mean correlation with Spanish-German bond spread, 2007-2013



Source: Bloomberg and Europe Economics calculations

The table below whole sample correlations of the assets with the Spanish-German bond spread (again, figures for equities, sovereigns and corporates are mean correlations).

Table 6.2: Assets' whole-sample correlation with Spanish-German bond spreads, 2005-2013

Asset	Sample correlation with Spanish-German bond spreads
Gold	0.909658
Equities	0.023707
Sovereigns	0.625718
Corporates	0.177734

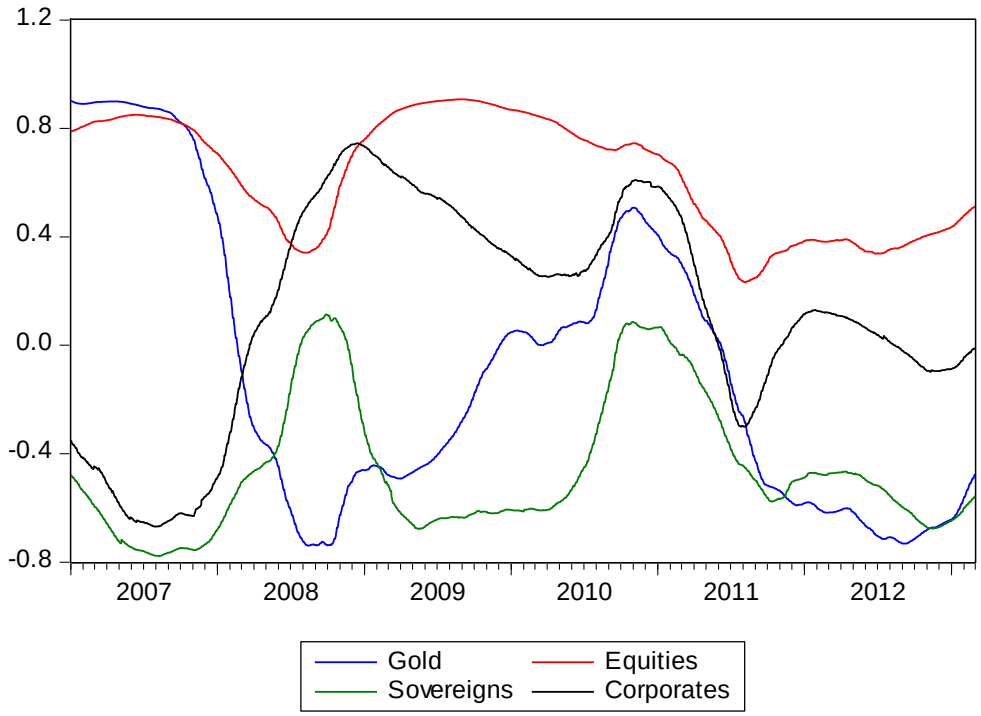
Source: Bloomberg and Europe Economics calculations

In this case, all assets have positive correlations, although equities' correlation is lowest and close to zero. Gold has a high positive correlation with spreads, followed by sovereigns and corporates.

6.2.3 Correlation with Europe Financials Equity Index

The chart below shows assets' mean correlation with the MSCI Europe Financials Equity Index, used as an indicator of financial equity performance more generally. Recall that a more liquid asset should display a less positive / more negative correlation with the equity index

Figure 6.4: Mean correlation with MSCI Europe Financials Index, 2007-2013



Source: Bloomberg and Europe Economics calculations

The table below whole sample correlations of the assets with the MSCI Europe Financials index (again, figures for equities, sovereigns and corporates are mean correlations).

Table 6.3: Assets' whole-sample correlation with MSCI Europe Financials Index, 2005-2013

Asset	Sample Correlation with MSCI Europe Financials
Gold	-0.71964
Equities	0.346411
Corporates	0.059097
Sovereigns	-0.53420

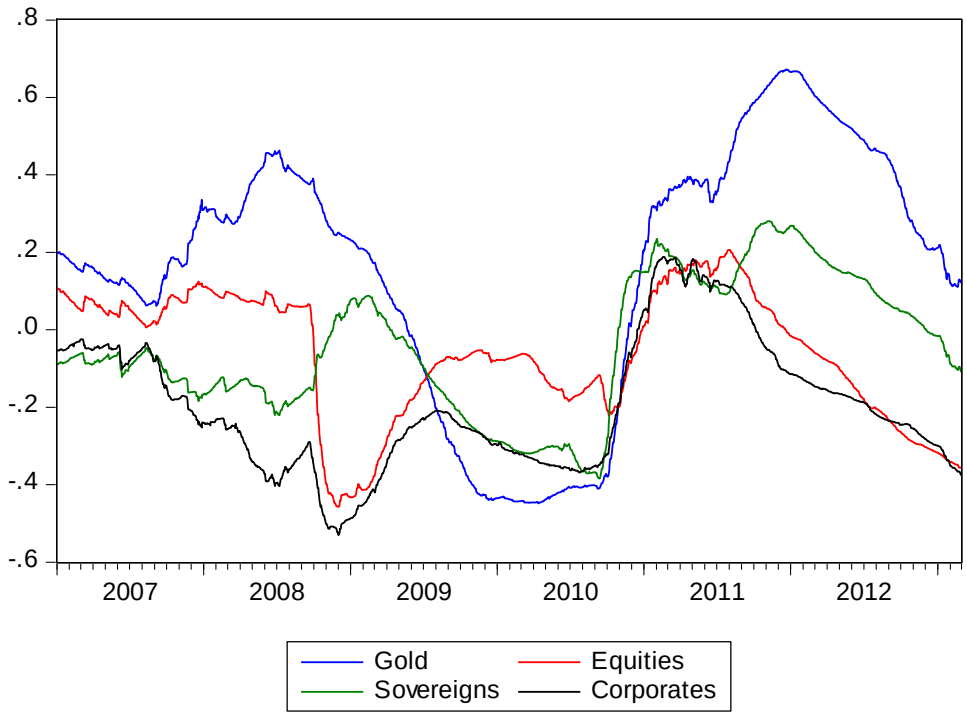
Source: Bloomberg and Europe Economics calculations

Gold performs the best of these assets on this measure of liquidity, displaying a large negative correlation, again followed by sovereigns.

6.2.4 Correlation with the EURIBOR-EUREPO spread

The chart below shows assets' mean correlation with the EURIBOR-EUREPO spread. Gold's correlation is generally high, although in the period from late 2009 to 2010 it turns negative and lower than other assets. Corporates generally have a negative correlation with the exception of a positive period in late 2010 and early 2011. Equities have positive correlations in the periods from 2007 to late 2008 and in early 2011 and negative correlations in other periods. Sovereigns have negative correlations in 2007 to late 2008, late 2009 to late 2010 and late 2012 and positive correlations in other periods.

Figure 6.5: Mean correlation with EURIBOR-EUREPO spread, 2007-2013



Source: Bloomberg and Europe Economics calculations

The table below whole sample correlations of the assets with the EURIBOR-EUREPO spread (again, figures for equities, sovereigns and corporates are mean correlations).

Table 6.4: Assets' whole-sample correlation with EURIBOR-EUREPO spreads, 2005-2013

Asset	Sample correlation with EURIBOR-EUREPO spreads
Gold	0.354168
Equities	-0.02620
Sovereigns	-0.01728
Corporates	-0.23341

Source: Bloomberg and Europe Economics calculations

Gold is the only asset that has a positive correlation, indicating that it is the most liquid asset under this measure of correlation of price with need. Equities and sovereigns have negative correlations, although these are both close to zero, while corporates also have a negative correlation.

6.3 Transaction Cost Measures

For transactions cost measures of liquidity we used daily data taken from Bloomberg[21] on bid, ask, mid and last prices for the assets in question. We calculated each liquidity measure for every day for which data was available for each asset over the period from 01 January 2005 to 28 February 2013. As we had a large number of equities, corporates and sovereigns in our sample, to compare the performance of these assets with gold we then calculated the mean, maximum and minimum value of the liquidity measures for each of these asset classes. (For display purposes we also smoothed the liquidity measure time series by using seven-day rolling average figures.) For comparison, we also calculate liquidity measures for sterling-dollar and euro-dollar trades. This constitutes a "sanity check" on our

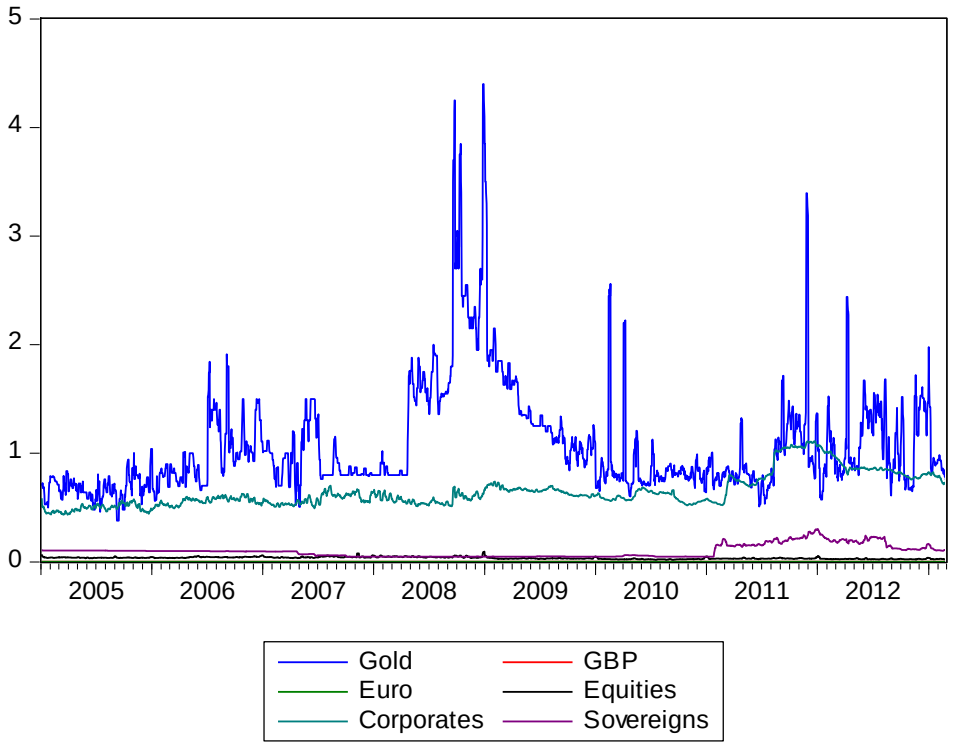
[21] As a robustness check, we also calculated some transaction cost measures using Datastream data on gold. There was no material difference between gold's absolute performance or performance relative to other asset classes when using Datastream data.

calculations and the liquidity metrics, since currencies are the most liquid assets and therefore should perform the best on all measures.

6.3.1 Absolute bid-ask spreads

We have calculated absolute bid-ask spreads using the difference between assets' ask and bid prices in US dollars. The chart below compares bid-ask spreads for gold with those for sterling and euros, and with mean bid-ask spreads for equities, corporates and sovereigns. This is equivalent to metric 8 in Annex 5 of the EBA paper. In general, gold has higher spreads than other asset classes, although with the exception of spikes in certain periods. Sovereigns and equities have consistently lower mean absolute bid-ask spreads than both gold and corporates.

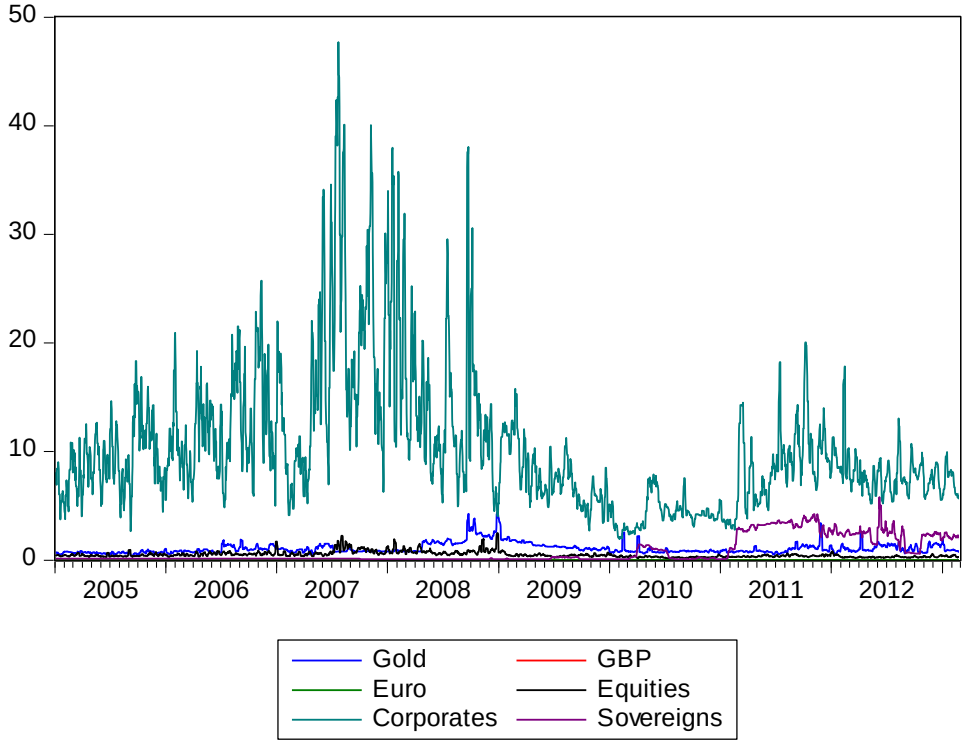
Figure 6.6: Mean absolute bid-ask spreads for assets in USD, 2005-2013



Source: Bloomberg and Europe Economics calculations

However, when the maximum level of the bid-ask spreads is taken into account, the maximum spread of corporates in consistently in excess of the gold spread. Moreover, for the period since 2011, the maximum sovereign spread has also exceeded the gold spread. (Recall that as we have only one set of gold prices, the gold series in the chart below is the identical to the one shown in the chart above.)

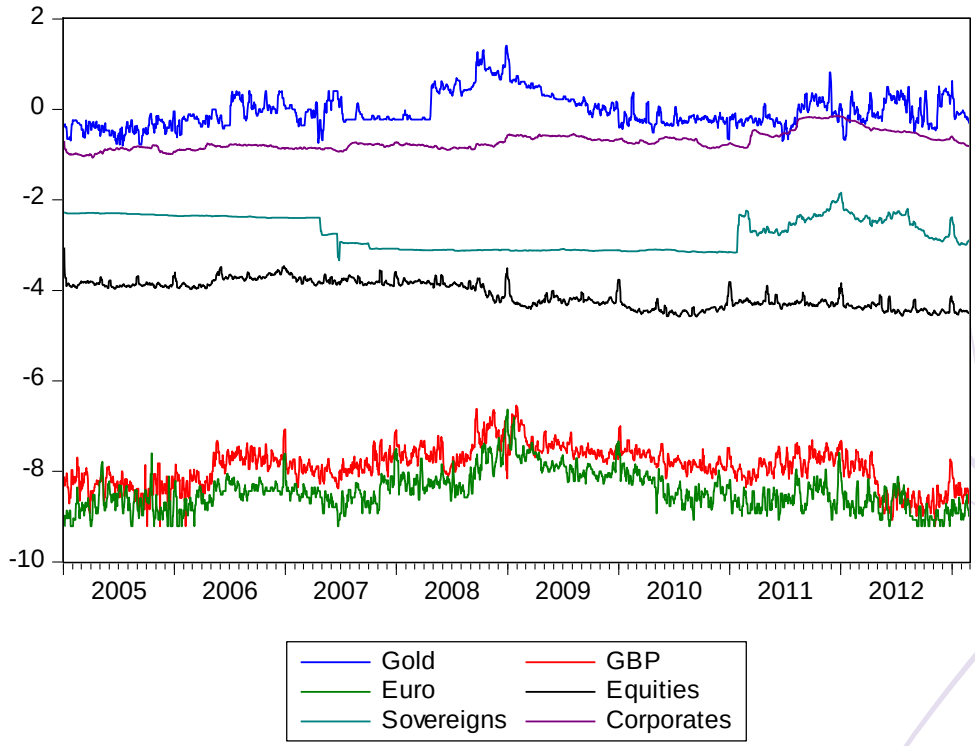
Figure 6.7: Maximum absolute bid-ask spreads for assets in USD, 2005-2013



Source: Bloomberg and Europe Economics calculations

The above observations may be seen more clearly by analysing the logarithm of the absolute bid-ask spread. This is equivalent to metric 9 in Annex 5 of the EBA paper. Mean absolute log bid-ask spreads are shown in the chart below, indicating that, in general gold has higher spreads than corporates, followed by corporates and then equities. As expected, currencies have significantly lower log spreads.

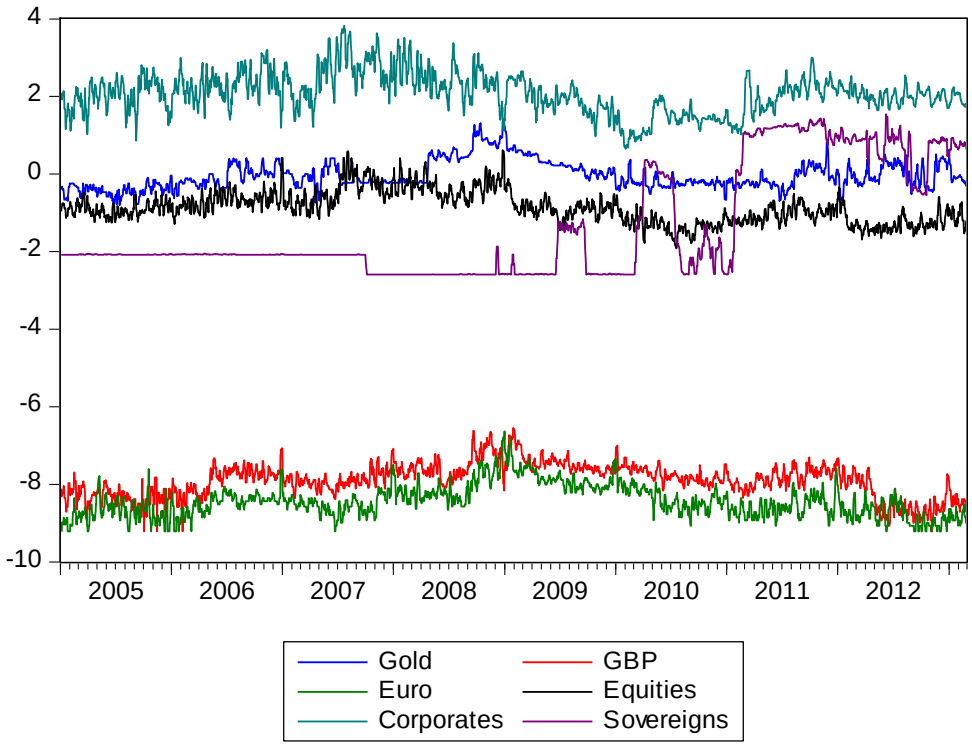
Figure 6.8: Mean logarithm absolute bid-ask spreads, 2005-2013



Source: Bloomberg and Europe Economics calculations

As detailed above, the maximum spread of corporates consistently exceeds gold's spread, while the maximum spread of sovereigns also exceeds gold's from 2011.

Figure 6.9: Maximum logarithm absolute bid-ask spreads, 2005-2013

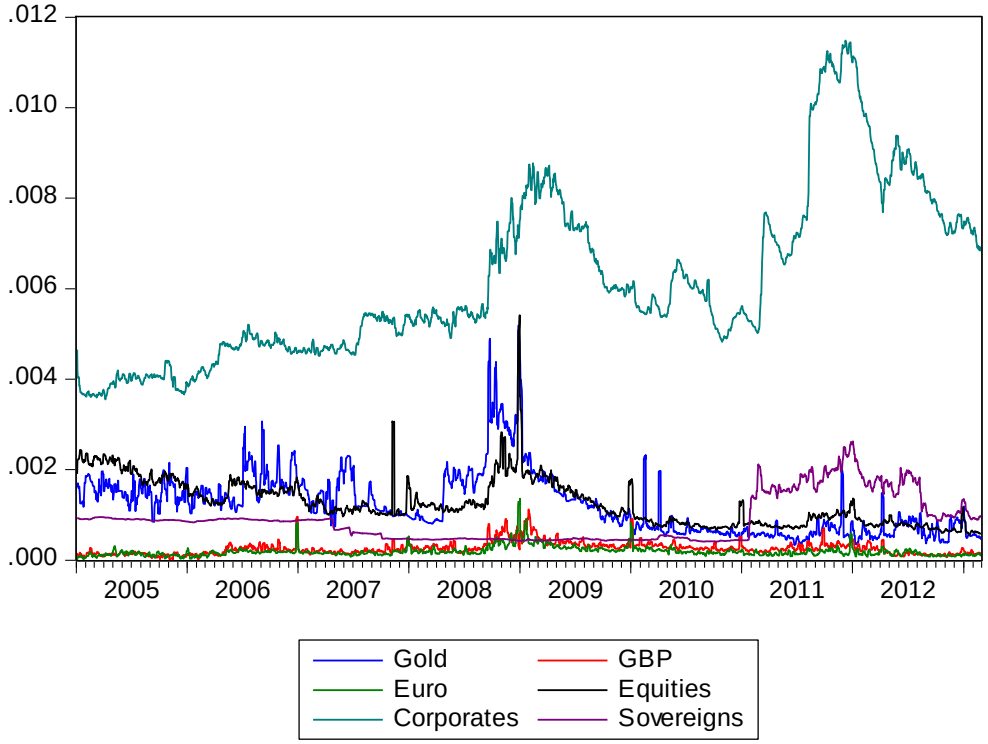


Source: Bloomberg and Europe Economics calculations

6.3.2 Relative bid-ask spreads

When relative, as opposed to absolute, spreads are considered, gold's performance is significantly improved. Relative spreads are calculated by dividing the absolute bid-ask spread by the price (mid or last) of the asset. The figure below shows mean relative spreads, calculated with respect to mid price. This is equivalent to metric 10 in the EBA paper. Corporates have consistently higher mean relative spreads, while mean relative spreads on equities are comparable to those on gold throughout the period 2005-2013. Until 2011, relative spreads on sovereigns are on average lower than those on equities or gold, but are in excess of them after 2011.

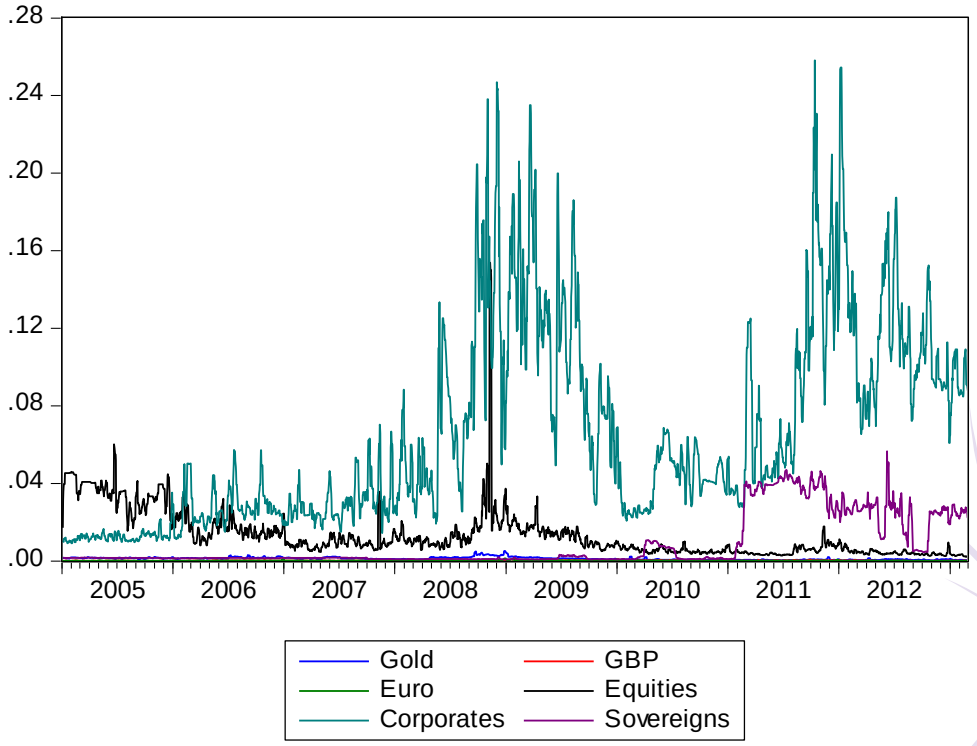
Figure 6.10: Mean relative spread (with respect to mid price), 2005-2013



Source: Bloomberg and Europe Economics calculations

The chart below compares maximum relative spreads on sovereigns, corporates and equities with those on gold. Maximum spreads on corporates are general higher than maximum spreads on equities, and the maximum spread on sovereigns lower than that on equities until 2011.

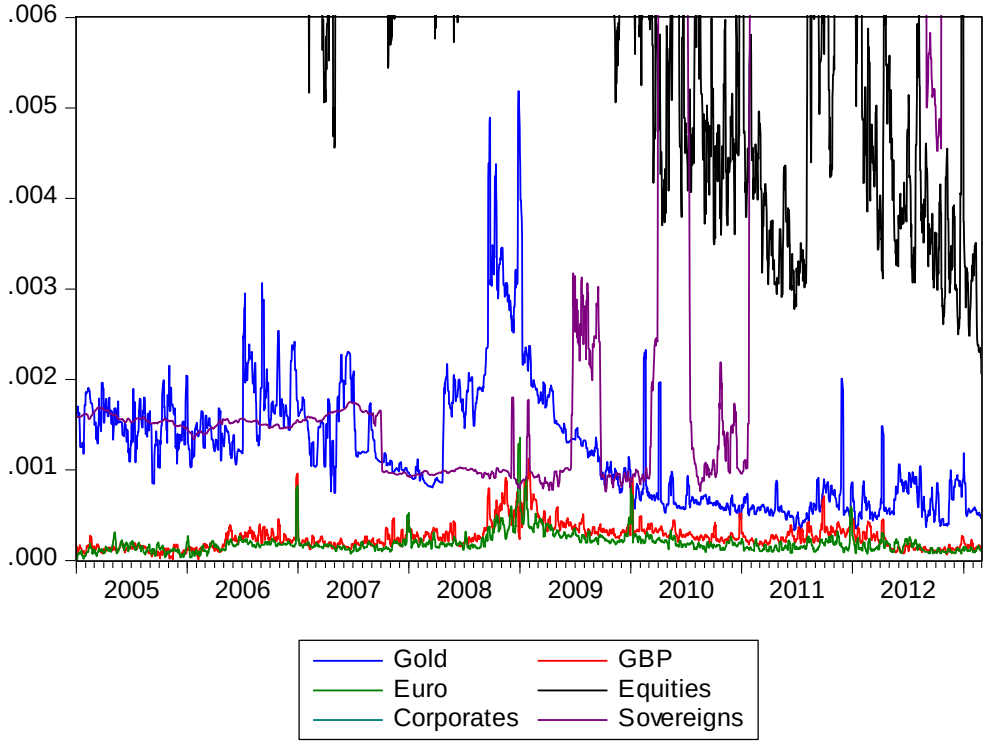
Figure 6.11: Maximum relative spread (with respect to mid price), 2005-2013



Source: Bloomberg and Europe Economics calculations

The chart below shows the lower portion of the above graph in more detail. Until 2008 maximum relative spreads on sovereigns are comparable to relative spreads on gold, although in the period from 2008-2009 they lie below gold and from 2010 are generally significantly above it.

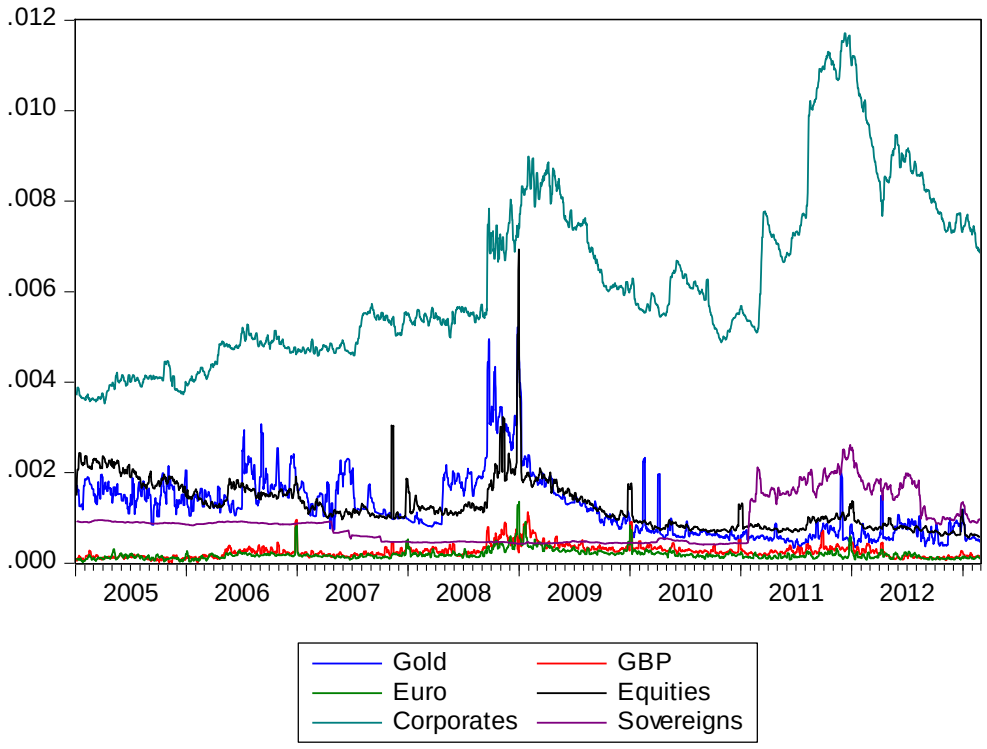
Figure 6.12: Maximum relative spread (with respect to mid price), 2005-2013



Source: Bloomberg and Europe Economics calculations

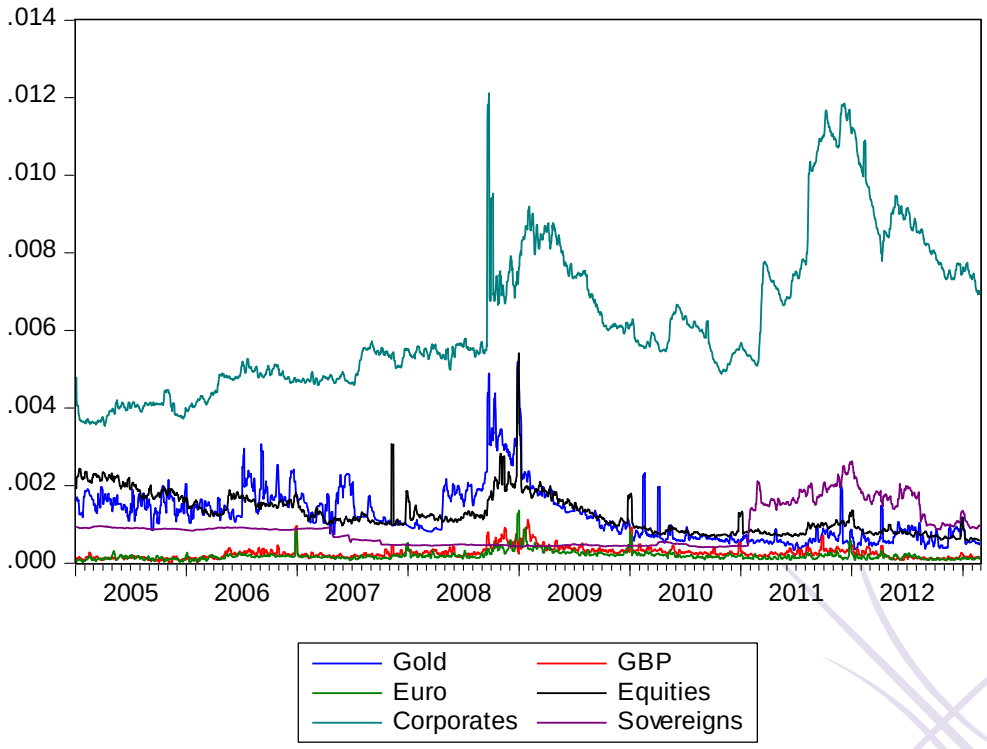
The above observations remain the case both when relative spreads are calculated with respect to last price and when log relative prices are used. These are equivalent to metrics 11 and 12 in Annex 5 of the EBA paper. This can be seen in the two charts below.

Figure 6.13: Mean relative spread (with respect to last price), 2005-2013



Source: Bloomberg and Europe Economics calculations

Figure 6.14: Mean relative spread of log prices, 2005-2013

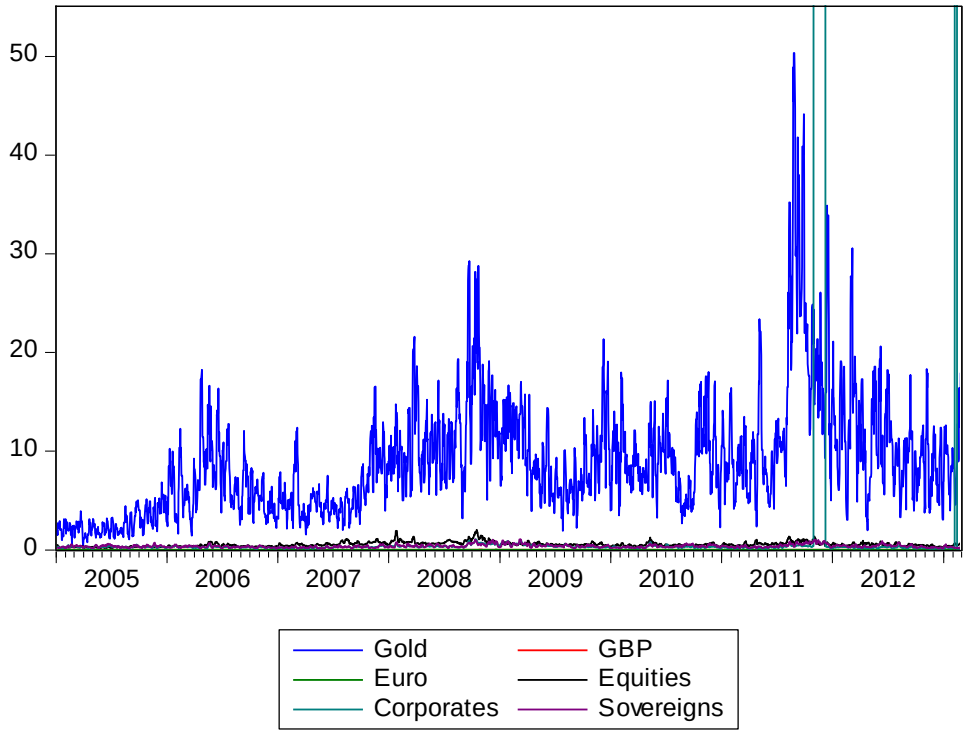


Source: Bloomberg and Europe Economics calculations

6.3.3 Absolute effective spread

Using absolute effective spread measures, gold generally performs poorly. Effective spreads are calculated as the absolute value of the difference between the last price paid before each trading day and the mid price on that day. This is equivalent to metric 13 in Annex 5 of the EBA paper. As can be seen in the chart below, gold's effective spread is consistently above the mean effective spreads of equities, corporates and sovereigns. (Note that that are a very small number of observations for which the mean effective spread on corporates is above the scale of the chart.)

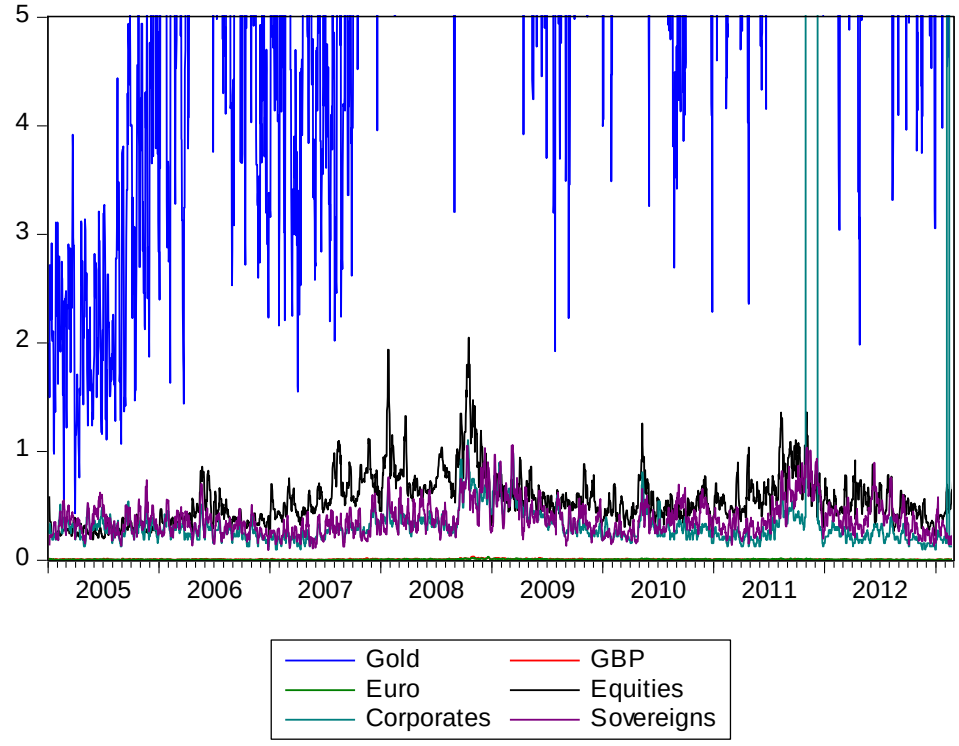
Figure 6.15: Mean effective spread, 2005-2013



Source: Bloomberg and Europe Economics calculations

The chart below shows the lower portion of the chart above. In general, equities, sovereigns and corporates perform similarly when mean effective spreads are compared.

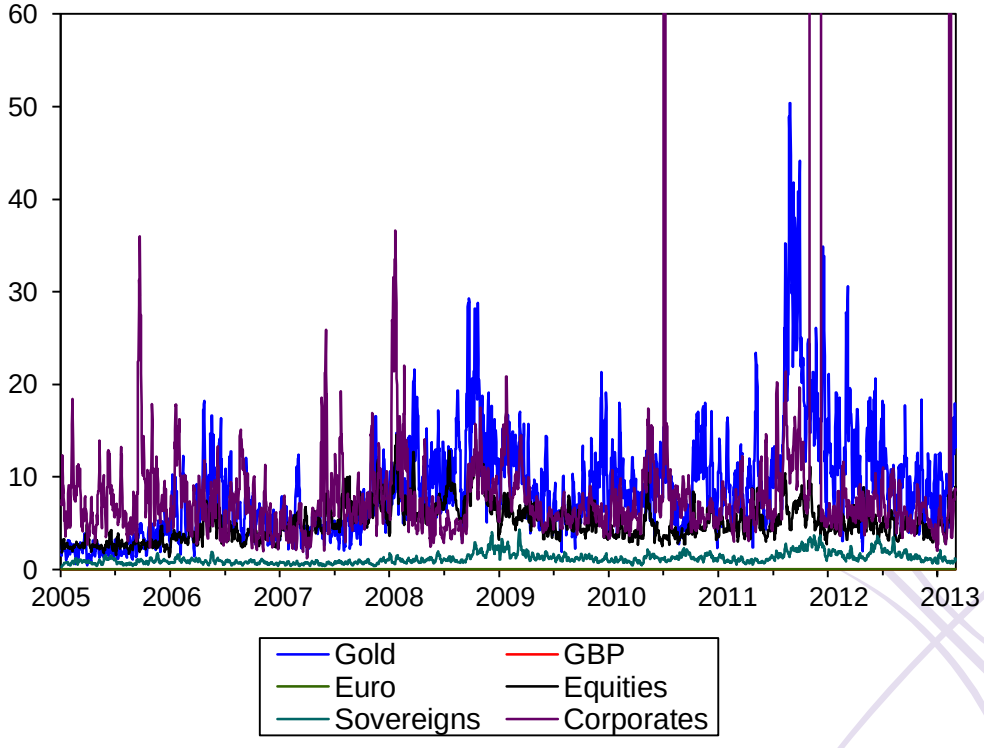
Figure 6.16: Mean effective spread, 2005-2013



Source: Bloomberg and Europe Economics calculations

However, when gold's effective spread is compared with the maximum effective spread of equities, corporates and sovereigns, although gold's effective spread is generally higher than that of other assets, its magnitude is not dissimilar to that of equities or corporates.

Figure 6.17: Maximum effective spread, 2005-2013

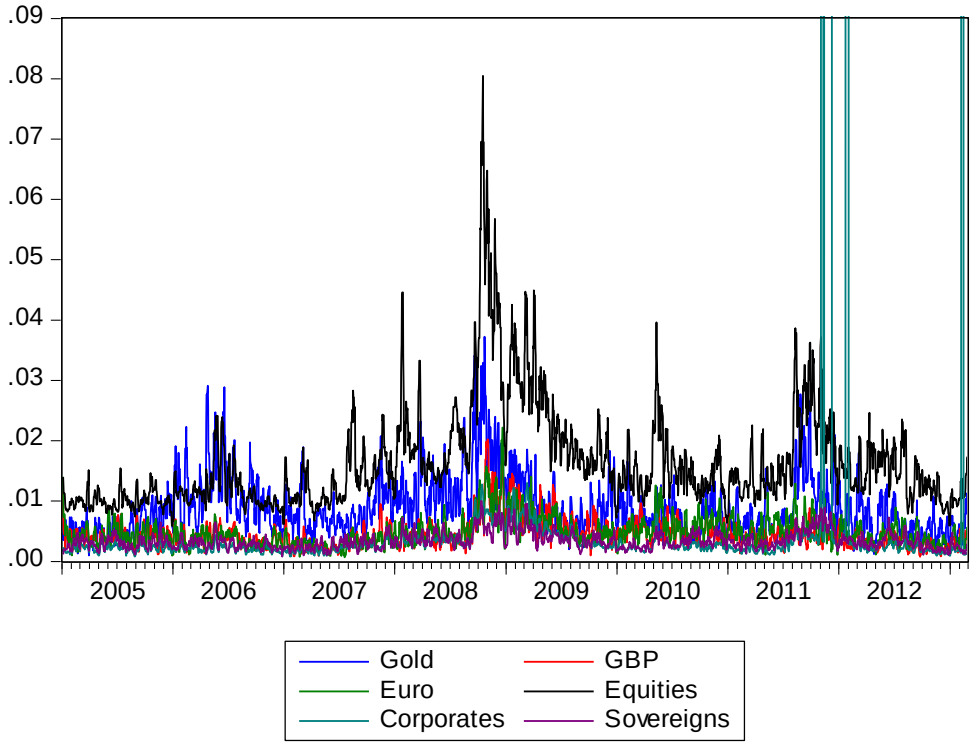


Source: Bloomberg and Europe Economics calculations

6.3.4 Relative effective spread

When effective spreads are considered relative to the price of the asset, gold's performance is significantly better than is the case with the unadjusted effective spread. Relative effective spreads are calculated by dividing the absolute spread by the price (mid or last) of the asset. The chart below shows mean relative effective spreads calculated with respect to mid price. This is equivalent to metric 14 in Annex 5 of the EBA paper. In general, relative spreads are higher on average with equities than gold. The magnitude of relative spreads is generally similar for gold, sovereigns and corporates, although generally relative effective spreads on gold are higher.

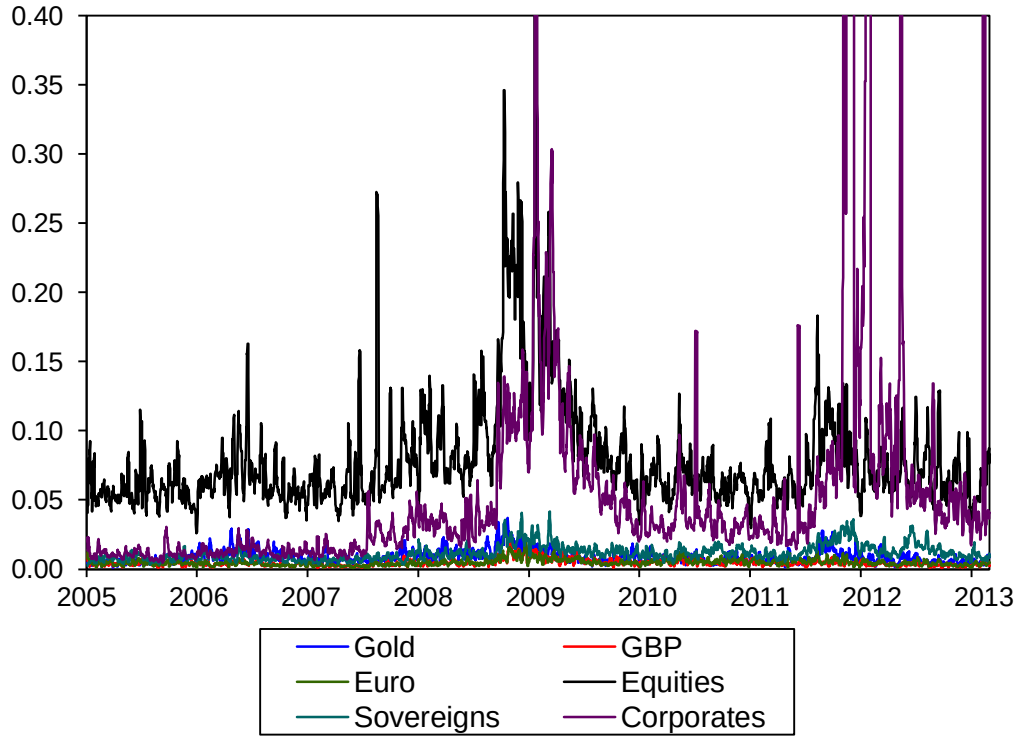
Figure 6.18: Mean relative effective spread (with respect to mid price)



Source: Bloomberg and Europe Economics calculations

The chart below compares relative effective spreads on gold with the maximum relative effective spreads on sovereigns, corporates and equities. In this case, maximum spreads on equities and corporates are higher than spreads on gold, which are comparable in magnitude to maximum spreads on sovereigns.

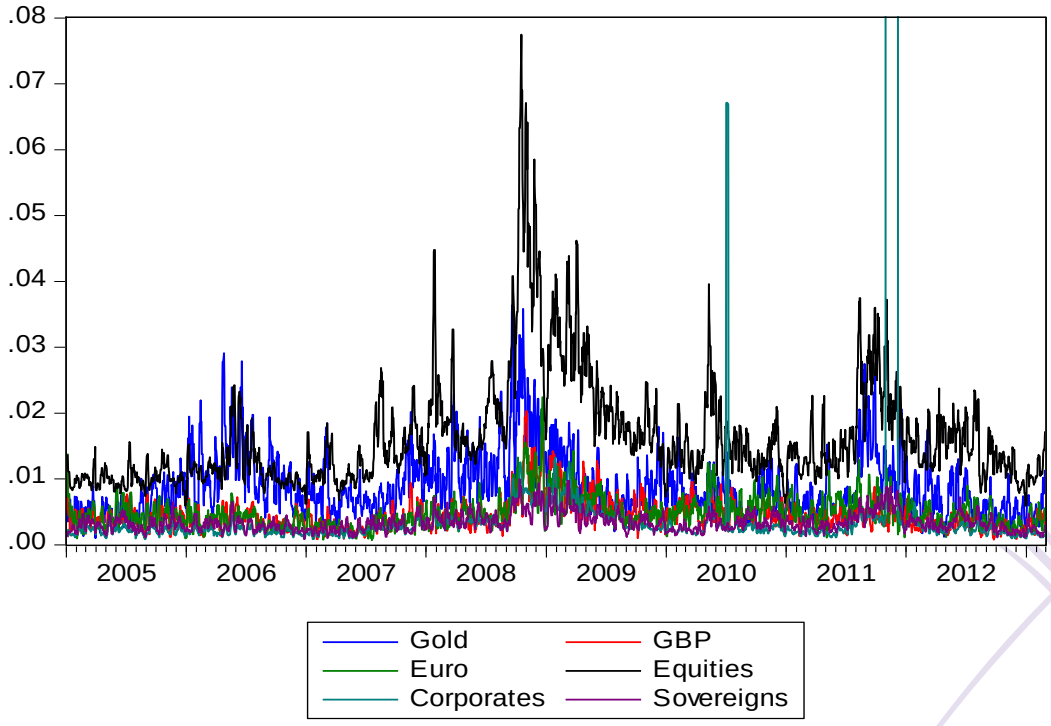
Figure 6.19: Maximum relative effective spread (with respect to mid price)



Source: Bloomberg and Europe Economics calculations

Using last price, as opposed to mid price, to calculate relative effective spreads does not materially alter this analysis, as can be seen from the chart below. This is equivalent to metric 15 in Annex 5 of the EBA paper.

Figure 6.20: Mean relative effective spread (with respect to last price)



Source: Bloomberg and Europe Economics calculations

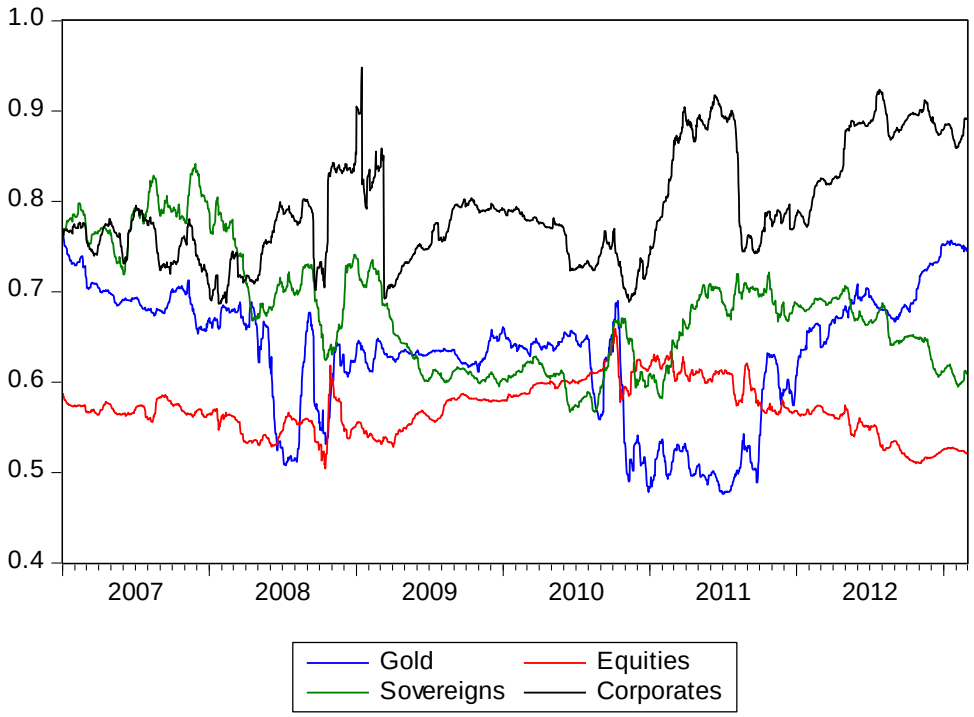
6.4 Price Impact Measures

As we do not have accurate data on trading volume either for gold or for corporate bonds, we have not calculated price impact measures. However, we have calculated the (imperfect) indicator of price impact – the market efficiency coefficient (MEC).

6.4.1 Market Efficiency Coefficient

The Market Efficiency Coefficient compares the variance of short- and long-term returns. In this case, we compare daily returns with returns calculated over a month, so that an MEC close to one indicates an efficient market. The figure below shows mean market efficiency coefficients for the assets in question.

Figure 6.21: Mean market efficiency coefficient



Source: Bloomberg and Europe Economics calculations

There is no clear ranking of the assets over time, although corporates have consistently high MECs and equities generally perform worse than other assets, with the exception of a short period in 2008 and a longer period between late 2010 and mid-2011, when gold performs more poorly. However, by 2013 gold performs better than both sovereigns and equities.

7 Implications for the Use of Gold for Bank Liquidity

Our discussion of the policy background on capital and liquidity requirements highlights the following points:

- The Basel Accords, CRD IV, and the CRR can be characterised as backward-looking regulation. This could lead to regulation not addressing future, unforeseen risks; and a disproportionate focus on the causes of the most recent financial crisis and measures intended to address these problems in particular.
- Liquidity has not been considered as a criterion for capital requirements until Basel III. Unlike an understanding of what "quality" capital is in general, the liquidity of assets generally and during crisis may not be as well understood. Defining liquidity through a set number of dimensions and measures may have unforeseen impacts. Measures and their weights in a ranking system (if any) should be reviewed over time.
- Some assets (including gold) are considered in the Basel III as liquid as other assets considered in the NSFR calculations, but not included as candidates for assets to be used in the LCR.[22]

Three important aspects of liquidity for the purposes of the LCR are:

- Convertibility (encompassing scale, diversity of asset holders and correlation of need with price)
- Transactions costs
- Price impact

Our calculations of the measures of liquidity for which data on gold is available provide the following results:

- Gold performs well relative to selected equity indices on scale measures, as shown by Figure 6.1. We note that this chart shows the volume of clearing turnover, not total trade volume, for gold and thus gold's performance is a conservative lower-bound.
- Additionally, the price of gold has moved steadily upwards since late 2008, which also happens to be a period of sustained economic stress. Therefore we would expect gold to perform well on measures of the correlation of the price of gold with the need to sell it. Indeed, we find that gold performs markedly the best on all four of our measures of the correlation of price with need.
- In respect of relative transactions costs, gold performs well.[23]
- When the fact that assets are priced in different units is taken into account (i.e. on relative measures) the price-unit disadvantage of gold seems to disappear and the precious metal performs

[22] In the Basel III document: 'Basel III: International framework for liquidity risk measurement, standards and monitoring' 2010, gold is listed in Annex 2 as being approximately as liquid as most equities, low investment grade corporate and covered bonds, and loans to corporates, sovereigns, and central banks.

[23] Given that the quoted unit of gold is on average more expensive than most equities and bonds, gold performs poorly on absolute measures of transactions costs (i.e. variations of spread measures). For example, gold price changes and spreads are not relatively large as a proportion of the overall gold price, but are significant when compared to absolute price changes of other assets. Transactions cost measures that use relative price differences should be used in preference to those that use absolute differences. This makes liquidity comparisons between gold and other assets involving absolute transaction costs largely meaningless.

well. Analysis of relative transactions cost measures shows that gold performs well compared to equities, and often better than corporate bonds (e.g. Figure 6; particularly figure 7)

- Gold performs roughly as well as equities and sovereign bonds on the one measure of price impact (the MEC).

Out of the five dimensions of liquidity that we identify in this paper, namely scale, diversity, correlation of price with need, transactions costs and price impact, gold performs well in four of these (scale, correlation of price with need, transaction costs, and price impact) under various measures. Although we do not have access to data in order to calculate a measure of diversity of asset holders, our intuition is that gold will perform well on this dimension.

Given that gold has been shown to perform well on the correlation of price with need dimension, and the likelihood of it performing well on diversity, the fact that these two dimensions are not reflected in the measures presented in the EBA's DP implies that an analysis based only on the EBA DP liquidity measures would be at important risk of being misleadingly biased against gold.