Central Bank Balance Sheet Analysis

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Abstract: Balance sheet analysis is standard practice for assessing private sector businesses. No such analysis has been applied to central banks previously. We provide the theoretical foundation and rationale for such analysis. This foundation is rooted in the *quality* theory of money which places special emphasis on subjective factors as a complement to the more conventional quantitative factors that determine money's purchasing power. The balance sheet of a central bank reveals the quality of the assets backing a currency and serves as an indicator of future monetary policy. Several accounting ratios proxy the quality of money in terms of assets held by the central bank, alluding to potential shifts in its purchasing power. These ratios can also be used to estimate the scope of future monetary policies that are feasible by the central bank.

Zusammenfassung: Bilanzanalyse ist eine Standardpraxis im privaten Sektor. Jedoch gibt es noch keine systematische Bilanzanalyse von Zentralbanken. Wir entwickeln eine theoretische Basis und Begründung für eine derartige Analyse. Die Grundlage der Zentralbankanalyse wurzelt in der Qualitätstheorie des Geldes, welche die subjektiven Faktoren betont und die konventionellen, eher quantitativen Faktoren ergänzt, die die Kaufkraft des Geldes bestimmen. Eine Zentralbankbilanzanalyse enthüllt die Qualität der Vermögenswerte, die eine Währung decken und ist ein Indikator für die Entwicklung künftiger Geldpolitik. Verschiedene Bilanzkennzahlen fungieren als ein Proxy der Geldqualität unter Berücksichtigung der Vermögenswerte der Zentralbank, die eine künftige Veränderung der

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Kaufkraft des Geldes andeuten. Diese Kennzahlen können auch dazu genutzt werden, um die künftigen Optionen der Geldpolitik auszuloten.

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1 Introduction

The balance sheet of any business summarizes the past results of its operations, and also gives clues as to what ventures will be desirable, or even possible, in the future. As such, an analysis of the balance sheet provides insights into the present and expected future financial health of the firm. Furthermore, with readily available data on publically listed corporations, balance sheet analysis is easily achieved at minimal cost. Finally, due to the transparent and open nature of balance sheet items, analysts can quickly reach consensus on the fortunes (or misfortunes) of a firm and thus minimize disagreements as to the company's general health.

While analyzing balance sheet strengths and weaknesses is an essential component in management studies, forming a core part of degrees in accounting, corporate finance, and business administration, there have been very few attempts to standardize the practice in the area of banking. This omission leaves *Werner and Padberg* wondering why it is "that until the present no specific analysis of banks' balance sheets has been conceived, although a separate treatment of banks´ balance sheets is necessary."[2]

Bank balance sheet analysis is still in its infancy but receiving new interest due to the recent financial crisis. Despite this attention, no comprehensive application to *central* banks has been attempted, and the implications of such analysis are still widely neglected. This article rectifies this omission.

A central bank's balance sheet has a different importance for the state of an economy than that of a specific firm. Firm specific balance sheet analysis primarily indicates economic value; central bank balance sheet analysis reflects changes to the assets which back a currency. A far broader economic meaning is provided through the latter. The central bank's assets enable it to pursue its monetary policy goals effectively through various instruments including open market operations, the discount rate and reserve requirements. The analysis of a central bank´s balance sheet has become especially fruitful as central bankers have started to use compositional shifts of their assets directly for money policy.[3] Zero interest rate policies

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[2] See *Werner/Padberg* (2006), p.1.
[3] See *Bagus/Schiml* (2009); *Bagus/Howden* (2009); *Brunnermeier* (2009); *Cecchetti* (2009); *Hamilton* (2009).

test the limits of conventional monetary policies. In response, changes in the composition and size of central banks' balance sheets have been pursued.[4] The dramatic compositional changes and expansion undertaken by the Federal Reserve from late 2008 2014 under the guise of quantitative easing are examples of these new monetary policies. Increased attention directed at central bank asset holdings has become a larger issue than in the past when central bank assets were more homogenous, i.e., primarily comprised of short-term government bonds.

This paper will provide the basis of a homogenous set of tools to analyze a central bank's balance sheet. Such analysis will only be useful if a link can be made between the quality and quantity of such assets and the value of the central bank's liabilities (mostly comprised of the monetary base). In order to make such a link, theoretical tools and instruments of both economics and business management must be combined. Over the course of the 20th century, mainstream monetary economics has emphasized the role of the quantity equation to determine the value of the monetary unit. While such an analysis is not obviously incorrect, the attention the equation affords to past quantities, both of money and nominal transactions, obscures the real problem at hand regarding the value of and demand for the monetary unit. While the value of the monetary unit is predicated on its usefulness in performing transactions, its demand will be based upon the expected future prices that it will be used to purchase (this is one key insight of *Mises*' "regression theorem" of money).[5] Since future prices are determined by the interaction between the demand for money and its future supply, balance sheet analysis can give insight into what the investor can reasonable expect the central bank to be able to target for the quantity of money.

Section 2 of this paper will overview how the purchasing power of money is established, incorporating both present and known factors as well as future expectations. Section 3 looks at the specific functions of money and how they are affected by future expectations concerning not just the quantity of money (as per standard analysis) but more importantly, the quality of money. Section 4 develops a standard set of tools to analyze the central bank's balance sheet, and as such sheds light on future changes to the quality of money as well as what type of quantity changes are feasible. In section 5 we provide some additional caveats to consider when making comparisons of central banks according to the previously developed

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[4] See *Bernanke/Reinhart/Sack* (2004), *Ueda* (2005) and *McCallum* (2006) who discuss the problems of zero interest rate policies.
[5] See *Mises* (1912), pp. 97-123.

analysis. Section 6 concludes with some brief and sundry comments on the importance of holding central banks to the same standard as private businesses in affairs concerning its balance sheet. Our elaboration of central bank balance sheet analysis lays the foundation for a new method of monetary policy analysis.

2 The Quantity versus the Quality Theory of Money

Modern monetary economics emphasizes the use of the quantity theory of exchange in determining the purchasing power of money.[6] The simple quantity theory of money can be expressed by the Fisherian equation of exchange, $MV = PY$, where M is the quantity of money, V is its velocity (i.e., rate of circulation), Y is real output and P is the price index of this output. With V and Y assumed constant in the long-run, the quantity of money directly determines money's value (as the inverse of the general price index). Qualitative factors play no explicit role in the quantity theory of money.[7] In contrast to the supply focused quantity theory, the quality theory emphasizes the importance of qualitative factors for money´s demand and contrasts sharply with the simple quantity theory of money represented most famously by *Irving Fisher* (1911) and updated by *Milton Friedman* (1956).

The quality of money is defined as the capacity of a good to fulfill money´s three roles: to serve as a medium of exchange, store of value and unit of account. Quality is a subjective concept in the sense that users individually regard a good as capable of fulfilling money's functions to differing degrees. The subjective valuation of money can change without changes in the money supply. As the purchasing power of money may change due only to a shift in the demand for money, the subjective valuation of money can change even with the expectation of a constant money supply. For example, the backing of currency (i.e., central bank reserves) can change and, thus, affect the subjective valuation of the representative currency through, e.g., changing expectations as to the future rate of inflation or the ability of the central bank to act as a lender of last resort to the private banking system.

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[6] Alternatively, the "fiscal theory of the price level" emphasizes the role of the fiscal authority in determining the quantity of money the monetary authority will supply if the government's budget is not sustainable. See *Leeper* (1991). Thus, government deficits affect the future price level through central bank monetary policy aimed at keeping the government solvent. This chain of reasoning ultimately falls back to the quantity theory of money with changes to purchasing power occurring through the money supply-side channel. Similarly, *Reis* (2015) assesses the different types of insolvency the central bank can enter if it lacks fiscal support. Under all types, insolvency implies an infinite price level as the central bank attempts to recapitalize itself.
[7] *Howden* (2013) reckons that the equation of exchange does not even exhaustively list the relevant quantitative factors. Bank-created fiduciary media and loans on current account allow for a quantity of purchasing power to be generated *ex novo*, something which is not generally accounted for by the quantity theory.

As the quality of money improves and users value it more highly in relation to other goods, its purchasing power increases.[8] One result of increases in quality is, *ceteris paribus*, price deflation. When the quality of a good improves such that it moves higher up an individual's value scale, its price increases as a response to demand-side pressures. As the price (or value) of money is the inverse of the money prices of goods and services, price deflation will be promoted by improving quality of money. Unlike changes to the quantity of money, which are generally continual, changes in the quality of money can be very abrupt, leading to strong and sharp purchasing power changes.

A long history of qualitative and demand-side analysis predates the modern attention to supply-side factors determining money's value. Early authors such as *Juan de Mariana* (1609) and *Sir William Petty* (1662) illustrate this long tradition of the *quality* theory of money.[9] *Adam Smith* (1776) explains the origin of money by pointing to the importance of certain qualities such as a commodity's divisibility and durability. Similar discussions of the qualities of a "good" medium of exchange are found in the classic works of *Jean Baptiste Say* (1803), *John Stuart Mill* (1848), and *William Nassau Senior* (1850). *Carl Menger* (1871) explained the origin of money as a market process whereby commodities with certain marketable qualities prevail at becoming generally accepted exchange media. By the time *William Stanley Jevons* (1875) wrote his treatise *Money and the Mechanism of Exchange*, the characteristics or qualities of "good" money were generally known (and are still today summarily detailed in most introductory monetary economics texts). In spite of this early focus on the quality of money, attention on this aspect has all but disappeared. Despite most introductory texts stressing money's emergence in terms of qualitative factors (i.e., fungibility, divisibility, durability, universal want, etc), the quantity of money is regarded as the primary factor determining its value.

3 The functions and the quality of money

3.1 Determinants of the quality of money as a unit of account and medium of exchange

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[8] See *Bagus* (2009; 2015).

[9] For example, they regarded coin clipping not only as an increase in the quantity of money in circulation, but also as a reduction in its quality and as an unfair tax. Coin clipping was an early form of inflation. Corners, or edges, of coins were literally "clipped" off to lower a coin's unit weight. The invention of the serrated edge on coins exposed this act, and reduced its prevalence.

The quality of money differs depending on which of its three functions it is fulfilling. The unit of account function is relatively stable under conditions of low and stable inflation. It changes abruptly only in hyperinflations, as users begin to calculate in alternative media. During the German hyperinflation in the early 1920s, for example, Germans began to calculate in gold marks or foreign exchange. The recent Zimbabwean hyperinflation (which culminated in November 2008 with a monthly inflation rate of 80 billion percent) led entrepreneurs to price goods in units other than their own devalued currency, preferring to unofficially set prices in a more stable standard, i.e., U.S. dollars.[10]

The classical economists analyzed money´s medium of exchange function extensively. The following conditions better satisfy this function: lower costs of transportation and storage, easier divisibility, greater recognizability, stronger durability, and superior homogeneity of the money units. Economists of the past focused on finding natural commodities to satisfy these conditions. Today´s modern economy is based on fiat money which fulfills these demands well (almost perfectly well).

3.2 Determinants of the quality of money as a store of value

The store of value function must be treated more extensively. Users store some of their wealth in the form of the most marketable good to use later in purchasing goods and services.[11] The better a good conserves its value, the better it will serve the larger function, ceteris paribus, as money. Despite their broad demand, perishable goods such as milk or eggs function poorly as stores of value, explaining why they fail to prevail as money.

The quality of money in its store of value function can essentially change in five ways.

First, an important influence on money´s quality is the evolution of its quantity. The modern fiat monetary system based on paper currencies can experience important quantitative changes. It can deteriorate through inflation to such an extent that a money is eventually demonetized. This is achieved by altering the degree to which fiat money´s store of value

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[10] Money's other uses may take on increased importance, or be abandoned, during a currency crisis. During the Weimar hyperinflation money lost its roles in the following order: first it ceased to be a store of value, second it failed to be a unit of account, and lastly it ceased to be a medium of exchange. See *Röpke* (1937), pp. 103-104. In practice, avoiding inflation by switching to an alternative medium of exchange is the most difficult of the three roles to substitute for. See *Bagus et al.* (2014).

[11] See *Menger* (1871), p. 278.

function is maintained. The store of value function is mainly, but not exclusively, influenced by the quantity of money in existence today or, more importantly, the quantity expected to exist in the future.[12] Expectations concerning the evolution of the quantity of money are not the only factor influencing money´s store of value function.

Second, changes in redemption ratio may influence the quality of money while the expectation concerning the future quantity of money remains constant. Consider two situations: a dollar bill can presently be redeemed for 1/20 of an ounce of gold and at a future date this redemption ratio is changed to 1/35 of an ounce of gold, or 1/20 of an ounce of silver, or redemption is suspended altogether. The quantity of money circulating is not changed by this act although its role as a store of value is affected negatively.[13]

Redemption changes may influence the valuation of the currency unit in relation to other goods even if expectations concerning the future quantity of money remain constant. Users may not value the currency unit as highly in relation to other goods as they would have without the change in the backing of the currency. Alternatively, the course of a war can influence the value of a currency as the end of a government can mean the end of the currency, i.e. the redemption ratio may be expected to fall to zero. *Henry Hazlitt* provides an example from World War II concerning events that influenced the quality, but not the quantity, of money: "One of the most striking illustrations of the importance of the quality of the currency occurred in the Philippines late in World War II. The forces under General Douglas MacArthur had affected a landing at Leyte in the last week of October 1944. From then on, they achieved an almost uninterrupted series of successes. Wild spending broke out in the capital of Manila. In November and December 1944, prices in Manila rose to dizzy heights. Why? There was no increase in the money stock. But the inhabitants knew that as soon as the American forces were completely successful their Japanese-issued pesos would be worthless. So they hastened to get rid of them for whatever real goods they could get."[14]

Third, the quality of money in its store of value function is also influenced by the general condition of the banking system. An illiquid banking system increases the risk of a bail-out

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[12] See *Hazlitt* (1978), p. 75.
[13] Changes in the redemption ratio are historically followed by increases in the quantity of money. *Bagus* (2008) discusses the quality of money and the cessation of specie payments for greenbacks. *Rothbard* (2002) provides an historical account of the halting of specie payment.
[14] See *Henry Hazlitt* (1978), p. 76.

that ultimately increases the quantity of money. Deterioration in the conditions of the banking system can be detected on the central bank´s balance sheet, e.g., by sharp increases in overnight lending or loan rates. Any deterioration decreases the quality of money and generates expectation-based inflationary pressures.

Fourth, the organization of the monetary authority is also of the utmost importance for the quality of money. A central bank receiving directives directly from the government increases the danger of monetizing government debts. Thus, when a formerly "independent" central bank loses its independence, the quality of money is changed instantaneously.[15] A government increasingly trying to influence the decisions of an "independent" central bank may deteriorate the quality of money without commensurate changes in the quantity of money circulating.

Changes in a central bank´s constitution (i.e., its philosophy or doctrine) may lead to changes in the quality of money. Assume, for example, that a central bank changes its stated target growth rate of the money supply from 5 to 10 percent. The announcement instantaneously changes the quality of money through increased inflationary expectations. If a central bank abandons a rule-based monetary policy and switches to targeting asset prices, this change will also immediately influence the quality of money as a store of value. Additional central bank objectives such as full employment or financing educational expenditures influence the quality of money. If the constitutional objective is originally price stability and it is changed to include ancillary aims (e.g., full employment, increasing asset prices, maintenance of a currency union, etc.) this will affect the quality of money: the aim of price stability might be less forcefully pursued compared to another goal. Uncertainty ensues with the business community unsure what the dominant aim of the central bank will be.

The staff of the central bank is also relevant for the quality of money. Central bank chairmen influence monetary policy primarily through building consensus, a role which directly

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[15] As central banks primarily hold government debt, independence may be tenuous at best (*Buiter* (2008), p. 6). On the "myth" of the independence of the Federal Reserve from the United States' government, see *DiLorenzo* (2014). An example of a central bank that recently succumbed to stronger political influence is the European Central Bank (ECB). During the Eurocrisis, the ECB started to bail out Eurozone governments by accumulating their debts. Instead of focusing on its existing mandate of maintaining the purchasing power of money, the focus shifted on holding the Eurozone together and financing politically motivated bailouts (*Bagus* 2012).

impacts the credibility of a proposed monetary policy.[16] The substitution of a conservative chairperson for a new, dovish one known to have an inclination toward expansionary monetary policy will reduce the quality of money based upon this inflationary expectation the day when this substitution is announced, irrespective of any changes in the money supply.[17]

3.3 The quality of the central bank´s balance sheet as a determinant of the quality of money

The fifth reason for changes in the quality of money in regard of its function as a store of value is a change to the reserves and assets of the central bank.[18] As central bank is the most relevant determinant of the quality of money for the purpose of this article, we treat it separately. In contrast to the soft factors mentioned above, the assets of the central bank are objective factors that can be assessed directly by analyzing its balance sheet. The monetary base, for example, can be observed directly as the central bank's non-equity liabilities.

The quality of money can be analyzed indirectly by the assets that back the monetary base. The average backing asset of the monetary base is essential for the quality of money and is recorded on the balance sheet. In a fractional-reserve banking system the average backing of the currency in circulation can decrease or increase as the monetary base changes. The average quality of the backing assets increases when newly bought assets are of a higher quality than the average of the existing assets. The average quality of the backing assets decreases when newly bought assets are of a lower quality than the average existing assets, a process known as "qualitative easing." [19]

The significance of the quantity of money for the quality of money should not be overestimated. Quantitative changes to the monetary base adversely affect the quality of money as its backing reserves may be diluted. However, the quality of the assets of the central

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[16] See *Gerlach-Kristen* (2008). *Axilrod* (2009) gives a detailed account of how Federal Reserve chairmen from *Martin* through *Bernanke* have been instrumental in effecting monetary policy through charisma and consensus.
[17] As a thought experiment, imagine what would have happened to the U.S. dollar´s value had *Alan Greenspan* not been succeeded by *Ben Bernanke* in 2006, but was replaced by the Governor of the Reserve Bank of Zimbabwe, *Gideon Gono*.
[18] See *Cunningham* (1992).
[19] See *Bagus/Schiml* (2009).

bank can change even with a constant money supply as the central bank substitutes its high quality assets by purchasing lower quality assets.

Central bank assets are important as they serve as collateral for its liabilities and "back" the currency. Even though in most fiat money regimes there is no legal obligation to redeem the currency against the central bank's assets, the assets represent the capacity of the central bank to defend the price of the currency domestically as well as internationally in foreign-exchange markets. The central bank can, for example, use its reserves to support its currency through foreign-exchange interventions.[20] Central bank use of reserves is a *de facto* redemption – reserve assets are used to purchase currency and users redeem their currency units against the reserves.

Additionally, the central bank may use its assets to support the banking system. Buying troubled assets from the banking system against good assets held by the central bank may restore confidence in the banking system's solvency. Only if the central bank owns a sufficient amount of high quality assets can it credibly swap them with the banking system. The quality of the central bank´s assets is important for its capacity to credibly support a struggling banking system. Under some plausible though unusual scenarios, central bank assets can be used in the case of monetary reform. (Such reforms were widespread amongst ex-Soviet bloc countries after 1992-93 and with the dissolution of Czechoslovakia in 1991.) The higher the quality of the assets, the better will be the backing of the new money (and resultant confidence in it).

The importance of the central bank's assets is revealed *in extremis* during a collapse of the currency. A break-down of the monetary system reduces the value of its currency. Meanwhile, the assets of the central bank may retain value and can be given to the creditors and currency holders, or used in exchange for imports. Currency holders prefer, ceteris paribus, a central bank that holds liquid assets (i.e., foreign exchange or gold) as its main reserves to a central bank that holds illiquid assets (i.e., subprime mortgages) in the case of a monetary breakdown. Insolvency will occur only in rare cases since the domestic government

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[20] Central bank cooperation may also improve the quality of a currency. When inter-central bank swaps are secured speculative attacks on a currency may be deterred.

or foreign creditors such as the IMF can recapitalize the central bank.[21] Government recapitalization of the central bank is generally financed through debt ultimately funded by monetary expansion. Deterioration of a central bank´s assets increases the danger of a recapitalization by a monetary expansion. This in turn decreases the quality of money as a store of value as inflationary pressures ensue.

Expectations play an important role for the quality of money. We previously looked at how institutional changes, staffing alterations and future policy directions all influence the quality of money through expectations concerning their changes. Expectations can also change concerning the quality of the currency's backing. Assume that a central bank sells gold reserves to buy mortgages of dubious quality. The quality of money is changed without a concurrent change in its quantity. Currency users can expect that the central bank's liabilities, i.e., mainly currency and member bank reserves, will be backed by assets of a decreased average quality. The recent Icelandic crisis illustrates this point.[22] The króna fell sharply even though the money supply did not increase correspondingly. It became apparent that the banking system´s liabilities were backed by low quality assets. Lacking a sufficient amount of quality assets, the central bank could not compensate the losses incurred by the banking system. The central bank was unable to be recapitalized by the Treasury as the creditworthiness of the Icelandic government was already negatively shaken. The market realized that the Icelandic króna was backed mainly by credits to an insolvent banking system and that the central bank and the banking system could not be saved by the domestic government.[23] The króna collapsed and the inflation rate increased without a correspondent change in the quantity of money.

The assets of the central bank have very important implications concerning the quality of its representative money. The historical evolution of the central bank's assets is summarized on its balance sheet. By combining the logic of balance sheet analysis used primarily for private

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[21] See *Bagus/Howden* (2014a; 2014b).*Fry* (1992) and *Buiter* (2008) discuss the possibility and repercussions of central bank insolvency. *Bagus/Howden* (2009) discuss differences pertaining to the recapitalization of the Eurosystem versus the Federal Reserve System.
[22] See *Bagus/Howden* (2011); (2015).
[23] Central banks functioning as lenders of last resort in economies heavily indebted in foreign currency face strict disadvantages. See *Buiter/Sibert* (2008). As foreign currency liabilities take an increasing share of the banking system, the central bank becomes increasingly impotent at combating currency and banking crises through expansionary monetary policy.

businesses with the quality theory of money we may generalize a method of balance sheet analysis specifically for central banks. [24]

4 Derivation of balance sheet ratios for central banks

A central bank's financial ratios are important for two reasons.[25] They indicate the ability to defend the value of a currency, e.g., on the foreign-exchange market, by representing de facto exchange possibilities via the currency´s backing assets. They also portend the danger of central bank insolvency which would presumably be prevented by a recapitalization by the government. Any rescue will likely deteriorate the quality of money through quantitative expansion.

The quality of money is made measurable and objective, to a certain degree, by these ratios. Unfortunately monetary policymakers are motivated by certain interests that may not be conducive to the full disclosure or transparency of all balance sheet items.[26] They may restrain the publication of pertinent or timely information in order to influence behavior from these communications.[27] Any central bank balance sheet analysis should attempt to uncover these discretionary policies and guarantee a policy-neutral disclosure of the actual situation. The situation of different central banks could be compared by standardized accounting practices for the purposes of a peer group comparative analysis.

One caveat in international comparisons of accounting statements is the lack of homogeneous data. International balance sheet comparisons are fraught with peril owing to diverse accounting traditions and standards which vary from country to country.[28] Banks and insurance companies generally operate more opaquely than other firms leading to much disagreement and uncertainty concerning their asset and liability values. This opaqueness remains even in a shared regulatory environment. Broader acceptance of the International

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[24] For another fruitful combination of business management and economics, see *Olbrich/Quill/Rapp* (2015), who apply economic subjective value theory to business valuation.
[25] Early central bank balance sheet analysis is found in *Hayek* (1925) and *McKean* (1949). More recent approaches have been sparse, although *Mishkin* (1978) and *Kiyotaki/Moore* (2002) look at financial crises as contagions spread through balance sheet shifts.
[26] See *Verrrecchia* (2001).
[27] A recent shift towards more transparency through central bank communications has occurred (*Geraats* 2009), with *Eijffinger/Geraats* (2006) providing an index to measure the transparency of distinct central banks. *Geraats* (2007) argues that there is still an optimal amount of opaqueness to central bank communications provided that objective targets for policy directions remain clear.
[28] See *McLeay* (1991); *Sherman/Todd* (1997); *Serrano/Cinca et al* (2002).

Financial Reporting Standards (IFRS) allow for a better comparison of balance sheets internationally and across different industries.[29] With this caveat in mind, we now define strength, liquidity, and equity ratios necessary to analyze the financial stability of a central bank.

International strength ratios indicate a central bank´s potential to defend the external value of a currency (i.e., the foreign-exchange rate). We define the "defense potential ratio" as the ratio of the foreign-exchange reserves (excluding gold, if applicable) to the monetary base. It portrays the percentage of monetary liabilities that are backed with foreign reserves available to be used to defend the currency on the foreign-exchange market. Selling foreign reserves on the open market and purchasing domestic currency can support the value of the currency in times of crisis or speculative attacks.

$$Defense\ potential\ ratio\ [\%] = \frac{foreign\ reserves}{monetary\ base}$$

Second, the "external strength ratio" is defined as the ratio of the foreign-exchange reserves of a central bank to total world foreign-exchange reserves, i.e., the total of foreign-exchange reserves held by *all* central banks of the world.

$$External\ strength\ ratio\ [\%] = \frac{foreign\ reserves}{total\ world\ foreign\ reserves}$$

The higher the share of total world foreign-exchange reserves that a central bank owns the greater will be the potential to defend the currency internationally. There results a higher degree of external strength as the central bank controls a higher portion of available reserves *vis-à-vis* other monetary authorities. It may also indicate the previous strength of a currency area to generate exports (and thus accumulate foreign currency as the central bank sells domestic currency to facilitate the cross-border transactions), benefiting the quality of money through increased trade-based demand. If a currency area is competitive it is easier to generate foreign-exchange reserves that can be used to defend the currency.

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[29] See *Barth/Landsman/Lang* (2008).

The external strength ratio also indicates the danger of a flight from a currency as a reserve currency. It is possible that a central bank´s share of total world foreign-exchange reserves falls because foreign central banks accumulate its currency. A central bank which unilaterally increases its currency supply which is then bought by foreign central banks will experience a decline in its external strength ratio. (This outcome was prevalent throughout the Bretton Woods era, and the culmination of this loss of external strength was the end of the gold exchange standard in 1971.) This arises as world currency reserves increase by the expansionary monetary policy while its own foreign-exchange holdings do not. The danger of future sales of this expanded currency supply rises, with a commensurate reduction in its quality. Thus, the large reserves of, e.g., the central banks of China and Japan create a potential danger for the U.S. Dollar. They may, for example, sell their dollar holdings and depreciate the American currency. A rising share of world foreign reserves indicates that a central bank can defend its currency more effectively against such speculative actions.

Alternatively, the external strength ratio is also relevant for a country whose currency is not a world reserve currency. The higher the dollar reserves of the central bank of Russia in relation to the world dollar reserves, the higher its capacity to defend its own currency from speculative attacks.

The "external impact" ratio is defined as the foreign reserves of a country divided by the overall daily trading volume in foreign-exchange markets of those reserves.

$$External\ impact\ ratio\ [\%] = \frac{foreign\ reserves}{foreign-reserve\ daily\ trading\ volume}$$

The dollar reserves of a central bank divided by the total daily trading volume in foreign-exchange markets is one important external impact factor. It indicates the capacity to influence the exchange rate as per general market, and especially trading volume, considerations. Traditionally the external impact factor for U.S. dollars has been rather low due to its widespread international use and demand; the external impact factor for gold and other less frequently demanded currencies tends to be higher. Low external impact factor values imply that large volumes of a currency may be traded with little effect on the prevailing exchange rate, thus bringing stability to a currency against speculative attacks.

The higher the share of liquid and high quality assets in the central bank's reserves the higher the quality of money will be. Gold and high quality currencies are generally considered very liquid. These prices may be volatile, but they do not face credit risk. The share of government bonds is important when assets are viewed in terms of credit risk. High quality government bonds (i.e., U.S. Treasury bills) enjoy a very large and liquid market enabling them to be sold *en masse* without losses through increased bid-ask spreads. Credit risk is also low.

Consequently, we can define another group of ratios: liquidity ratios I, II, and III. An asset is considered more liquid the lower the costs incurred during a high volume sale. During a crisis, liquid assets can be used to support a faltering currency. The higher the liquidity ratio the lower the portion of illiquid assets held in reserve. Illiquid assets are problematic as they cannot be sold in high quantities during normal market conditions (without suffering a widening bid-ask spread), and may find no buyer under panic conditions. The higher the share of illiquid assets the lower will be the liquidity ratio. The quality of money will likewise be reduced.

Gold has traditionally held the coveted position as a highly liquid asset and this is especially apparent during economic or banking crises. Important qualities had helped it to retain the position as the dominant world currency until the early 20th century. Gold can be sold in high quantities without adverse bid-ask spreads as it is always and everywhere demanded (even experiencing heightened demand during times of crisis). In contrast to other non-money financial assets, gold has no credit risk as it does not represent a debt.

Liquidity ratio I reports the percentage of assets that are readily saleable and which do not represent a debt. Typically this is limited to the share of gold in the central bank assets.[30]

$$Liquidity\ ratio\ I\ [\%] = \frac{gold}{monetary\ base}$$

[30] Gold is the most common central bank commodity holding. This need not always be the case. It is foreseeable that a central bank could stockpile other commodity holdings, such as silver, platinum, or other valuable metals. Due to gold's near universal acceptance in central bank reserves, we focus exclusively on this factor in liquidity ratio I.

Liquidity ratio II compares the sum of gold and foreign-exchange reserves in relation to total assets. Foreign-exchange reserves are normally very liquid as they are traded daily in large volumes. Their value is less assured than gold since credit risk implies that their value can theoretically be reduced to zero in extreme cases. Downward pressure exerted by central banks on the gold price is limited by their gold reserves, while central banks can devalue their own currency to virtually zero through inflationary policies.

$$Liquidity\ ratio\ II\ [\%] = \frac{gold + foreign\ reserves}{monetary\ base}$$

Liquidity ratio III includes high quality government bonds with a low default risk (e.g., AAA rated) with the previously mentioned liquid assets: gold and foreign reserves.

$$Liquidity\ ratio\ III\ [\%] = \frac{gold + foreign\ reserves + government\ bonds}{monetary\ base}$$

High quality government bonds typically remain liquid during times of crisis. Turbulent markets may, in fact, invoke a flight to safety increasing their demand. The value of such bonds is backed by the government´s taxing power and ultimately by the productivity of the economy. An excessive issuance of government bonds will reduce their value. Government deficit spending reduces the quality of money by implying the danger of higher future taxes or the danger of debt monetization.

Government bonds can become illiquid if the creditworthiness of the government becomes questionable, especially during extreme crises. During the recent economic crisis a recapitalization of the Icelandic central bank with Icelandic government bonds could not have increased the quality of the króna sufficiently to save the banking system. The taxing effectiveness of the Icelandic government was insufficient to provide liquid assets to back the currency.

The last ratio we discuss is the equity ratio. The equity ratio indicates the central bank´s leverage. A higher ratio implies a more conservative situation (i.e., less leverage) and an increased quality of money.

$$Equity\ ratio\ [\%] = \frac{equity}{total\ assets}$$

Potential losses on the asset side of the balance sheet can be cushioned by available equity and thus prevent a government initiated recapitalization which may potentially increase the quantity of money. Additionally, recapitalization can lead to an increase in debt with further negative consequences for the quality of money.[31]

5 Additional considerations

As important a consideration of the ratio in question is the task of identifying an acceptable range of values. At the one extreme, various ethical and legal considerations warrant a return to full-reserve banking.[32] By keeping full gold reserves against the monetary base, liquidity ratio I would take an ideal value of 1. Indeed, no central bank would be necessary to sustain a full-reserve banking system.

It is not possible to establish some gold rules for the ratios we develop. We can only make the qualitative assertion that the higher the liquidity ratio, equity ratio, defense potential ratio, etc. the better for the quality of a currency. Due to the subjectivity of the concept of the quality of money there can be, for instance, no objective threshold at which there necessarily would be a hyperinflation or devaluation. The ratios represent objective determinants for the quality of money. However, they influence also the subjective assessment of the currency. No deterministic relationships may be established, especially in a fiat currency system where the value of the currency is wholly based on trust.

There are some further caveats and comments. First, other ratios could be considered. Ratios involving repurchase agreements or discount activities could be calculated with the appropriate adjustments for each individual central bank. The quality of the collateral for the repurchase agreements and discount activities are also important for the quality of money, as are the amount of direct credits to financial institutions, the quality of such guarantees and the potential for haircuts.

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[31] *Bagus/Howden* (2014a; b) assess the methods and costs of a central bank recapitalization.
[32] See *Huerta de Soto* (2006); *Bagus/Howden* (2009c; 2013); *Bagus et al*. (2013).

For example, the longer the term of the securities used as collateral or guarantees, the more illiquid they tend to be. Loans granted by the central bank to the banking system are typically illiquid assets that cannot be used to defend the currency. Moreover, they contain greater credit risk than government bonds. If banks are allowed to use securities of dubious quality instead of government debt as loan collateral the quality of money decreases. The calculation of a collateral ratio can complement the analysis, but is more difficult to objectively define and consistently apply.

It may be necessary to calculate an adjusted equity ratio as the central bank balance sheet may contain hidden reserves or burdens. This can be done via a revaluation reserve without influencing the central bank income statement. For example, the gold reserves held by the Federal Reserve consisting of 8,134 tons are valued at the historical price of $42.44 per troy ounce. Its current market value is approximately 30 times higher, implying substantial hidden reserves. Conversely, it is possible that impending write-downs of assets have not yet taken place.[33] This possibility presents the balance sheet in an artificially advantageous way.[34]

Finally, asset transparency should be considered in any analysis. First, the exact quality of the accepted guarantees and collateral is important. Second, the naming of the debtors increases transparency. The Federal Reserve's Term Auction Facility (TAF), introduced at the beginning of the financial crisis and concluded in March 2010, hid the identity of the users of such programs as well as the quality of the collateral. This has led to complaints of non-transparency.[35]

No supervisory institution akin to private rating agencies exists for central banks. Central bank balance sheets are also very heterogeneous lacking a standard set of reporting guidelines. Transparency can be improved by providing an appendix and financial reporting similar to the disclosures which are now standard practice among their corporate counterparts.

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[33] As was the case during Iceland´s crisis in 2008-09, when loans held as assets by the Central Bank of Iceland were recorded at their historical cost instead of their (lower) market value (*Bagus/Howden* 2015).

[34] An analysis of a central bank's balance sheet should aim to eliminate the manipulations implied in monetary policy reporting as far as possible and make balance sheets of different central banks comparable by using current market values of assets.

[35] See *Pittman* et al. (2008) and *Pittman* (2008). *Bagus/Howden* (2009a) analyze the responses from the ECB during the recent financial crisis, especially focusing on the uncertainties stemming from non-transparent assets. *Dincer/Eichengreen* (2009) argue that central bank transparency has increased substantially during the past decade, becoming the "greatest change in the conduct of monetary policy."

6 Conclusion

While accounting and balance sheet analysis are well developed for the business community, few bank specific balance sheet analyses exist. More egregiously, a framework for analyzing *central* bank balance sheets is missing altogether. This is especially problematic since new monetary policies used by central bankers are continually developed and their results are as yet difficult to ascertain. Balance sheet analysis is especially apt for those policies as they are not reflected so much in interest rates as they are in changes to the size and composition of asset holdings.

An analysis of a central bank's balance sheet conveys important macroeconomic implications. In the case of a central bank, stakeholders are all those counterparties holding its obligations. These stakeholders are the holders of cash who use this money for payments, or whose bank deposits are covered by reserves held at the central bank. For money users it is important to know which real assets back and constrain the money supply. Surprisingly, there is little supervision for reporting bank asset and liability balances. This dualism in accounting standards – highly developed standards for the private business community versus lax or absent ones for central banks – is problematic.

We have developed a foundation for the previously missing method of central bank balance sheet analysis. Starting with the quality theory of money, we have derived seven different balance sheet ratios, differentiating between defense, liquidity, and equity ratios as proxies for the quality of the assets backing a currency. Important caveats include the lack of transparency concerning central bank reporting, and also the effects of hidden reserves on or off the balance sheets of a central bank.

Detailed balance sheet analysis is justified as a central bank's assets are closely connected with the value of its currency. The assets of the central bank back its obligations, comprised mostly of the monetary base. An analysis of a central bank´s balance sheet can indicate future directions in monetary policy, money's ensuing quality, and how these factors are able to influence the expectations of households and firms. This analysis can serve, therefore, as an early warning for future financial crises and inflationary trends.

Since the beginning of the liquidity crisis of 2008 central banks around the world have not only increased the size of their balance sheets but also significantly altered their compositions. Important challenges have resulted. First, it is important to analyze the consequences of the crisis for the individual central banks and compare them accordingly. Second, relevant insights may be deduced by comparing balance sheets of central banks during the financial crisis to historical parallels like the Japanese bubble of the late 1980s or America´s Great Depression. Finally, our own approach to analyze central bank balance sheets must be continually improved by focusing on present events and developments to monetary policy. We have created the necessary framework to analyzing future changes in monetary policy. We leave empirical applications – both historical and current – to future research.

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