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Abstract

Central bank independence is a multifaceted institutional design. The financial component has been seldom analysed. This paper intends to set a comprehensive conceptual background for central bank financial independence. Quite often central banks are modelled as robot-like maximizers of some goal. This perspective neglects the fact that central bank functions are inevitably deployed on its balance sheet and have effects on its income statement. A financially independent central bank exhibits the adequate balance sheet structure and earnings generation capacity to efficiently perform its functions. From a long-term perspective, as far as the demand for banknotes is maintained seignorage waters down any central bank financial independence concern. However, from a short-term perspective central bank financial vulnerability may condition its effective independence. Vulnerability may be real or accounting based. However, no matter its origin, institutional solutions are needed to minimize their impact. Adequate capitalization turns out to be a key issue. Alternatively, contingent capital in the form of institutional arrangements to bear central bank losses may be a (second-best) solution. The paper analyses in the context of simple VAR model the interplay between capitalization, accounting rules and dividend distribution. This analysis is preceded by a thorough discussion of the risk-return profile of central banks net return on assets. Three main conclusions shape the input to the capitalization model. Central banks return on assets can be very volatile from a short term perspective. From a medium term perspective, natural earnings generation cycles dampen down volatility. On average, central banks net return on assets typically exhibits a discount over government debt financing cost. These observations shape the central bank financing planning problem as follows. Namely, the size of the discount relative to the social costs that would arise in case of a lack of central bank independence, along with central bank exposure to risks and the volatility thereof, determine the incentives of the government to maintain an excess of financial assets in the form of central bank capital. Actually, the working of smoothing mechanisms operating across time on central banks earnings leads to a distinction between short-term and medium term capital, i.e. the optimum capital solution is a band. In the same vein, the need to maintain optimal consistence between central bank financial strength and dividends distribution policy leads also to smoothing proposals for pay-out policy.

1. Introduction

Central bank independence has become one of the central concepts in monetary theory and policy. Most economists agree that central bank independence is desirable because it helps to reach the long term goal of price stability. The idea has also found confirmation in the fact that more and more countries in the OECD and beyond have made their central banks independent.

Different theoretical arguments have been provided to justify central bank independence. Rogoff's solution to time inconsistency problems in monetary policy has been credited as a necessary argument for central bank independence. Further analysis has challenged this view on different perspectives, although the positive assessment of insulation from the political domain is, generally speaking, maintained. An interesting departure from the seminal argument for central bank independence is Eggertsson and Le Borgne (2003), who defend it as the sort of institutional framework that allows the emergence of a body of professionals fit to perform a complex and long-term oriented task like monetary policy. Independently of its justification, the need to reconcile insulation from the political arena and sources of political sovereignty has also granted central bank accountability a prominent role in central bank theory and practice.

The theoretical dispute on the factual determinants of central bank independence seems not to have found an expression in the statutory requisites for central bank independence. Practice and academic literature are almost unanimous in assessing central bank independence on the basis of a number of key factors, no matter if disagreements come to light on their degree of exogeneity. The following factual categories of institutional freedoms have been typically judged as characterizations of the degree of central bank independence:

1. Legal independence
2. Goal independence
3. Operational independence
4. Financial independence

Legal, goal and operational factors that contribute to central bank independence have been extensively discussed in the literature due to their influence on monetary policy decision making. It is thus widely accepted that institutional features aimed at granting legal independence to the central bank must ensure its undisputed authority to fulfil a clear monetary policy mandate. In turn, this normally entails the adoption of central banker appointment schemes that intend to insulate their decisions from political meddling in normal times.

Independence in the operational domain is understood to be equivalent to having wide discretionary powers to effectively implement monetary policy goals. Operational independence typically requires interest rate setting to be under the umbrella of the central bank. Exchange rate policy formulation tends to be a more contentious issue. However, no matter the legal attributions in place as regards monetary and exchange rate policies, their dual nature is understood to imply that conflict resolution procedures exist that endorse the priority of the central bank instrument.

The wide coverage in the literature of factors striving central bank independence surprisingly contrasts with the limited attention that has been paid to determinants of central bank financial independence. This fact does not proof that central bank financial independence is unimportant. Rather it turns out to be the case that generic financial independence aspirations occupy a prominent role in most central banks' statutes. Moreover, issues pertaining to central bank financial independence have reached the public debate in a range of countries, but most prominently in Finland, Japan and Switzerland.

The purpose of this paper is to make a contribution to fill the existing gap on central bank financial independence issues. A good starting point to achieve that goal is a comprehensive definition of central bank financial independence. One that emphasizes its ultimate purpose has been proposed by Stella (2002). A financially independent central bank or, equivalently, a financially strong central bank is one that possesses sufficient resources to attain its fundamental policy objectives. This notion of central bank financial independence can be reformulated in the following equivalent terms. A financially independent central bank exhibits the adequate balance sheet structure and earnings generation capacity to efficiently perform its functions. Similarly, the central bank financial independence domain can be understood to encompass the study of any disturbing influence on central banks optimal behaviour due their financial "corporeity".

The definition is intentionally broad. Ultimately, its breadth is a reflection of the complex nature of real-world central banks, unlike assumptions made in standard monetary policy models that tend to represent them as robot-like maximizers operating in some "vacuum". Such broad perspective allows to systematically deal with a range of potential constraints for central bank behaviour due to their financial materiality, i.e. to balance sheet and income statement driven effects.

Dealing with central banks balance sheet adequacy requirements in its entirety is outside the scope of this paper. Any abstract discussion on this topic can just with big difficulties descend to practical recommendations. They quickly become shadowed by the influence of a myriad of institutional and contextual issues. However, it is still very relevant to ask whether a sort of Modigliani-Miller irrelevance proposition applies to the composition of central bank assets. A negative answer, as it turns out to be the case from a theoretical perspective, sets a very general reference for the discussion of central banks financial shape. However, the fact that monetary policy effectiveness is based on its impact on financing conditions in the margin leads in practice to ample scope for diversity in central banks balance sheet profiles.

Asset composition determines to a large extent a central bank's risk-return profile. The naïve notion prevails that central banks enjoy a stable and voluminous source of earnings. Admittedly, this may be largely so most of the time. That explains why central banks have traditionally been a political target under the fiat money era: the extraction of rents derived from their monopoly over money production (seignorage) entails no apparent costs. To a large extent, the process towards central bank independence amounts to a ward against those temptations. Independence statutes have recognized the need to preserve such primary dimension of central bank financial independence.

However, the scope for financial-mediated political influences is not limited to direct recourse to central banks' vault. Free decision making by an otherwise independent central bank could be jeopardized if financial vulnerability on its side might transform it into a ductile sort of institution. Notice that decision making distortions by a financially vulnerable central bank might arise even without explicit external interference. Self-restraint in the adoption of monetary policy measures which, if implemented, could drive the central bank to a situation of financial distress may also be an indirect source of lack of independence.

From this perspective, this paper deals with the sources of central bank vulnerability as well as mechanisms needed to cope with it. The position is held that outright central bank capitalization is the optimal solution, although it also highlighted that enforceable contingent capital[1] may also be a second-best alternative. A model of central bank capitalization is proposed on the basis of its capacity to offer a cushion against political meddling in moments of central bank financial weakness. The model balances in a VAR-like optimization framework the social costs of having to

[1] The term contingent capital refers to institutional arrangements between the government and the independent central bank whereby the former assumes the enforceable commitment to cope with central bank losses if they ever take place.

yield to government's pressures in exchange of fresh funds in a situation of financial weakness, against the financing costs of the extra debt needed to fund central bank shares. Both excess and deficit of capital have proved to be in practice a problem for some central banks. Balance sheet structure proves to play a key role in the solution.

The model intends to be realistic in the representation of a central bank chief financial officer's problem. From a policy perspective, the main conclusion of the model is that the society has to endow the central bank with the capital necessary to efficiently perform its duties. From a practical perspective, the model formulation and the discussion of sources of central banks financial vulnerability preceding it can serve as a guide of issues arising in central bank financial planning. Therefore, the paper places substantial emphasis on the discussion of the conceptual issues surrounding any central bank risk budgeting exercise.

Financial vulnerability can be real or just apparent. As regards the second alternative, it is well known that accounting policies may play an important role either to moderate or to exacerbate earnings volatility. As a confirmation of this observation, some central banks have lately needed to adjust their accounting policies in order to limit the accounting-driven unreal perceptions of vulnerability. The paper also focuses on the different roots of central bank real financial vulnerability: un-hedged currency exposures, interest rate risks, banknote-driven balance sheet volatility, contingent commitments that belong to the core duties of central banks, services provision without a cost recovery policy etc. In other words, central bank financial vulnerability is determined by the inter-temporal risk-return profile that arises from a complex set of central bank on- and off-balance sheet exposures. The emphasis on the inter-temporal perspective is crucial. It allows differentiating between apparent and real financial vulnerabilities and determines the band-like nature of the optimal capital solution as well the dividends smoothing proposition.

Once an optimal degree of central bank capitalization has been justified, a closely linked problem arises. It is, so to say, the reverse side of the central bank equity problem: namely, a solution must be found to the problem on how to distribute central bank profits so that the legitimate rights of its shareholders to receive dividends and the central bank capitalization optimum are compatible.

The apparent lack in practice of single solutions to the central bank financial structure and policy problems can be justified on different practical grounds, but most particularly on the existing diversity of accounting models for central banks. With one exception, this paper does not take a position on central bank accounting issues. It takes for granted that accounting should reflect the economics of the institution that it intends to portray. However, consistent with this assumption, a defence will be made of a particular divergence of central bank accounting from conventional standards, so that financial independence becomes a feasible goal. Namely, the feasibility of the capitalization optimum can be just safeguarded if distributable profit does not necessarily encompass all income generated. The rationale for this argument is straightforward: whereas general purpose accounting principles are aimed at serving decision taking by managers and shareholders, the very definition on an independent central bank, based on the negation of government involvement in its operations, supports the construction of a distributable profit metrics that leaves no margin for some erosion of central bank strength. A joint implication of this departure from general purpose accounting principles, together with the existence of earnings generation cycles for some central banks, will be some degree of profits smoothing.

An essential counterpart of having independence from the government is accountability. Financial independence involves special transparency and accountability requirements. Some of them will be highlighted as appropriate in the paper. Actually, financial accountability concerns implicitly underlie the fact that the problem discussed in this paper is currently a topical one. The adoption by central banks of financial reporting practices originally conceived for commercial financial

institutions, like accounting standards close to market value ones, has magnified the image of central banks as financial vulnerable entities. This being said, it is nevertheless important to emphasize that the whole range of challenges posed by central bank financial and/or operational accountability are outside the scope of this paper.

The paper is organized as follows. Section 2 makes a short conceptual "excursion" through monetary economics, with the focus placed on fiat money: its backing, its inherent inflationary bias and its institutional solution, i.e. central bank independence. Section 3 identifies the main financial-based risks to central bank independence. Section 4 deals with the interplay between central bank mandate, earnings generation capability and financial vulnerability. Section 5 develops a simple Basel-like model of central bank equity and discusses its practical implications. Section 6 deals with profit distribution and accounting, the complementary pieces to achieve optimal central bank capitalisation.

2. From Monetary Economics to Independent Central Banks: A Short Theoretical Excursion

2.1. Money and central bank corporeity

The basis that defines central bank activity is obviously money. Although purely from a formal perspective, it is nevertheless relevant to start the discussion on central bank financial independence raising the question on the material resources that central banks need to perform their core activity around money. Notice that, at this very initial stage, central banks main function is considered to be the one also defining the object of modern monetary economic modelling: namely, how to ensure that fiat money is valuable in the economy.

One may identify in the literature three main different strands of monetary economy modelling approaches: search models, overlapping generation models and turnpike models. These different paradigms manage to rationalize on different grounds –money as a medium of exchange, money as a store of value and money as a unit of account– the fact that, although otherwise useless, fiat money is still valuable. However, in these models central banks play almost no role at all. One might be tempted to conclude from that, that the confidence capital inherent in monetary economies is totally alien to the existence or absence of central banks and, more specifically, to their very materiality.

However, a contribution by Kocherlakota (1998) offers new light on the existence of money and, implicitly, on the fundamental role of central banks around money. Kocherlakota (1998) demonstrates that the paradigms of money mentioned above are just descriptive explanations of the functions of money. An explanatory account of the role of money in the economy and its broad acceptance is rather based on a fundamental technological contribution: namely, money is a record-keeping device, in the precise sense that it permits to efficiently summarize for economic purposes the most basic aspects of past transactions in the economy.

Again, no explicit role for central banks or for central bank capital is evoked in Kocherlakota's theoretical contribution. Probably, an overlapping-generations model for money with a central bank should be the right set up to tackle issues linking dynamic confidence in money and central bank structure. However, factual precedents (see reference below to the Rentenmark case) lead to guess that, even this avenue leaves a scarce margin to pin down central bank capital in a pure theoretical frame. Nevertheless, Kocherlakota's analysis offers a comprehensive image with regard to the diverse set of roles of central banks around money. The essence of that view is that central banks should ensure in practice that the record-keeping functionality supplied by money is performed in the most efficient way.

The reason for the interest of this perspective of money for the purposes of this paper is twofold. Firstly, it fundamentally justifies the broad spectra of roles actually played by central banks in most financial systems. Ensuring efficient record-keeping functionality implies de facto a mandate to safeguard prices stability, because otherwise inflation might distort the summary of past-transactions defining the essence of money and, more importantly, damage the trust on its record-keeping capacity for the future. In other words, the value measuring yardstick should be itself as free of distortions as possible, something that incidentally has been positively assessed under metallic regimes. However, the very desire of guaranteeing that money exhibits efficient record-keeping ability automatically leads to broaden central bank's natural boundary of interest to microeconomic aspects of the financial intermediaries involved in the supply of inside money[2]. The involvement of central banks in clearing and settlement issues can also conceptually be understood as provision of "database" update services as new transactions take place in the economy.

Secondly, the view of central bank activity revolving around a record-keeping technology is also alluring because it somewhat sets a theoretical background on the otherwise obvious observations that central banks require assets to operate and that its operations entail the management of its balance sheet. To be more precise on the latter point raised, notice firstly that setting in circulation the mnemonic device that notes and current account holdings are understood to represent, does not constitute the only ultimate role of a central bank. If that were the case, off-balance sheet entries would suffice a central bank to accomplish its task of "database manager" of summary records of past transactions in the economy. In other words, a central bank would not require a balance sheet as we know it, i.e. one where money entries are recorded in the liability side (on-balance) of the "database manager".

However, the acceptance of fiat money as a valuable item in the economy, together with the need to control its outstanding stock, so that a certain concept of price stability is safeguarded, radically modifies the last conclusion. Central banks must exhibit certain (valuable) goods or assets that can be used in exchange of (valuable) money, if some draining action is needed in order to safeguard some policy objective as price stability. Thus a central bank cannot be expected to operate on the vacuum, but needs assets.

In a classical paper, Cagan (1958) analyzed the reasons for the prevalence of money and bonds as the means used by central banks to control activity and prices. The question arose in a theoretical and empirical context that questioned the classical transaction-based rationale underpinning the belief in the ability to command the economy by means of money supply control. In a general hypothetical setting with open market operations based on arbitrary commodities, Cagan concluded that, even if the transaction theory of money exhibits weak validity, that fact does not undermine a role for money in stabilization policies. His arguments, based in the special characteristics of the supply and demand for money, are still valid to understand the balance sheet of an efficient central bank.

From a money supply perspective, Cagan argued that open market operations based on fiduciary money guarantee net aggregate real effects (albeit possibly temporary ones), unlike what happens with any form of commodity money. The reason lies in the government's monopoly on fiat money and consequently on the absence of substitution effects as a result of its interventions. From a money demand perspective, the key aspect favouring money as control instrument in open market operations has to do with the speed of adjustments triggered by excess of cash holdings, as compared with holdings of other assets. The basic determinants for that high speed are its broad use as exchange media and widespread distribution throughout the economy. As it will be discussed

[2] Under a fiat monetary system, checking accounts with banks can be drawn by their owners and converted into banknotes at a one-to-one parity, leading to the so called inside money. Goodhart (1991) convincingly makes the case that monetary policy issues supported quite early in history a regulatory role over financial intermediaries which provide inside money.

later on, this same reason argues in favour of bonds as the second ideal "commodity" entering the monetary control tool-kit and, as consequence, supports a key role for government bonds in the asset side of a central bank. In other words, in the purest theoretical framework no analogue of the Modigliani-Miller theorem applies to a central bank balance sheet. However, to the extent that monetary policy operates by affecting financing conditions in the margin this conclusion is not binding in practice.

It should be cautioned that the need for a central bank of having earmarked assets may arise for deeper reasons than purely the monetary policy control ones just mentioned. The need of proper assets in the asset side of the central bank would be reinforced if confidence on the widespread use of fiat money can just be built on the basis of it being backed by something valuable or trusted. However, it must be admitted that trust can be based on the most diverse set of psychological foundations. Consequently this perspective does not precisely define how the asset side of a central bank should look like.

Surprise as to what the sources of trust in fiat money can be becomes most striking in situations of overall crisis. A well known historical example epitomizes this argument. In 1923 Germany experienced an extreme hyperinflation period that, incidentally, has been decisive for future monetary arrangements in Europe. Sargent (1982) and others have documented how over-issuance in a profound social and economic crisis context diminished the real value of the German currency to risible levels. The curiosity in the recovery of trust and exit from the monetary mess lies in the nature of the backing of the new currency (Rentenmark) launched in the fall of 1923 to stabilize the German monetary system. Due to the lack of gold, Rentenmarks were backed by a generic mortgage on the land, factories and mines of Germany. The backing was somewhat a fiction, since factories and land couldn't be turned into cash or used abroad. But Germans wanted desperately to believe in the Rentenmark, and so it succeeded. The central bank contributed to keep alive that confidence. However, its real contribution in that regard was not so much its effort to amass dubious titles on the German economy, but a commitment not to devalue the new mark by graciously financing the government.

No matter how the need of earmarked assets arises, the relevant conclusion from the foregoing theoretical discussion is the fact that the central bank "toolkit" is its own balance sheet and that, optimally, it should be based on bonds on the asset side and on money in the liability side. Profit generation or seignorage[3] thus pertains to the intrinsic nature of central banks, because (monetary) income is necessarily derived from the monopolistic rights over currency in circulation. However, as it will be discussed in section 4, various sources of central bank's financial vulnerability also exist. Their nature can be of two broad types. First, they can consist of events leading to a complete erosion of the central bank's earnings generation capacity. A widespread success of e-money[4] is an example of a technology development impinging on central banks' financial strength from an earnings generation perspective. Or, second, vulnerability may arise from events leading to wipe out any past profits accumulated in the central bank balance sheet.

[3] A stock and a flow concept of seignorage exist. The latter reflects grossly speaking the rents on central bank assets whereas the former is based on the present value of current and future monetary income [see Repullo (1991)].

[4] A BIS report (1996) devoted to e-money defines it "as monetary value measured in currency units stored in electronic form on an electronic device in the consumer's possession. This electronic value can be purchased by the consumer and held on the device and is reduced whenever the consumer uses the device to make purchases. This contrasts with traditional electronic payment transactions such as those with debit or credit cards which typically require online authorisation and involve the debiting of the consumer's bank account after the transaction. There are two different types of electronic devices: prepaid cards and prepaid software products. With prepaid cards, the electronic value is stored on a computer chip (or integrated circuit) embedded in the card and value is typically transferred by inserting the card in a card reader. With software products, the electronic value is stored on the hard disk of a computer and is transferred over communication networks such as the Internet when payments are made".

2.2. Central bank politics-driven ductility and financial independence

The characterization of central banks as specialized record-keepers illuminates vividly the origin of the bias towards inflation existing under fiat monetary regimes: whereas the marginal cost of money creation is almost inexistent, its capacity to influence allocations in the economy is enormous. Bernholz (2003) documents the marked inflationary bias since the start of the discretionary paper money era at the end of the 30s. Generally speaking, the bias has arisen out of the absence of self-discipline on central banks side not to yield to demands of economic agents that can be accommodated at cero cost in the short term.

Inflation has thus been a persistent phenomenon until the first 90s due to its apparent ability to accommodate the effects of different shocks, policies or bargaining attitudes. Nowadays, the consensus has been reached that this accommodating capacity entails significant costs. Moreover, it is broadly agreed that a key determinant of the central banks ductility, that made possible the inflationary bias, lies in the political and institutional system surrounding them. The short term responsiveness of economic activity to expansionary policies has traditionally made of central banks a strategic institution to influence. In such context, central bank independence emerged in the 90s as an institutional mechanism that managed to de-link monetary policy making from government influence.

The institutional set-up for central bank independence typically envisages special provisions as regards government borrowing from the central bank. The magnitude of the economic stimulus seek by incumbent governments is frequently based first on expansionary fiscal policies that lead to budget deficits. The difficulty to finance these deficits depends on the ability and incentives to tap financial markets. But even if markets exist, funding from central bank "magic" capabilities has typically been an easier and cheaper alternative, if the monetary institution behaved subserviently to government wishes. Cottarelli (1993) systematically tracks down the reasons why governments have a natural preference to borrow from central banks.

It is well known that the counterpart of the seemingly free-lunch provided by money financing is pressure to higher levels of inflation. Eventually, the scope of the mishandling may exhibit such size that real money balances demand starts to fall: agents in the economy anticipate hyperinflationary developments and try to avoid their negative effects by shifting to other types of money or even to barter. Bernholz (2003) documents that every hyperinflation in history took place under a fiat money regime. As a matter of fact, catastrophic distrust to one's money has always emerged as a result of central banks balance sheet manipulation by governments.

The academic literature did not paid much attention to these practical risks for some time. Money has been viewed from a fiscal dimension even under a monetarist tradition, as the classic result by Phelps on the optimal level seignorage taxation shows. Namely, Phelps (1973) argued that the marginal social costs of inflationary taxation of real money balances should not differ of those imposed by other tax instruments. As an immediate implication of this idea, inflation rate targeted by the central bank should reflect the overall efficiency of the taxation system. Obviously, this solution takes for granted that a subservient central bank is in place. In contrast, modern monetary policy-making literature has established that the benefits of seignorage income are insignificant compared to the risks posed by an institutional framework that too easily allows the development of deviations from nominal stability goals. Section 3.1 will briefly summarize the special measures that limit governments' recourse to central bank funding under the independency paradigm.

In addition, the consensus has over time been reached that independent central banks should act as fiscal discipline makers. The overall context for an active role of central banks at influencing fiscal policy was paved by Sargent and Wallace (1981). In a path-breaking contribution, they managed to

give a new sense to the non-separability of monetary and fiscal policies in a fiat money regime. They argued that although it may be appropriate to think of monetary and fiscal policy actions as separate ventures, it is important to understand their interactions. They figured out an economy where financing the deficit with bonds could ultimately be more inflationary in the long term than financing it by printing money. The emergence of such a long term-short term inflation trade-off depends on conditions, some of which have been criticized as exotic. However, one of the realistic conditions (central bank dependency) was not removed from the landscape until the first 90s. Another important output from the posterior research strand rooted in Sargent and Wallace's concerns is the conclusion that the benefits of central-bank independence might finally not bring its fruits, if absence of fiscal discipline leads to some Ricardian regime that makes unfeasible in practice the achievement of central-bank goals.

Combating such negative fiscal outcomes has thus become a cornerstone of central bank activity. However, central banks' only available tool in such endeavour is just persuasion. On the other hand, it is well known that virtue is a prerequisite for effective preaching. From this perspective, both the value of credibility to defend fiscal prudence and interest in preserving their own freedom lead independent central banks to wish for themselves the fulfilment of some minimum financial strength requirements. The core of the argument is the idea that effectiveness in central bank actions and messages rely intensively on its reputational capital. Criticisms to government fiscal profligacy stemming from the central bank might be easily countered or played down if central bank performance was itself deficient or, if being that the case, an adequate explanation for the fact was absent. An extreme situation of that problematic could arise if the central bank had to seek fresh resources from the government to bring its books back to balance. Thus, even under a formally independent central bank regime decisions could be somewhat influenced if financial performance is improper.

Central bank financial vulnerability can create channels for such outcomes to arise. Notice that financial vulnerability is understood to be something not unlike the financial distress situations capturing the attention of the corporate literature, in that the erosion of central bank financial strength might lead to significant costs. In the central banking case, the costs are those due to the real effects ensuing from the lost of reputational capital, i.e. ultimately inflationary bias.

The solution to the central banks financial strength problem is twofold. Firstly, central banks must be endowed with sufficient capital, so that it can stand on its own after the realization of some worst-case scenarios on its vulnerable profile. Secondly, central banks need to establish an adequate transparency and accountability regime on financial matters so that financial weakness can be understood by economic agents.

In summary, goal or instrument central bank independence statues could be voided or seriously impaired in practice by two types of financial mechanisms. Firstly, the central bank balance sheet might be materially outside its own control capacity if exogenous undesired draws on its base money production capacity are possible so as accommodate external draw downs[5]. Secondly, an otherwise legal independent central bank may see its functional freedom of choice impaired if a poor financial performance compels the monetary authority to somewhat having to yield to government's goals, if the latter holds the key for the provision of new resources to continue central bank operations, or, if the poor performance itself damages central bank credibility. The immediate steps to discuss these issues are as follows. Section 3.1 summarizes some of the widespread measures in pace aimed at limiting government recourse to central bank funds. Section 3.2

[5] Obviously, strictly speaking exchange rate pegs are outside this characterization of lack of independence. However, a central bank genuinely pursuing nominal stabilization goals and pegging its exchange rate so as to import credibility may be considered as a central bank somewhat importing a necessary ingredient to later achieve full-fledged independence.

advances some the arguments strictly pertaining to the central bank financial strength problematic. Its detailed discussion will fill the rest of the paper.

3. Financial-driven Threats To Central Bank Independence

3.1. Government recourse to central bank funding

The historical origin of central banks as bankers of the government has traditionally determined that a fiscal agent condition was a natural companion of their monetary policy role. The breadth of fiscal agent services may be quite varied and dependent on historical and institutional developments[6]. As a rule, access by central banks to information on liquidity developments driven by payments and receipts of public entities has traditionally lead to a positive assessment of combining a fiscal agent role and monetary policy execution. However, two risks of this dual role have tended to finally dominate the assessment of fiscal agent services provision by central banks. Firstly, an unrestricted involvement of central banks as fiscal agents may effectively facilitate monetary budget financing if it eases in practice its access to overdrafts. Secondly, even if that is not the case, "leasing" the central bank balance sheet to supply fiscal agent services may be the cause of distortions to base money control that ultimately may outweigh the informational advantage gained[7].

Such considerations, along with instrument independence ones, have led to the outcome that central bank independence laws normally set stiff restrictions on central bank advances to governments. Legal inflexibility on this dimension is agreed to be a basic condition to put at good use the off-budget nature of central banks. However, it is important to notice that such prohibitions and statutory requirements do not exclude government debt from central banks' asset composition. To the contrary, such limits must be compatible with the benefits derived from the optimal properties of government debt as asset covering a significant chunk of central banks' liabilities.

The imposition of strong limits to governmental recourse to central bank funding has traditionally been perceived as a milestone in the evolution of central banks towards independence standards. In the US, Federal Reserve-Treasury relations evolved to keep monetary policy and debt management separate. After the Treasury-Federal Reserve Accord of 1951, the Federal Reserve was freed from the obligation to support government bond prices in the secondary market. Currently, the Federal Reserve makes all additions to its portfolio through purchases of securities outstanding[8]. However, in a refunding the manager of the SOMA portfolio can directly subscribe bonds, although by an amount that not exceeds the one of the maturing securities it holds. The Bank of Japan also faces a prohibition to underwrite government bonds and to make loans to the government. However, subject to limits and transparency requirements also some exceptions to that rule are contemplated, e.g. when the newly issued bonds are intended to refund maturing bonds included in the portfolio held by the central bank for monetary policy reasons. In the European System of Central Banks (ESCB), Article 101 of the EU Treaty prohibits overdrafts or any other type of credit facility as well as direct purchases of public debt instruments by the ECB or by national central banks. However,

[6] The fiscal agent function may comprise functions like making and receiving payments for public entities involving accounts at the central bank, bringing coins into circulation for Government, servicing public title on behalf and for the account of the public issuer, issuing and redeeming debt instruments for public debtors and maybe at the same time advising public entities on the characteristics and conditions of debt instruments to promote their placement in the markets, advancing funds for public expenditure in relation to international operations or institutions, granting advances to public entities enabling them to bridge temporary need for funds, holding public entities cash etc.

[7] The issue at stake is instrument independence. Obviously, this independence concept depends heavily on the operational scheme in place. This explains the diversity of arrangements that traditionally has existed across central banks as regards the provision of Treasury services. In the ESCB, the practice of offering such services "through" the central banks balance sheets has been established, i.e. minimizing distortions of the central banks balance sheet.

[8] The main Fed portfolio is the one corresponding to the system of open market account (SOMA).

the acquisition by national central banks or by the ECB of public sector debt instruments in the secondary market is not prohibited by the Treaty, although such purchases must not be used to circumvent the objective of Article 101 of the Treaty.

The common principle underlying all those restrictions is twofold. Firstly, they intend to grant central banks full autonomy on their decisions on assets portfolio and, therefore, the ability to control base money as well as the appearance thereof. Secondly, the limits have generally speaking been formulated so that one of the basic and historical roles of central banks is not undermined, i.e. its capacity to elastically provide currency.

However, central bank independence statutes seldom have taken so far into consideration how to deal with the special type of overdraft situations that motivates the subject of this paper, i.e. central bank accumulated losses[9]. Accumulated losses may deplete central bank capital. In this regard, it is important to notice that, should profits obtained in good years not be available to repair damages to central banks' financial strength in bad ones, amounts in economic terms to granting a zero rate indefinite term loan to the government.

3.2. Central bank inadequate financial position

A frequently decisive financial link between governments and central banks regards the shareholder condition that the former normally exhibits in the latter. Although some central banks still have private shareholders to some extent[10], public ownership is however the standard in accordance with the nature of their economic function. Governments are thus entitled to transfers of dividends out of the profits earned by the monetary authority. This paper will deal with the interplay between such use and the alternative one of safeguarding central bank financial independence.

Central banking has historically evolved towards negation of profit seeking as a valid objective. This is especially a true statement in the era of independent central banks. However, disregard of profits does not necessarily imply some sort of natural endurance of financial losses, because central banks financial distress is perceived not to be in accordance with normal economics[11]. It is this divergence with normal outcomes that ultimately makes possible perverse interactions between monetary policy making and (bad) central bank financial performance.

An otherwise legal and instrument independent central bank might see its effective freedom of choice impaired if approval of its annual budget or some lack of material resources would compel the monetary authority to somewhat having to yield to government's goals or suggestions[12]. As a matter of fact, even if no capital injection providing new resources is needed, poor financial performance may still be the source of undesired pressures on decision-making by central bankers. Pressure might be explicit or implicit. A form of implicit distortion on free decision making might be self-restraint on the central bankers side on the adoption of monetary policy measures that eventually could drive it to a situation of financial distress. Two sorts of issues arise in connection

[9] A recent survey of central bank accounting practices shows that 42% of the respondents had no legal provisions for the recapitalization of the central bank, should it become necessary [see Kurtzig and Mander (2003)].

[10] Examples of followers of such historical tradition are the Federal Reserve System, the National Bank of Belgium, the Bank of Italy, the Bank of Greece or the Swiss National Bank. Remarkably, shares of the last three central banks are listed either in bearer or registered form. In the Federal Reserve System, law requires that all nationally chartered commercial banks and saving and loans institutions buy stock in their regional Federal Reserve Bank proportionally to their respective sizes. Bank of Italy shares were originally held by public commercial banks. Their privatization has thus altered their initially indirect public charter.

[11] However, Goodhart (2000) argues that in a free banking regime central banks should be willing to bear losses to still be able to control monetary base. Anyway, if they would show such willingness monetary policy would still be possible.

[12] In some cases of central banks being also held privately, corporate disputes have occasionally arisen around economic rights. Although Statutes normally leave no margin to private shareholders in material central bank business, it may be arguable the need to maintain an exposure to commercial disputes just because of shareholding legacy reasons. However, for this paper they are just anecdotes.

with this generic problem. Firstly, how can dearth of resources for a seemingly almighty central bank come about? Secondly, what is the optimal institutional and procedural way to handle situations of distress?

Responding to both questions calls for going beyond a robot-like portrait of central bank behaviour and consider basic microeconomic aspects of central bank structure. Section 4 will work out how in theory the mandate and balance sheet structure of a central bank determine its earnings generation capacity as well as its on –and off– balance exposure to financial risks. Central banks earnings capacity is quite often most seriously impaired by the materialization of extraordinary exposure to risks. Financial stability concerns typically define either implicit or explicit funding commitments for central banks with markets and/or institutions. Thus, losses stemming from banking rescue operations accounted for in central banks books may end up being an insurmountable drag for central bank independence if remedy measures are not undertaken in advance. In the same vein, development banking mandates for central banks in emerging markets can similarly undermine their effective autonomy.

In normal times, the type of backing for the monetary base in circulation inevitably leads also to risk exposure. Similarly to its effect on private decision makers, earnings volatility may ex-ante or ex-post condition central bankers' behaviour; particularly if it might be conductive to losses. Under market value based accounting, an important volatility source is the straightforward effect of assets prices and exchange rate movements imparting directly on the income statement, i.e. the effect of unrealized gains and losses. Excessive volatility in central banks' financial statements may simultaneously be problematic and somewhat avoided. As regards its potential to promote situations of distress, one should notice that an excess of volatility of profits increases the risk, already pointed out before, that too many dividends might be distributed in good years, whereas no call back mechanism on them is available when losses arrive.

This argument is reinforced by the fact that the recourse to hedging tools enabling large scale damping down of earnings volatility is severely limited in the central bank world, if their use may exert a distorting influence on monetary policy signalling. Therefore, a key mechanism to safeguard central banks financial health is the existence and recognition of mechanisms that autonomously dampen volatility. The existence of well defined cycles of earnings generation normally justifies moving from volatile full fair value accounting schemes to smoother alternatives. In this regard, two important central banks' earnings generation cycles will be identified in section 4, which inspire the main results of this paper. However, for expositional reasons a full fair value accounting framework will be assumed throughout most of the paper. In the event, its unconstrained validity will nevertheless be negated, as hinted by the reference before to the existence of natural earnings generation cycles.

Section 5 and 6 will elaborate on financial arrangements to safeguard central bank financial independence to the light of apparent (i.e. accounting driven) and real financial threats. Previously, the conceptual issues that arise in an exercise of central bank risk budgeting will be systematically covered in section 4. The actual budgeting exercise is out of the scope of this paper. Section 5 deals specifically with the short-term capital requirement for central banks consistent with their risk exposure. Section 6 deals with the interplay between accounting, profit distribution and central bank capitalization so that the rights of the shareholders over dividends, the financial strength of the central bank and overall transparency of the setup can be consistent goals.

Interestingly, the solution to the financial strength problem must bear also in mind the fact that excessive central bank capital may end up being the cause for some central bank unrest too. In a seminal article Jensen (1986) highlighted the risks of an excess of free cash flows in a corporate context. The argument can arguably be extended also to a central bank context. In effect, central

bank autonomy strengthens the scope for such risks to actually materialize. The controversy around an allegedly excessive capitalization that actually broke out in Switzerland, between the Swiss Social-democratic Party and the Swiss National Bank, is a good case to illustrate the practical relevance of this argument[13].

4. Central Bank Functions, Earnings Sources and Financial Vulnerability

This section intends to highlight the major considerations determining the earnings generation capacity and exposure to financial risks of a generic central bank. The goal is to outline the overall shape of central banks' financial statements in their policy mediated determinants. Some of the policy or structural factors have already been pointed out in previous section. However, a more systematic discussion is warranted in order to assist budgetary and accountability perspectives.

Before going into the details, it is important to emphasize the overall approach to deal with the problem. The conceptual elements of a risk budgeting exercise for central banks will be delineated. With that view in mind, a discussion is made on the implications in terms of asset-liability management from the different functions of a generic central bank. It is acknowledged in advance that central banks balance sheets are in practice not easily amenable to a straightforward matching of assets and liabilities. However, even if the actual mechanisms leading to the makeup of central banks balance sheet in terms of assets and liabilities can not be simply reduced to segregated components along neat functional dimensions, the conclusions attained on central bank overall risk-return profile will be still valid.

An analytical (unmatched) outline of the balance sheet of a generic central bank may be as follows

Table 1

Central Bank Balance Sheet

	Assets	**Liabilities**	
A_y	F (i_f) B (i_g) RF (i_r)	P (i_p) R (i_d)	L_c
		N	
A_{qf}	L (i_l) Q (i_q)	RR	L_{nc}
A_{ny}	G O	K	

where the comprehensive entries A_y and A_{ny} stand for yielding and non-yielding assets, respectively, and A_{qf} represents central bank assets whose financial terms are "out of the market". Similarly, L_c and L_{nc} stand for costly and non-costly liabilities, respectively. As regards the main entries, F, B and RF stand, respectively, for foreign assets, government debt and refinancing balances, whereas L and Q designate, respectively, preferential loans to the government and other preferential operations. G denotes gold holdings and O other assets. On the liability side, P stands for costly liabilities other than reserves (R) maintained by banks in the central banks' book and N stands for banknotes in circulation. RR and K designate, respectively, the set of provision and capital accounts. Next to every balance sheet entry, its corresponding rate of reference is

[13] See Ungern-Sternberg (2002).

displayed when applicable. Chart 1 shows a stylized version of actual balance sheets scaled to the respective sizes of the central banks as of 31st December 2002.

Chart 1

Stylized Central Bank Assets
(as % of total assets, year end 2002)

			Outright Holdings		Financial Institutions		
	Foreign Assets	Gold	Govern. Debt	Other[1]	Refinancing	Other Fin.	Other Credit
Australia	61.6	2.0	9.0	0.0	25.3	0.0	2.1
Canada	1.5	0.0	91.8	0.0	6.4	0.0	0.3
Denmark	51.0	1.4	4.7	6.2	35.2	0.0	1.6
Eurosystem	32.0	16.4	5.6	4.0	28.6	0.0	13.3
Iceland	30.6	1.5	1.6	0.0	66.3	0.0	0.1
Japan	3.0	0.3	62.8	20.6	8.6	0.2	4.4
Norway[2]	26.8	0.3	1.5	0.0	0.1	0.1	71.2
Spain	33.5	5.7	4.6	10.1	18.9	0.0	27.2
Switzerland	45.9	24.1	5.8	0.0	22.9	0.0	1.3
U.K.[3]	0.0	0.0	6.8	28.7	50.2	0.0	14.3
U.S.	2.7	1.6	90.0	0.0	2.6	0.0	3.1

[1] Includes loans to the government.

[2] The Petroleum Fund is included in Other Credit

[3] Consolidated balance sheet of the Issue and Banking Departments.

Stylized Central Bank Liabilities
(as % of total liabilities, year end 2002)

		Deposits					
	Banknotes	Financial Institutions	Govern.	Other	Securities	Other[1]	Capital
Australia	48.3	0.9	20.7	0.5	0.0	12.0	17.5
Canada	93.6	2.7	1.2	0.9	0.0	1.5	0.1
Denmark	12.7	15.1	13.4	1.4	42.8	1.4	13.2
Eurosystem	46.8	16.8	5.8	1.1	0.3	10.8	18.5
Iceland	8.2	20.9	19.4	0.0	0.0	17.0	34.5
Japan	50.3	22.7	22.8	0.0	0.0	0.1	4.1
Norway[2]	5.2	6.7	6.3	0.0	6.6	72.2	3.0
Spain	38.9	9.6	15.8	0.0	0.0	22.2	13.5
Switzerland	28.2	3.2	5.0	0.5	0.0	13.5	49.6
U.K.[3]	66.9	5.1	2.6	10.1	0.0	12.4	3.0
U.S.	92.2	3.2	0.6	0.1	0.0	1.6	2.4

[1] Includes foreign denominated debt.

[2] The Petroleum Fund Balances distorts the real capitalization of the central bank.

[3] Other deposits includes those maintained by other central banks. Other liabilities includes the balance of foreign isssues.

Central bank earnings accounts contain entries that reflect the interaction between central bank balances and relevant interest rates as well as records that reflect revaluation adjustments, fees and expenses.

Table 2

Central Bank P & L

Income		Expenses	
I_d	Interest income, domestic portfolio	Interest expenses.	I_e
I_f	Interest income, foreign assets	Operative expenses, notes and coinage.	E_n
Rv_d	Revaluation adjustment, domestic portfolio	Operative expenses, services provided.	E_s
Rv_f	Recognized adjustment, foreign portfolio	Administration expenses.	E_a
I_s	Income from services provided	Provision charges.	Ch_p
R_o	Other revaluation adjustments	Reserve charges.	Ch_r
I_o	Other income	Profit/Loss	Π

It is important to emphasize that accounting principles are not for the time being a subject of concern. As advanced at the end of previous section, a market value approach will be used as benchmark throughout the discussion. However, sections 5 and 6 will exploit the conclusions gained in this setting to elaborate on the role of accounting for central bank financial independence matters.

The overall appearance of central bank financial statements is mainly shaped by three fundamental set of factors. Firstly, the confluence of the different policies implemented by central banks decisively determines the aspect of their balance sheet and earning accounts. Secondly, the strategies and instrumental procedures chosen for policy implementation purposes also definitively delimit central banks financial profile. Thirdly, contextual restrictions in various forms such as degree of development of local financial markets, the level of government debt outstanding or law practices also shape the structure of central banks financial statements.

Laymen usually assume that central bank's business is exclusively monetary policy making. Although normative positions justifying the correctness of such an assumption may exist, the fact is that central banks may also implement financial stability and credit policies. Financial stability aimed actions have acquired of late a dimension that goes beyond a rule-making or prudence encouragement role, to potentially also entail the deployment of financial resources to assist markets or institutions in trouble. Reputational and financial risks may also arise in connection with credit policies pursued by central banks. In line with this functional dissection, section 4.1 will cover the earnings and risk budgeting issues arising in connection with the exercise of the monetary and exchange rate policy. Section 4.2 and section 4.3 will deal with the same problematic with regard to credit and financial stability policies, respectively. Section 4.4 will cover the risk-return issues arising in connection with financial statement entries that deserve some separate treatment like gold holdings, intra-system accounts or entries related to services provision.

4.1. Monetary and exchange rate policy

Monetary and exchange rate policies are respectively concerned with the internal and external value of domestic money. It is well known that in a world free of restrictions to capital and trade flows independent goals for both policies are naturally inconsistent. Therefore, monetary constitutions must ascribe a pre-eminent role to one of the policies, keeping a subordinated one for the other.

From a central bank financial independence perspective, these very general remarks are important because the actual choice made in that regard determines a fundamental aspect of central banks risk profile. In general, pursuance of some type of external value objectives for money implies the need to maintain substantial precautionary holdings of foreign assets and, therefore, to take on significant exchange rate risk. Thus, from the standpoint adopted in this paper, the relevant dividing feature between monetary and exchange rate policies are the risk-return profiles of the portfolios by whose means they are materialized, i.e. domestic portfolio and reserve assets.

4.1.1. Domestic portfolio

There is substantial disagreement among economists concerning the nature and magnitude of influence of monetary policy on the price level and real activity in the short term, but this does not obscure the broad agreement on the central role of purchases and sales of government securities by central banks (i.e. open market operations) as the most effective instrumental procedure to set the monetary tone, possibly with the assistance of standing facilities. Also, a general agreement exists in that there is an important unique role for the public sector in the management of banknote issuance. In particular, a widely held view among economists is that the supply of the ultimate media of exchange is an activity that should not be left to the private sector. For example, Milton Friedman (1960) argues that the provision of money is fraught with market failures and that the government should have a monopoly in the supply and control of the stock of circulating currency.

The efficient execution of those classical functions of a monetary authority is typically understood to involve maintaining holdings of government debt on the central bank's balance sheet, even though many other assets may serve also as cover. However, we will see that the contribution to a central banks risk-return profile of balances held to back notes in circulation and the one of holdings underlying open market operations may be quite different. Some central banks even exhibit segregated accounting units in charge of note issuance and of banking business, respectively. The Bank of England is a classical example of a central bank with such a dual setup.

4.1.1.1. Banknote issuance

As regards the backing of currency issued, a good starting point is a reminder of the historical origins of central banking. Goodhart (1991) documents how banks of the government gradually came to naturally concentrate the monetary and regulatory functions which are now understood to belong to central banks. The "natural" forces operating in that process of selection among entities operating under free banking regimes were basically two: the overall confidence of customers in the assistance of the government to his own bank if a panic situation would arise[14] and the economies of scale achieved with banknotes issued backed by the most abundant homogeneous liabilities in the economy, i.e. by government debt[15].

[14] However some banks bankrupted due to the default of the government.

[15] In this regard, a historical reminder illustrates the complementary relationship between government debt and currency. The distinct feature of the Bank of England as private bank back in the seventeenth century that led to an outstanding position in the note issuing activity was the fact that, instead of discounting bills as other private banks did, banknotes issued by the Bank of England were used to buy government debt. The Bank of England exploited thus the liquidity-enhancing network externality created by the widespread circulation of its notes. See Quinn and Roberds (2003).

For our purposes now, the relevant conclusion from that evolution is that currency is naturally backed by government debt. It is far from true that such an outcome is free from trade-offs. Williamson (2002) discusses from a classical perspective the compromises implicit in the choice of public versus private media of exchange. His analysis opposes the economic efficiency achieved with private money (because of its backing with productive investment) and the alleged sterility of government debt backed fiat money. On the other side of the balance, one must obviously consider the cost of having circulating private money that could more easily be counterfeited than fiat money and the ramifications from that circumstance in terms of social welfare.

In the market value accounting basis considered thus far, central bank earnings associated with money issuance have two neat economic components: i.e. interest payments, either from government debt or from any other asset holdings backing notes, and capital gains and losses on those holdings. In practice, accounting definitions of monetary income exclusively focus on the stable component of earnings[16]. Monetary income thus measures central bank medium term profitability. However, from a central bank financial independence perspective the relevant metrics are total earnings. Incidentally, it is also important to notice that central banks can just costly counter earnings volatility with hedging instruments, given the signalling effects that its recourse could unleash. Namely, hedging actions aimed at smoothing the financial impact of outright government bond exposures backing currency in circulation could distort both the signals and transmission of ordinary monetary policy tools based in the control of short interest rates.

From the discussion so far, it might look as if the domestic debt backing portfolio were intrinsically volatile. However, a proper view of the central bank risk-return trade-off associated with the currency-backing portfolio can just be gained by considering the life cycle of notes issued. With that purpose in mind, let us see the mechanism followed to place currency in circulation. Notice that its continuous working leads to the automatic genesis of a big part of a central bank's balance sheet.

Banknotes are issued at commercial banks initiative. When banks need currency, they draw on their current accounts at the central bank, i.e. newly issued notes are paid for with the reserves they held in the central bank. Thus, issuance of notes initially results in the swapping of one liability (reserves) for another (banknotes), with no impact on the central bank's income statement at that very precise moment. Afterwards, the recurrent impact on the income statement arises from the combined effect of the permanent base money needs faced by commercial banks, due to the banknotes issued, together with the profile of the refinancing instruments offered by the central bank to accommodate those needs. Namely, as will shortly be described, central banks typically provide current account reserves in exchange for liquid securities, such as government bonds delivered outright or through repo operations. In other words, although banknotes issued are initially paid for with deposit reserves, ultimately they are paid with government debt or with other eligible asset[17]. Having in mind the mechanism leading to the emergence of banknotes' cover, let us resume our initial goal dealing with the life cycle of notes and its impact on the return-risk profile of central banks' banknote issuance business.

Leaving aside deterioration-driven replacement of currency, the expected life of net additions to banknotes outstanding typically has no defined term to maturity. In many countries banknotes outstanding follow a secular growth process in nominal terms that relegates the redemption horizon

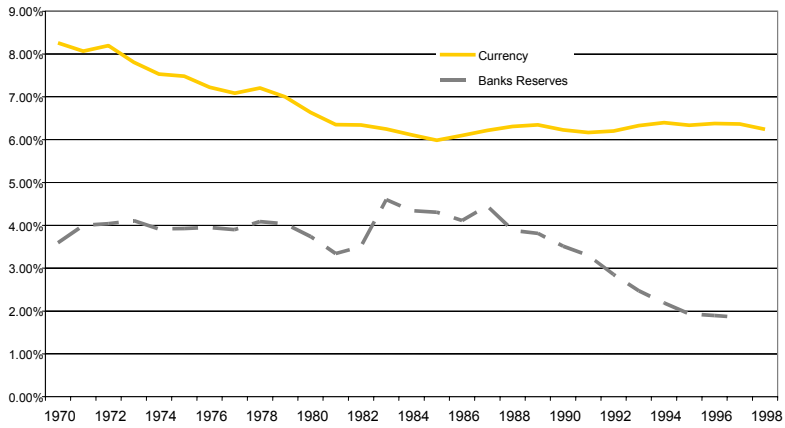
[16] More precisely, monetary income is defined as income from assets backing monetary policy. In accordance with this general definition, monetary income encompasses not just interest on assets backing notes but also interest of assets backing banks' reserves at the monetary authority. However, as will be argued later on, the last component is frequently quite small if reserves are remunerated.

[17] In markets where government debt outstanding is insufficient, collateralized credit to banks has traditionally been a substitute. Section 4.1.1.2, dealing with monetary policy control, will elaborate further on the risk-return trade-offs arising from alternatives different to outright government debt holdings and on collateral issues.

for new currency issued very far in the future (see Chart 2). Certainly, it can not be discarded either that banknotes outstanding could shrink at any time. These features leave ample margin to the central bank asset managers as regards investment decisions on the maturity profile of assets covering banknotes. A buffer of temporary operations that match potential currency redemptions and outright holdings covering the whole maturity spectrum could be combined rather arbitrarily to cover currency outstanding[18]. In other words, central bank interest rate exposure could be expected to rather unrestrictedly cover the whole yield curve spectrum.

Chart 2

Secular Evolution of Currency and Banks Reserves*



Source: IMF, International Financial Statistics.

* Calculated as the cross-country average of the ratio of currency and bank reserves to nominal GDP. Sample of countries: Canada, France, Germany, Italy, Japan, Netherlands, Spain, Switzerland, UK,US.

However, in practice assets covering banknotes are not entirely dedicated ones, so that the performance of other central banks' functions set additional constrains to the portfolio problem. Namely, preferences on the liquidity and maturity of the government debt portfolio also depend on the requirements set by the delivery of the financial stability function. As an example of this fact, it is noticeable that, in the US, preferences of the Federal Open Market Committee for the liquidity of SOMA portfolio sharply increased in the aftermath of the Continental Illinois crisis since a massive volume of loans provided through the discount window had to be somehow offset[19]. In other words, reasons other than currency backing ones normally bias central banks' portfolio to shorter duration ones.

So far no restrictions have been derived as regards the degree of activism in the management of the outright portfolio backing banknotes. However, in many countries most securities owned by the central bank as a backstop to base money are held to maturity[20]. For example, in the SOMA portfolio debt holdings are maintained across the entire yield curve according to per issue guideline limits. This policy ensures neutrality of central bank balance sheet management actions as regards

[18] Sometimes even long cycles of banknote demand are accommodated with temporary operations covering time intervals much longer (i.e. three months) than those of temporary operation for monetary policy purposes.

[19] See Federal Reserve Bulletin (1997).

[20] Canada, Japan , New Zealand and the US count among them.

their impact on the working of affected markets. Elsewhere, major policy objectives for domestic portfolios are normally instrumented in terms of benchmarked mandates to line managers, with the additional goal of enhancing the return over the one that would have been achieved with a pure buy and hold strategy.

The risk-return implications of following a buy-and-hold strategy or a benchmarked one for the portfolio covering banknotes outstanding can be quite different. The first choice defines a cycle of central banks' earnings that minimizes the significance of market value accounting for central bank medium term profitability measurement. Its outstanding feature is the fact that principal is recovered at maturity under any market developments. In other words, no matter if bond prices go up and down over a short term horizon the yield to maturity at trade date sets an expected component for total return. A benchmarking strategy cannot offer such guarantee. As a counterpart to the return add-on, some risk must be incurred, i.e. risk-budgeting techniques must be deployed to account its contribution to the return-risk pair. These remarks turn out to be important for some aspects of central bank financial strength. As we will discuss in sections 5 and 6, a market value accounting basis causes artificial appearance of central bank vulnerability if applied to a buy-and-hold portfolio. The issue is more complex for the case of a benchmarked strategy[21].

In previous paragraphs, the risk-return analysis related to unitary exposure, i.e. the outstanding amount of banknotes was considered to be fixed. However, total earnings from banknote issuance are unitary earnings scaled by the amount of notes in circulation. No matter how obvious this statement may be, it nevertheless significantly widens the profile of central bank independency issues. The underlying economic ground for this additional source of complexity is one of the basic tenets of central banking. Namely, monetary authorities must be ready to elastically provide notes as demanded. In other words, the scale factor determining central bank earnings from banknote issuance is as volatile as demand for currency can be.

Leaving aside seasonal factors, the technological dimension of money discussed in section 2 seems to put payment system innovation enabling alternatives to banknotes at the forefront of the set of factors moving the scale of currency demand secularly. In the limit, technological developments that, theoretically speaking, enable e-money solutions that evade central bank's monetary income generation channels, have led to extreme propositions claiming that central bank revenues might at some point no longer be able to cover operational costs. However, radical conclusions like that one fail to consider some basic facts that strongly limit their feasibility. First, they fail to ponder that regulatory authorisation of payment system innovation must reach compromises between innovation as such and broader policy concerns. Thus, in Europe the EMI Directive (Directive 2000/46/EC) has been moulded on the basis of a compromise between the free access to the e-money activities to non-banks and the position favoured by the European Monetary Institute (1994) of restricting that business to credit institutions. The prospect of significant migration of banknotes to bank issued e-money has led to various suggestions aimed at safeguarding central bank financial independence: imposing non-remunerated reserve requirements on deposits backing bank issued e-money, making central banks a competing issuer of e-money or even restricting to them the ability to issue e-money[22]. However, so far e-money has not been a great success so that it can be perceived as a challenge for the "shadow base of central bank capital", as Henckel *et al.* (1999) fittingly have named banknotes outstanding.

[21] Annex 1 briefly discusses how benchmarking impacts on central banks' risk-return profile as opposed to buy-and-hold strategies. Its content will be recalled in sections 5 and 6 because it has a definitive impact on capital and accounting issues. If the yield curve turns out to evolve across time in accordance with its shape at the inception of the benchmarking strategy, the return of that strategy over a horizon equal to the duration target equals the return of an investment to maturity. In the realistic case, anticipation to yield curve movements is the source of return add-on and risk.

[22] See Groeneveld and Visser (1997).

There is a second conceptual reason that assigns a limited potential for e-money. Leaving aside operational advantages, one of the deepest differences between banknotes and e-money relates to their recording capacity. As discussed in section 2.1, the essence of banknotes is their anonymous recording ability. In this regard, Goodhart (2000) notes the potentially devastating effects for the use of e-money if its capacity to store information on transactions is perceived by users as a threat to the anonymity of trades[23].

Payment system innovation has thus been somewhat downplayed as a mover of the scale factor for currency demand. More important for most central banks are developments related with overseas holdings of one's banknotes. Thus, dollarization or euroization processes in transition countries enrich the monetary base of larger central banks at the expense of those of transition countries. Most prominent is the US dollar case, where the official estimate for 2001 establishes that 50 percent of the $580 billion of US currency in circulation was held abroad. Unstable monetary and political regimes have ultimately led to widespread situations of unofficial dollarization that amount in financial terms to a transfer of income to a foreign economy. Interestingly, proposals to share seignorage with dollarizing countries subject to economic performance conditions have not succeeded so far[24].

Individual central banks in federal systems are by definition also exposed to banknotes migration effects and, as a consequence, their respective financial independence is subject to the vagaries of banknotes' excursions throughout the monetary area. Section 4.4.2 will specifically deal with financial independence issues arising in a federal context.

However, at this point it is relevant to identify two sorts of federal systems. On the one hand, stands the class represented by the US Federal Reserve System, where notes are direct claims of the issuing Federal Reserve Bank and, therefore, are marked accordingly. The Eurosystem[25] would be a prototype of the second sort of federal system with regard to banknote issuance: namely, notes are totally undifferentiated means of payment. The distinction is relevant in terms of financial independence of individual central banks. Whereas under the first modality of federal system the decrease of earnings due to banknotes redeemed in a central bank other than the issuing one can be passed on to the latter, in the second one the absence of any differentiating mark in the currency hinders that central banks' balance sheet resizing in the aftermath of banknote redemption can be governed by information on who in the system was originally the issuer. In turn, such indeterminacy brings about the need of clear rules as to how share monetary income between central banks[26].

4.1.1.2. Monetary policy control

In section 2.1, the reference to the arguments by Cagan (1958) on the prevalence of open market operations based on money and bonds, was focused on the first element of the couple. It is now the right place to remind the theoretical arguments in favour of bonds as the second component of the monetary policy lever. Notice that in doing so, one also implicitly justifies the trend towards the presence of government debt among central banks' assets.

[23] Following a similar line of reasoning, Rogoff (1998) has interpreted that the provision of high denomination banknotes is tantamount to a supply of a taxation evasion technology. From a different perspective, one could also view them as a means to tax the underground economy.

[24] Humpage (2002) discusses an incentive-compatible proposal for returning seigniorage to officially dollarizing countries, under which the US Treasury would purchase dollar-denominated, zero-coupon bonds at face value from the governments of dollarizing countries that undertake sound budgetary practices and that liberalize their financial markets.

[25] The Eurosystem comprises the subgroup of ESCB central banks that have adopted the euro.

[26] In the ESCB, monetary income allocation is ruled by articles 16 and 32 of the ESCB Statute, along with Decisions ECB/2001/15 and ECB/2001/16.

The widespread use of bonds in open market operations and its preferred status over other assets can be said to rest firstly on the broader impact achieved by dealing in bonds. Net bond purchases by a central bank tend to lower the cost of borrowing funds and stimulate investment. Further to this point, government bonds are singled out because they normally act as benchmarks for private borrowing price setting. In addition, government bonds also fulfil a precondition that ensures a high speed of adjustment to price changes; namely, the widespread distribution of government debt holdings among agents typically accelerates responsiveness to actions of control. Obviously, these statements about efficient monetary policy tools rest on the precondition of having mature government and money markets[27]. As a matter of fact, it turns out to be a widespread phenomenon that central banks tend to be quite involved in the development of government debt market infrastructure in early stages[28]. Notwithstanding such commonalities, some central banks (e.g., US Fed) rely more intensively on outright transactions than on repurchase agreements (e.g., the Eurosystem) as instrument for open market operations. The different degree of use of repurchase agreements may reflect various factors: the different importance in financial markets of such operations, a disparate secular rate of growth of the central bank portfolio, existing constraints and, possibly, and more important for the purposes of this paper, a dissimilar perception of central banks themselves on the need to limit their interest rate risks.

As an alternative to government debt, market-based monetary policy operations can also be implemented with securities issued by the central bank itself. This is a practice mostly followed by countries in transition, especially those plagued by problems of excess liquidity due to previous policies[29]. For the purposes of this paper, the interesting feature of such central bank issued monetary policy instruments lies in the fact that they may lead to a reduction in central bank profits or even to losses if they have to be issued in large amounts. One just needs to notice that their mere placement among commercial banks under market conditions entails a costly liability to the central bank. It is important to stress that such an outcome can be crucial for the continuity of reforms in central banks in transition countries, if their financial performance is assessed in isolation, i.e. without reference to the goals of the transition process[30].

Leaving aside the described impact of central bank issued securities, monetary policy control based on "outside securities", can be said to be largely neutral for the finances of central banks relying more intensively in repurchase operations. The reason for that is the normally tight matching pursued between short-term assets and liabilities.

It is not the purpose of this paper to cover these aspects in detail. Borio (2000), Blenck *et al.* (2001) and Kopcke (2002) survey some of the issues surrounding monetary policy implementation from a

[27] The case for bonds in central bank balance sheet is valid no matter if the instrumentation procedure is based in a short-term interest rate (see below) or a longer term reference as reminded by Bernanke (2003) in connection with unconventional monetary policy options to combat deflation. In the former case, well functioning repo and money markets capable of transmitting monetary impulses to longer maturity terms are a key precondition. As money markets develop, repurchase agreements suit the efficient execution of policy in comparison with standing facilities. They allow central banks to limit their risks, adjust the terms of their transactions (such as amount, maturity, frequency, and tender system) to match market conditions, trade with more counterparties, and expand the assets backing market operations.

[28] For a thorough discussion of monetary implementation issues in transition countries, see Sundararajan (1997).

[29] More precisely, countries plagued by problems of excess liquidity where, in addition, resorting to the primary market of government debt as liquidity draining device entails coordination problems with the issuer (government) and, consequently, a deterioration in the operational independence of the central bank.

[30] The financial performance of central banks that still follow non-market-based monetary policy procedures is not easy to characterize. Non-market-based monetary policy procedures can be broadly defined as administrative measures aimed at the control of money and credit without no regard for the willingness of the financial intermediaries involved to serve that purpose under those conditions. Non-market-based monetary interventions amount thus, ultimately, to implicit taxation-subvention policies across the financial system. From this perspective, the direct impact of non-market-based procedures on central bank's financial statements from less developed countries is any income obtained by the central bank from financial transactions penalizing intermediaries in addition to the cost associated with the deployment of the necessary resources to manage the administrative system in place.

comparative perspective. However, a brief summary of standard aspects of the process will be helpful to introduce the concept of central banks short-term interest rate risk exposure.

The immediate step whereby monetary policy control actions find a reflection in the balance sheet of the central bank is the phase of liquidity control of the reserves market. The gross magnitude of those actions depends on a diverse set of conjuncture, institutional and strategy factors. In some countries monetary authorities force deposit institutions to periodically keep as reserves in their central banks some fraction of the transactional deposits maintained by their customers[31]. This forced demand for reserves brings about recurring refinancing needs for commercial banks, whose magnitude is modulated by the evolution of autonomous factors contributing to liquidity creation or destruction in the reserves market. Refinancing operations are thus conducted, generally speaking, with the neutral objective of covering aggregate remaining reserve needs as well as the policy one of driving the pricing conditions in the reserves redistribution market (interbank deposit market).

Reserve requirements have been sometimes used also as instruments to levy taxes on the financial industry. Although lacking a reserves requirement system, the "deposit cash ratio" envisaged by the Bank of England Act 1998 to fund its non-remunerated operations (monetary policy and financial stability) illustrates a modern update of an old solution[32]. However, altogether both reserve balances and refinancing operations have normally evolved to have a very limited quantitative impact on a central bank's financial position. On the latter count, one should notice that, to the extent that the policy objective requires just an influencing ability on money market rates in the margin, just a minor part of the central bank balance sheet needs to intervene. Notice the coincidence of this perspective with the remarks by Friedman (1999) on the disparity between the size of open market operations and the one of the markets that they are supposed to drive. Namely, Friedman makes the vivid example that the difference between a tight and lax monetary condition in the US in a given year corresponds to a tiny difference between net purchases of securities by the Federal Reserve over the period[33]. Consistent with that argument that emphasizes the policy relevance of conditions at the margin, it needs to be stressed the bulk of the central bank balance sheet can deviate in practice from Cagan's theoretical recommendations. This is often in practice the case and, therefore, a sort of validation of the central bank asset side irrelevance proposition outside a pure theoretical frame.

Sure enough, central bank refinancing outstanding balances are often moderate in relative terms (see chart 1). A diverse set of forces, most notably a trend towards a market-based approach to policy-making, has driven ratios of required reserves to low values, close to their technical minimums. This effect is still more noticeable where financial innovation/deregulation, allows depository institutions to economize on reserves requirements, as exemplified by the sweeping

[31] In other countries, additional required balances are envisaged. For example, in the US depository institutions that use Federal Reserve payment services may establish the so called clearing balances. Their nature would recommend dealing with their financial implications (minor ones) in section 4.4.3. However, they are referred to here for the sake of completeness, because their dynamic is partially linked to the one of required reserves (for details see Meulendyke (1998). There are also countries, like Australia, Canada, the UK or Denmark, where there is no reserve requirement system in place. Thus settlement balances determine in the margin money market rates. The Danish system is specially peculiar due to the fact that the central bank can be said to intermediate to some extent the money market. However, the effect is largely neutral on central bank finances.

[32] Under the cash ratio deposit scheme, certain institutions authorised under the Financial Services and Markets Act 2000 to accept deposits (such as banks and building societies) place non-interest bearing deposits at the Bank of England. The Bank invests these deposits and the income earned is used to fund the costs of the Bank's sterling liquidity, monetary policy and financial stability operations, which benefit sterling deposit takers. In this regard, it is important to remind that in the UK seignorage from banknote issuance flows directly to the government. The ratio (currently, 0.15% of eligible sterling deposits over a threshold) is set by the Treasury.

[33] Namely, given the volume of total reserves the difference between a 2% and a 10% growth of reserves over a year corresponds to net purchases by the Fed of 1 billion or 5 billion of securities.

accounts practice in the US[34] or where vault cash may also serve them to fulfil their reserve obligations.

In terms of financial impact on central bank earnings, the overall effect of small gross positions in the asset and liability side that practically match each other is inevitably low both in terms of income and risk, when remuneration of required reserves is analogue to the one of refinancing operations. As a matter of fact, situations close to income neutrality can also arise under schemes where required reserves are not remunerated as in the US. Regulatory forbearance with regard to sweep accounts and flight of deposits away from the "taxed" banking system can end up more than compensating the intended collection of income. In terms of financial risks, recourse to closely matched temporary operations allows central banks to limit their risks even if they expand their range of eligible assets. Importantly, such operations mitigate the need for these central banks to define, manage, and maintain significant capital or valuation reserves.

Both outright and repurchase-based open market operations should refer to thoughtfully chosen underlying instruments. So far the optimal quality of government debt has been emphasized. However, outside ideal conditions other alternatives must be employed[35]. The set of issues that such departure elicits goes beyond the scope of this paper in its full entirety. However, it seems appropriate to make some remarks on the incidence of such second-best choice of underlying assets on central bank's financial risk-return profile.

One should notice first the deep differences between eligible assets criteria for outright operations and those relating to the underlying of temporary operations: whereas the former entail direct central bank exposure to credit, liquidity and interest rate risks, the latter alternative involves basically a contingent exposure[36]. As a result, acceptability criteria can be laxer. Blenck *et al.* (2002) document how the criteria followed in the three main monetary areas for the eligibility of assets underlying operations substantially differ, depending on they being temporary or outright ones. Outright holdings tend to be restricted to government debt. The impact of direct credit risk exposure on central banks' balance sheets will be dealt with later on.

As regards temporary open market operations backed with risky assets, the basic observation profiling a central bank's risk-return is that both the central bank counterparty and the name underlying the assets supplied by the former must collapse before the central bank incurs significant losses on its collateralized exposure. The use of haircuts effectively approaches exposure and collateral amounts, so that the uncollateralized part gets close to zero. Cossin *et al.* (2003) have derived an analytical framework to determine haircuts so that desired probability that the central bank will incur a (unitary) loss higher than certain pre-specified level (l) can be matched. Although their results are derived for government debt collateral, they can be generalized for private assets. In other words, quantitative tools exist to measure central bank capital necessary to back refinancing lending exposure. Obviously, the capital is proportional to the product of l and the volume of refinancing operations (RF). One aspect not covered by the approach followed by Cossin *et al.* (2003) is correlation risk. If private assets are acceptable as collateral, double-default may become a sensible concern. However, generally speaking, correlation risk is quantitatively of a minor

[34] Since January 1994, hundreds of banks and other depository financial institutions have implemented automated computer programs that reduce their required reserves by analyzing customers' use of checkable deposits (demand deposits, ATS, NOW, and other checkable deposits) and "sweeping" such deposits into savings deposits (specifically, MMDA, or money market deposit accounts). Under the Federal Reserve's Regulation D, MMDA accounts are personal saving deposits and, hence, have a zero statutory reserve requirement.

[35] Examples of situations where the optimum might not prevail can be: (i) the government debt market dramatically shrinks (see Federal Reserve System (2002), for a systematic study of the alternatives thought out in the US for such a situation); (ii) the demand of government debt to back open market or payment system operations grows beyond available effective supply (taking into account any existing segmentation in markets). The ESCB is an example of central bank reviewing its asset policy on the latter grounds. For similar reasons, in Switzerland forex swaps have traditionally been the primary instrument for managing bank reserves.

[36] Obviously, both classes share the costs required to run the systems in charge of screening and monitoring credit risk.

magnitude. This is specially the case if anti close-links provisions are applied to the universe of eligible underlying names by every central bank counterparty, i.e. if banks can not deliver as collateral paper issued from a company that would most probably share its destiny if it ever defaulted. In other words, there is scope for quite laxer criteria as regards the universe of credit names eligible for temporary open market operations in comparison with outright ones. Obviously, the analysis supporting central bank capital coverage of temporary operations must take into account carry or liquidation costs of lower quality assets if fails[37].

All in all, the eligibility frontier for assets underlying temporary open market operations can be said to be an awkward problem. Although the sort of financial arguments given before delineate part of the answer, operative considerations may alter the final response. Theoretically speaking, the eligibility frontier of private assets in terms of their credit profile should balance the benefits derived from the operational goals that justify its choice and the (contingent) costs that they may entail.

4.1.2. Foreign assets

There are many rationales justifying that countries hold certain amounts of official foreign currency reserves. Trade and debt servicing reasons stand as the most basic motivation for holding foreign reserves. Exchange rate targeting is obviously a major reason to have the means to exercise the intended control on the external value of one's currency, i.e. to intervene in the fx market. The ability to exercise control on exchange rate volatility may also force to possess the resources to either exert smoothing interventions on the external value of one's currency or to limit the dynamical range of overshooting situations. The widespread opinion also exists that the role and management of reserve assets should be conceived alongside external liabilities with a view to enhance credit rating standing and confidence. Lower in the ranking, but also important for smaller countries, stand rationales for holding foreign reserves based on microstructure grounds, so that liquidity and effective convertibility can be ensured. Domestic monetary policy implementation purposes may even lead to instrument operations in terms of foreign currency swaps[38].

In terms of risk, the relevant variable is obviously central bank net exposure. In other words, gross exposures may offer a distorted view of actual risk. For instance, forex swap-based open market operations are by definition free from exchange rate risk[39]. The achievement of some policy objectives may even not require net exposure to fx risk at all. For instance, liquid foreign exchange holdings financed in the foreign currency may suffice for some fx-market microstructure goals, as pointed out by Archer and Halliday (1995).

The size of optimal gross exposures is an awkward question being outside the scope of this paper. Mulder (2000) offers a review of approaches followed to determine it. Existing guidelines are not very precise, especially as regards a maximum figure. Respondents to the latest questionnaire on reserve assets management conducted by Pringle and Carver (2003) confirm the fuzzy nature of the problem. Countries that experienced important currency crisis in the recent past or that have adopted fixed exchange rate systems, like some Asian ones, have accumulated significant volumes of reserves[40]. Elsewhere the assessment of the success of sterilized intervention strategies has somewhat downplayed the rationale for too large holdings of foreign assets.

[37] These costs can be reduced if the central bank has in place selling procedures for assets acquired as a result of counterparty default situations.

[38] The shrink of the government debt market in Australia and New Zealand has driven these countries towards a practice that was traditional of Switzerland.

[39] Even if just one leg of the operation is recorded on-balance, the off-balance forward leg neutralizes currency risk exposure.

[40] In 2002, the volume of reserves in terms of GDP had a world average of 7.8 %, whereas seven Asian economies had fx reserves that accounted more than 30% of their GDP.

This view, along with clear priorities between monetary and exchange rate policies, has even led to extreme positions, like the one posted by a Fed President, who suggests that the Fed should disengage from foreign exchange operations completely[41]. The diversity of issues at stake when considering the optimum size issue probably hinders any general conclusion. However, the important thing for the purposes of this paper is the fact that, whatever the decision ends up being, it is grounded on sound policy considerations and supported by solid governance arrangements. The reason for this caveat is due to the fact that foreign currency reserves turn out to be crucial for central bank financial independence. In other words, all else equal an excess of foreign assets may end up compromising central bank financial strength. Consequently, foreign assets holdings due to rationales other than those corresponding to central bank mandates should be subject to special financial arrangements between Treasury and central bank if a financial distress situation could lead to distortions to central bank behaviour.

The decisive role of foreign assets for central bank financial strength can be justified with two kind of arguments. Foremost, holding foreign currency denominated assets financed with one's currency has a hazardous impact on earnings for obvious reasons: namely, exchange rate risk-based investing is exposed both to the gyrations experienced by the exchange rate and by the asset price itself. The exposure to currency risks does not necessarily imply some immediate damaging effect. For example, it is remarkable that the break-up of a hard peg may lead to large capital gains (even if hidden) to the monetary authority, if the defence of the fixed exchange regime has not exhausted its external assets holdings. Nevertheless, central bank financial independence might ultimately also suffer from such apparently beneficial event[42], if it ends up leading to an inadequate distribution of central bank profits. As a matter of fact, absent an adequate central bank financial framework, a cash constrained government might have fiscal incentives to break up its peg commitment earlier than speculative attacks models usually assume.

Focusing now the analysis on the effect of external assets price volatility, security and liquidity restrictions on eligible assets for investment have set in practice an indirect limit to the acceptable degree of sensitivity to market conditions that reserve assets may exhibit. In practice, this has traditionally implied a bias towards investments in shorter term assets. When the volume of reserve assets is large enough, liquidity and security requirements may apply to just some "tranche", thus allowing a return oriented strategy for the rest of the portfolio. Altogether, the risk profile of net foreign assets imposes the need to apply risk-budgeting techniques so as to reconcile policy goals and financial strength[43].

The second type of arguments to focus the attention on foreign assets holdings when discussing central bank financial independence issues becomes clear when one adopts a cross-country perspective on where are those holdings effectively booked, i.e. when one looks at the institution (central bank or government) that holds he title of property on reserve assets . Differences in this regard reveal that the rationale for reserve assets has not been interpreted uniformly across jurisdictions. The assignment of property rights on foreign assets to the central bank or the lack thereof underlies the distinction sometimes made between narrow and broad oriented central banks.

In this respect, it is noteworthy to mention that in most countries reserves are managed by the central banks, and in the majority of cases reserves are part of the balance sheet of the central bank. However, there are some significant counterexamples to such rule (e.g., the United States, the UK, Canada, and Japan), where reserves are formally and explicitly owned by the government, even if

[41] See Broaddus and Goodfriend (1996).

[42] The perspective here is strictly a central bank financial one. From a macroeconomic perspective, such events are indisputably situations of short term crisis and distress.

[43] From a central bank perspective, Lavigne (2003) sketches the elements of risk budgeting.

the central bank may still be closely involved in their management[44]. Nugée (2003) presents some of the arguments for the different institutional alternatives, history and precedents not being minor ones. It is important to emphasize that the will to management assets alongside external liabilities happens to be an important reason. The important observation for the purpose of this paper is that, whenever reserves ownership falls outside the central bank, the allocation of earnings and risks arising from that portfolio correspond to the government budget, and, therefore, that leaves basically unaltered the financial position of the central bank. Interestingly, the questionnaire conducted by Pringle and Carver (2003) also reveals a sample of central banks that implicitly undertake macro-hedging activities without caring about the existence of financial arrangements to share risks between the government and the central bank itself. The first column in chart 1 conveys a comparison of net foreign assets as a proportion of total assets in a sample of central banks that includes the Federal Reserve System, the Bank of England, Bank of Japan and the Eurosystem.

All in all, the main threat to central bank financial position from foreign assets holdings appears to be exchange rate risk. Unlike market risk, it is less susceptible to control. The ability to fully hedge the exposure with derivatives is normally limited both on practical and policy grounds. In other words, it looks as if on a market value basis central banks' financial statements must necessarily reflect as capital gains and losses the year-on-year gyrations imparted by exchange rate risk exposure, i.e. no margin for inter-temporal smoothing mechanisms like those operating in the domestic debt portfolio seems to exist. However, this conclusion proves to be wrong.

As it happened with the government debt portfolio, it is also a common misconception to contemplate foreign assets from an isolated perspective, i.e. just as an asset portfolio without associated liabilities. Not considering the funding of the assets may be a reasonable working assumption for the day-to-day activities of the portfolio managers. However, this paper intends to go beyond such a partial perspective.

From a more integrated standpoint, it should be evident that the return of a highly liquid foreign currency denominated portfolio funded in that same currency will normally tend to be either small or negative. The inter-temporal properties of the risk-return profile of central banks' uncovered exposures, although less evident, are very relevant for the purposes of this paper. Investments on short-term foreign currency denominated assets yield interest plus principal valued at the end-of-period exchange rate. If interest rate differentials were unbiased predictors of future exchange rate movements, this would approximately imply that reserves assets financed out of monetary base would yield around the same return as short-term domestic currency denominated assets do. However, it is well established that the "uncovered interest parity" theory performs poorly on short-term horizons. In a survey of 75 published estimates, Froot and Thaler (1990) report few cases where the sign of the coefficient on interest rate differentials in exchange rate prediction equations is consistent with such hypothesis.

However, Chinn and Meredith (2002) have tested the hypothesis for long horizons and found empirical evidence consistent with it. Thus, from a longer term perspective [5 years, in Chinn and Meredith (2002)] time becomes a natural hedge to resort to, so that the otherwise contemporaneously volatile earnings from uncovered reserves can be smoothed out. Section 6 will resort to this conclusion to justify a proposal of minimum central bank capitalization across a cycle. Notice that the hedge is a statistical one and, therefore, no rule on the choice of the averaging horizon can be proposed a priori.

[44] In the countries mentioned above, official reserve assets are held by local versions of the US Exchange Stabilization Fund, i.e. funds maintained by the government for the purpose of promoting the order and stability of the currency on the foreign exchange market. However, in the US the Federal Reserve System has gradually evolved towards a deeper albeit subordinated involvement in fx interventions. In particular, since 1980 an amendment to the Federal Reserve Act allows the system to invest its foreign-exchange holdings in obligations of foreign governments and interventions are typically equally split between the Fed and ESF accounts. See Humpage (1994).

The discussion so far has made no distinction between the financial impact of unrealized capital gains&losses on foreign exchange holdings and realized earnings from their sale. Ultimately, this should not be a big surprise since revalorization and income are equivalent under a full fair value accounting scheme. Nevertheless, differential effects may arise if central banks also practice off-balance interventions[45] whose market value is not accounted for in a symmetric way to the one employed for on-balance holdings.

The reference to differential effects in the case of interventions based on derivatives is not intended to be an exercise of academic precision-making. Certainly, an asymmetrical accounting may be judged as an inconsistency from a pure theoretical perspective. More importantly, however, there have been important cases of asymmetrical accounting of off-balance based interventions that have led to situations of central bank financial stress. Price (2003) reports how back in 1967 the UK used forward transactions in a large scale to hide a wakening position of the pound and to delay remedy actions. Eventually, the devaluation could not be avoided. The financial impact of the strategy reached an accumulated loss around 6% of GDP. Certainly, this outcome did not impact directly on the financial statement of the central bank, given its condition of agent for the government in this case. However, the episode vividly illustrates the potential damaging impact of contingent exposures for central banks' financial position. More recently, a similarly obscure accounting framework for forward interventions on the eve of the Asian crisis led to important losses for the Bank of Thailand.

4.2. Credit policy

Section 4.1 has discussed the financial implications of conventional fiat money backing policies. Now under the credit policy heading, the subject of analysis will be the rationales and implications of deviations from conventional central bank asset composition.

4.2.1. Domestic credit policy

Previous sections have established that the natural backing of base money is government debt. As pointed out before, this contention is not free from trade-offs if a world where private money is considered as a feasible alternative, or, if government debt markets are not sufficiently developed. The issue for discussion in this section is the realistic case of central-bank-issued fiat money whose cover is not restricted just to government liabilities, i.e. with private assets also eligible to back money. Leveraging on Cagan's arguments presented above, it can not be said that central bank asset composition policy is neutral on the capability to exert monetary policy control. However, it has already been stressed the fact the relatively minor amount of central bank assets necessary to set the monetary policy tone determines that, in practice, the composition of the central bank portfolio is not necessarily crucial from a pure implementation perspective in normal times.

The assessment is more negative both in theory and practice when credibility considerations are taken into account. An outspoken credit policy entails various risks for central bank independence. By definition, credit policy involves granting guarantees to private borrowers[46]. If their pricing does not respect market conditions, a bold central bank credit policy poses the risk of interferences with fiscal policy goals. As a matter of fact, the risk is material even if the pricing ex-ante reflects market conditions: signalling effects can easily drive credit market conditions in the direction of central bank portfolio choices. As pointed by Broaddus and Goodfriend (2001), a quid pro quo approach to

[45] In an off-balance intervention, a central bank typically defends its currency by selling spot the foreign currency borrowed through a forex swap transaction.

[46] Any credit title can analytically be decomposed into a risk-free investment and the sale of a put on the name underlying the credit.

inter-institutional relations counsels central banks not to interfere with fiscal policy if independence is a valued attribute. From a different perspective, bold credit policy would imply that central bank and financial intermediaries compete to some extent. The scope for perverse conflicts of interest capable of put at risk central banks' reputational capital is obviously large.

On the positive side of the balance, backing outside money with domestic credit would top up monetary income. However, the magnitude of its costs, together with the fact that central banking does not have profit maximization as primary goal, makes of domestic credit policy a rarity among central bank practices. Altogether, practice in the three main monetary areas disregards private securities as a vehicle to back permanent monetary base injections[47]. A central bank investment policy that deserves further research is one intended to balance prons and cons of private assets and formulated in terms of broad indexes of (private) assets.

4.2.2. External credit policy

Section 4.1 adopted the neutral position that foreign assets may naturally belong to central banks' assets for various reasons, and, most importantly, for monetary policy targeting reasons. The discussion there focused on the exchange rate risks that holding uncovered foreign assets entail. In this section the focus is placed on the quasi-fiscal dimension that may derive from exchange rate commitments and from assets held for that purpose. From a principles perspective, it may appear inconsistent splitting in two sections the discussion on the financial implications of foreign assets held by central banks because of monetary policy reasons. However there is a reason for that. Namely, external credit is an outspoken policy in hard peg regimes that typically entails a running financial impact. In other words, under hard peg regimes it is no longer true that monetary policy operations aimed at controlling domestic base money have insignificant impact on central banks finances.

From an autarky perspective, it is obvious that granting external credit has no policy justification. However, external credit policy becomes crucial when exchanges with the outside world are taken into account, be it because of the intensity of trade or because monetary policy itself is imported. Even if the focus is outside exchange rate risk, external credit policy is still understood here as granting credit to foreign institutions in foreign currency. In other words, the financial arrangements surrounding federal-like central banks, where granting external credit through intra-system accounts is implicit to the operations of the overall system, is outside the intent of this section. They will be dealt with separately in section 4.4.2.

The main external credit based mechanism modulating central banks' earnings has normally to do with the quasi-fiscal costs arising as a consequence of the automatic transfers of income implicit to exchange rate pegs. Under an exchange rate peg, just as exporters and importers may end up exchanging subsidies at each other's expense, suppliers of capital inflows may benefit at the expense of central banks committed to parity maintenance.

For several reasons, countries resist capital inflow surges[48]. The choices available to policy makers wishing to stem capital inflows are limited. Policy makers confronted with a surge in capital inflows can either implement some form of capital control, through either a quantitative restriction on inward capital movements or a tax on these movements, or attempt to mitigate the inflationary impact of these capital flows by sterilized exchange rate intervention. Sterilization is usually the first policy response to a sudden rise in financial capital inflows. Under this policy, central banks swap domestic securities, such as government treasury obligations, for incoming foreign assets. The

[47] See annex 4 in Blenck *et al.* (2001).

[48] See Reinhart and Reinhart (1998).

net impact of a sterilization exercise is that the monetary base is unchanged, but the share of foreign reserves in central banks' asset holdings has increased.

Sterilization entails normally costs, as central banks either exchange domestic government debt for foreign securities typically paying lower nominal yields or take on the foreign assets and issue base money draining liabilities. Moreover, these swap driven sterilization costs are normally topped by the impact of tighter money market conditions in terms of higher central bank interest rate expenses. As implicitly admitted in the introductory statement to this subsection, sterilization costs are incurred with monetary purposes in mind. However, it is also true that the authority over the external value of one's currency falls normally upon governments and that institutional arrangements are feasible alternatives to transfer sterilization costs to the budget[49]. From this perspective one can qualify central bank sterilization costs as quasi-fiscal ones, even if they literally do not conform to the definition given by the IMF[50]. The usefulness of such categorisation derives from the application to central banks of information provisions for quasi-fiscal activities similar to those contained in IMF Manual on Fiscal Transparency[51].

Generally speaking central banks from transition countries are more susceptible to any type of quasi-fiscal costs including sterilization-driven ones. For example, Hanke and Sekerke (2003) report how losses to Costa Rica from an exchange rate subsidy amounted to 4.5% of GDP or, similarly, an exchange rate guarantee on foreign currency deposits in the former Yugoslavia cost the central bank around 19% of GDP. More widespread are examples of bulky sterilization costs. Macroeconomic stabilization in emerging countries often entails the need to engage in some sort of exchange rate pegging as a credibility-enhancing device. Initial success in reforms leads quite often to explosions of capital inflows obeying to some degree an interest-rate-mediated feedback mechanism: efforts by the central bank to contain the inflationary and destabilizing effects of capital overflows by means of sterilization actually straighten money market conditions, what in turn attracts "hot money". Latin America countries vividly experienced the operation of such a mechanism in the first 80s and 90s[52]. Kiguel and Leiderman (1993) indicate that during 1990 to mid-1992 Chile's central bank losses due to sterilization policies were about 1.4 percent of GDP. Among other examples, Markiewicz (2001) estimates for the Czech Republic a loss amounting to 2.8 percent of GDP in 1998.

4.3. Financial stability policy

Monetary policy functions have long shadowed the key role played by financial stability motivations in the emergence of central banking. This short-sighted assessment has recently been surmounted under an interpretation of financial stability policy broader than a strictly banking policy based one. However, banking policy still remains the core element of financial stability measures. Banking policy may be defined as regular lending and emergency financial assistance to individual banks and similar institutions. The recurrent low risk profile of regular lending has already been covered in section 4.1.1.2. Therefore, henceforth it is considered to basically entail the provision by central banks of line of credit services to solvent but illiquid commercial banks in situations other than regular ones. Undisputedly, a central bank has a unique role to play as lender in

[49] Exchange Stabilization Accounts (see section 4.2.1) may serve such purpose.

[50] The perspective adopted here resembles the one adopted by Mackenzie and Stella (1996, p.18), who define quasi-fiscal activities of central banks and other public financial institutions as "operations or a measures carried out by a central bank or other PFI with an effect that can, in principle, be duplicated by budgetary measures in the form of explicit tax, subsidy or direct expenditure and that has or may have an impact on the financial operations of the central bank, other PFIs, or government."

[51] The IMF Manual on Fiscal Transparency states in its item 74 that the annual report of the central bank should indicate any non-monetary policy activities conducted on behalf of the government. Here, a reinterpretation of this statement is considered so that whenever sterilization costs are significant an analogue transparency regime is applied.

[52] Kaminisky (2003) reviews the history of capital flows to Latin America.

[53] Goodfriend and King (1988) rightly compare private line of credit fees with penalty rates recommended by Bagehot.

liquidity-driven crisis situations, due to its ability to commit unlimited liquidity resources as well as to act with the required speed. In passing, let us remind that liquidity is by definition a wide ranging concept. In particular, one may also consider credit policies followed by central banks to cover timing mismatches in wholesale payment systems as an integral part of their banking policies.

An ideal banking policy should be neutral as regards its impact on central bank's financial position. In accordance with Bagehot's classical dictum lender of last resort policy, an ideal banking policy is one whose implementation allows perfectly discriminating between solvent and illiquid institutions and in addition central bank funding is adequately collateralized. In other words, a good banking policy should not entail more financial costs than those needed to run regulation and supervision departments as well as a collateral management one, i.e. the costs needed to screen out and cover central bank exposures. Lending at a penalty rate, as also recommended by Bagehot, should help the central bank to recoup some those of expenses although its basic purpose is to discourage subsidized borrowing[53]. Significantly, the Federal Reserve System has recently joined the club of followers of Bagehot: primary and secondary standing facilities with increasing penalizing interest rates define, respectively, a corridor for overnight interest rates and a lender of last resort facility[54]. Consistent with their different purposes, it is worth to notice the broader set of eligible collateral for standing facilities as compared with open market operations. However, protection of the financial integrity of the central bank is still judged as a basic constraint[55].

Elsewhere, central bank protection and splitting of monetary and banking policies has lead to outright departures from Bagehot's proposition. Thus, in some jurisdictions it is understood that the banking system may sometimes be in a better position to act as lender of last resort and, in accordance with such view, open markets operations serve both for monetary and regular banking policy purposes. For example, Germany instituted in 1974 a Liquidity Consortium Bank (Liko Bank) where the various categories of the German banking industry and the Deutsche Bundesbank hold participating interests. In a crisis, the Liko Bank can grant short-term liquidity assistance to institutions which are considered to be solvent and have run into liquidity difficulties through no fault of their own. The Liko Bank is financed through capital and reserves which can be increased by virtue of an obligation on the part of shareholders to make further contributions and by bills of exchange whose standing is assured by corresponding signatures of other banks. Such securities can be used as blue-chip collateral to obtain funds from the Bundesbank. In Tietmayer's (1999) words, Liko Bank acts as a next-to-last resort lender.

In practice, it may be far from true that banking policy has a mild impact on central banks' financial position because of the difficulties to distinguish between solvency and liquidity problems. The viability of private liquidity provision to a stressed institution is often curtailed by doubts in the market about its solvency, so that recourse to lender-of-last-resort quickly precipitates, thus leaving the central bank not much margin to carefully examine its books. The scale of the problem is compounded when the bank facing a crisis is big from a systemic risk perspective. Dealing with the banking regulation and supervision arrangements necessary to cope with these and similar problems is obviously outside the scope of this paper. The role to be played by central banks in these arrangements is frequently a subject of controversy. However, informational economies and financial muscle reasons justify that central banks are involved in the prevention and management stages. At any rate, the relevant issue to consider for the purposes of this paper is the trade-off

[54] See Federal Reserve System (2002).

[55] Kaufman (1999) reports that under the old discount window program no Federal Reserve bank ever reported a loss on its loans, even though 90% of the banks that received extended emergency credit subsequently failed.

inherent in the provision of banking system stability by means of lender-of-last-resort actions, i.e. banking system stability versus central bank financial deterioration as a result thereof[56].

In order to tackle that issue, it is enlightening to consider the amount of the costs of banking instability. Hogarth and Saporta (2001) have estimated both fiscal and output costs of 24 major crises. Although varying markedly from crisis to crisis, cumulative fiscal losses have been large – around 16 percent of GDP for the whole sample. Banking crisis alone, i.e. excluding cases where both banking and a currency crisis took place, amount on average a less daunting 4.5 percent of GDP. However, this figure typically covers normal central banking profits several times. Thus, the scale of funding necessary in some banking crisis goes far beyond the sums which the central bank can provide from its own resources. At such juncture, Goodhart and Schoenmaker (1995) along with many others rate negatively the possibility that a central bank exercising supervisory functions might (temporarily) give up its monetary policy goal if a rescue operation needs to be funded. Obviously, this judgment is valid if efficient rescue funding alternatives are available that respect the joint offer of monetary control and supervisory functions.

As a matter of fact, explicit deposit insurance has become a principal feature of policy advice on financial architecture partially on those grounds. Today, most OECD countries and an increasing number of developing countries feature some form of explicit depositor protection. Deposit insurance appeal is twofold. Firstly, it may contribute to the stabilization of the financial sector by avoiding bank runs. Secondly, and of special bearing on this paper, it may serve as a budgetary buffer to the banking crisis costs and, therefore, a seemingly costless solution. These interesting features may however come at the price of moral hazard. In this regard, central banks exercising supervisory powers have the adequate expertise to offer input in the arrangement of deposit insurance models that are both efficient and somewhat protect the integrity of the lender of last resort.

A key variable of deposit insurance schemes as regards central bank financial protection in a banking crisis situation is the amount of assets accumulated by the fund to cover outlays under normal circumstances. It is often acknowledged that it may be too costly for the banking system to maintain a fund capable of funding pay-out of deposits of the largest banks, so that IMF experience across countries shows that fund's size targets should be set as some percentage of insured deposits that would enable to cover deposits in a number of medium banks' crisis[57]. Thus, even normal size crisis might reach the central bank even with a deposit insurance scheme in place. Furthermore, in some jurisdictions loss-sharing agreements between the central bank and the deposit insurance fund are imposed because of the incentive problems that might arise between them[58].

Further to the argument of impossibility of total protection, it may be added that deposit insurance schemes are normally insufficient to cope with systemic crisis. For example, the Federal Savings and Loans Insurance Corporation of the US ultimately bankrupted in 1992 after accumulating large losses throughout the 80s due to the Savings and Loans crisis and being recapitalized in several occasions. The ensuing reform in US regulation biased the crisis funding burden away from taxpayers towards prompt action and co-insurance solutions[59]. Notwithstanding the possibility of such a resolution funding approach, in many cases there is no other alternative than resorting to

[56] Notice that a hypothetical quest for central bank financial insulation in a banking crisis situation should not be understood as synonymous of policy indifference to it. In fact, the latter can seldom be the case since a banking crisis almost inevitably brings about alterations in money demand and output gap in the short and medium term.

[57] For a survey on deposit insurance models see García (2000).

[58] In the US, the FDICA, in addition to limit discount window lending to undercapitalized banks, also specifies that the Board of Governors shall be liable to the FDIC, if additional credit is extended to a critically undercapitalized bank 5 days after the bank is so classified. The issue at stake is the possibility that lender of last resort action may be stripping bank's collateral and thus stripping enlarging the risk for the deposit fund.

[59] See Ely (1999).

taxpayers pockets. Goodhart and Schoenmaker (1995), reporting how major crisis up to 1993 have been handled and financed, confirm that the balance of funding has effectively shifted in time to using taxpayers' money and in very few occasions central bank's money has paid the bill. Special funds have thus been put in place by the government in Sweden, Japan etc. to channel budget funds[60].

However, it seems important to emphasize that the outlined trend towards budgetary forms of crisis funding does however not preclude that central banks have sometimes to urgently have to post advances. In emerging countries, lack of institutional development or limited access to capital markets may hinder banking crisis resolution schemes that would leave unaltered central bank's balance sheet. Jacóme (2001) documents several cases in Latin America where the central bank was directly involved in the crisis resolution. The major flaws in monetary legislation in the period covered by the study refer to the absence of limits to the engagement of the central bank in lender-of-last-resort operations in most countries. The pursuit of central bank financial independence advices to adequately enshrine in law the terms for funds restitution to the monetary authority of funds advanced[61] or costs incurred.

Protracted situations of systemic crisis can lead to significant departures of central bank balance sheet structure from orthodox standards. Japan is a paramount example of novel balance sheet policies aimed at maintaining financial stability. Ample provision of liquidity to ensure that banks could meet their funding needs without difficulties has implied the adoption by the Bank of Japan of a program of outright government debt purchases since end 2002. A more radical departure from the classical orthodoxy elicited by Cagan have been the Bank of Japan initiatives to buy asset-backed securities in order to strengthen the monetary transmission mechanism as well as its program to help banks reduce their equity risk by buying banks' shareholdings. Ultimately, one interesting perspective, where these measures welcomed by the IMF[62] may be framed, emphasizes a substitution relationship between Japanese commercial banks (insufficient) capital and central bank equity. The Chilean case can be said to also fit to some extent such a description. The costs of the banking crisis in the first 80s were massive and mostly borne by the central bank, which initially funded emergency loans with bond issuance. Subsequent compensation by the government with long-term dollar denominated government liabilities exposed the central bank to peso appreciation in the 90s. As a result, the Central Bank of Chile has long exhibited since then negative net worth and losses. However, the Chilean economy recovered from the banking crisis at a higher pace than other count.

As a conclusion to this section, the usual reminder applies that the first-best response to financial stability risks is always obvious: a robust regulatory regime for the banking and financial sectors should be in place so that the scale of failures is limited by an incentive structure that reduces the incidence of bad banking and through early intervention of the authorities in failing banks. The financial component dealt with in this section emerges when the first-best policy fails. Contingent planning and financing sources should be in place to cope with the problem. Honohan (1999) sketches a methodology for fiscal planning for banking crisis. Although the budget is the natural funding mechanism for crisis resolution costs, the participation of the central bank may eventually also be decisive as financing-bridge solution before permanent ones are implemented. Even this limited role imposes to maintain a capital buffer to cope with some stylized "normal" crisis. The problem formulation is in its essence not much unlike the one faced by central counterparties, which must arrange the financial means to cope with the failure of some maximum of member failures. However, an important difference also exists. Budgeting for financial crisis should respect the

[60] See Enoch, Garcia and Sundararajan (2001).

[61] Jacóme documents that Central Bank of Venezuela still maintains claims against the government for the assistance provided to the financial sector during the systemic banking crisis in 1994.

[62] See IMF Article IV Consultation with Japan, Public Information Notice (PIN) N.º 03/112 September 5, 2003.

conclusions derived from policies of constructive ambiguity with regard to the magnitude of rescue operations in situations of crisis. Notwithstanding this constraint, the size of the capital buffer for financial stability reasons should exhibit a scale corresponding to some characteristic size of the banking system.

4.4. Balances and income items arising because of other reasons

4.4.1. Gold holdings

Definitively, the role of gold holdings in modern central banking is a subtle issue. Central banks still account for around one fifth of the world's gold in circulation. Official holdings of gold on average represent 11-12% of reserves, whereas in the EU the percentage is over 25% and the USA holds around 60% of its reserves in gold (outside the central bank). Obviously, one of the reasons for such large gold holdings in the official sector has to do with its past role as monetary policy anchor. Central bank gold reserves played by definition a key role under the gold standard, where the purchasing power of money was tied to the price of gold. As a matter of fact, one does not need to go back to the 19th or beginning of the 20th centuries to justify the prominent role for gold in monetary policy. Indeed gold can be said to have been the ultimate reserve asset under the Bretton Woods system, since at the heart of that international monetary arrangement was the US, ready to convert official dollar holdings in gold as requested. Strictly speaking, the move to fiat money made central bank gold reserves obsolete from a strict monetary perspective[63] [64]. From a financial perspective, gold is also a rather unique type of asset: its returns are basically based on capital gains & losses, because it yields very low convenience interest in the market for gold loans and swaps[65].

In other words, at first glance gold looks like a problematic investment from a central bank perspective because of the seemingly unjustified renounce to income and exposure to risk. Moreover, no natural cycle for gold value can be theoretically ascertained. Reliance on gold investments has even led some commentators to compare some central banks investment strategies with those of some hedge funds [see Gross and Schobert (1999)].

However, a more balanced assessment of gold is needed. The key insight to identify a role for gold in modern central banking relates to the source of its arcane attraction among private investors: gold is perceived as a natural shelter investment for times of crisis. The fact is that their financial stability functions expose central banks financial performance precisely around times of crisis. Central bank gold holdings find thus support in that they may act as a natural hedge for the rest of their balance sheet. Obviously, such a case for gold can never be an unconditional one. Just a thorough assessment of overall risk can justify its precise weight in the portfolio. Ultimately, the difficulty to grasp the role of gold also stems from the difficulty to figure out the probability and financial impact of rare crisis events. As a matter of fact, even the nature of the shocks can be controversial. For example, Bernholz (2002) has defended in Switzerland the case for gold as vehicle of value immune to adverse international political developments, following the traditional neutrality position of the alpine country.

[63] Nowadays, article IV 2(b) of the "Articles of Agreement of the International Monetary Fund" goes as far as to forbid members states to peg their currency to gold.

[64] A reaction to the private market fears of uncoordinated official detachment from the gold market was the signature in 1999 of the Washington Agreement on Gold. The 15 signatory central banks agreed to contain their collective sales in a five year horizon expiring in 2004 to the 2,000 tones already planned to be sold before the signature.

[65] Gold loan rates amount to just few basic points. Moreover, it must be noticed that central bank gold lending must involve a careful balance decision to avoid granting ammunition to bearish speculators and containing credit risk exposure from gold loans to miners.

4.4.2. Operation of a federal central bank system: intra-system accounts

A federal central bank system exhibits a more complex pattern of features than the ones of an isolated one. The keys to this higher complexity are multiple. One may summarize most of them under a common label: "mechanisms and arrangements that ensure the fulfilment of the achieved agreements on decentralization of both policy-decision-making and implementation". However, from a central bank financial independence perspective two are the decisive issues to look at, when assessing federal central banks. Firstly, one must carefully consider the federative concept in place as regards both central bank earnings generation and distribution as well as recapitalization, i.e. the degree of differentiated clienteles that intervening central banks face. From this perspective, one could say, for example, that the ESCB is an imperfect federation in comparison with the Federal Reserve, because of the multiplicity of constituencies that the former system faces[66]. Secondly, one must also examine the implications of the balance sheet-based links between the central banks of the system which underpin its capability to act as federal monetary authority.

Let us elaborate on one mechanism leading to balance sheet links between central banks in a federal system[67]. Basic to the working of a common monetary policy is the capability to effectively impart common monetary impulses to the diverse sub-areas comprising the region. For that to be the case, it is not enough to establish a central decision body [68] with the power to set a common reference interest rate. In addition, mechanisms must also be deployed that further a harmonious functioning of the transmission channel across sub-areas. A minimum requirement for that is the ability to smoothly arbitrage out any divergence in short-term interest rates across the area. In turn this imposes the need of connected wholesale payment systems enabling an efficient and secure transfer of funds.

The key point now for the arguments about financial strength is that the provision of such a cross-border payments mechanism in a federal central bank entails reciprocal lines of credit between central banks of the system. Let us illustrate the issue with a stylized example: A financial institution with an account with Central Bank A wants to transfer funds to another financial institution with an account with Central Bank B. In order to execute the transfer order, Central Bank A reduces its liabilities with a debit to its Deposits-Financial Institutions account and credits an intra-system account representative of the service that Central Bank B provides in the completion of the order. The service is as follows: Central Bank B acknowledges the performance of the payment to the payee by automatically increasing its liabilities with a credit to its Deposits-Financial Institution account, and debits its intra-system account with Central Bank A.

In other words, cross border payment systems in a federal central bank system[69] impose the existence of creditor-debtor relationships between central banks in the area. This fact together with the federative concept in place, make of intra-system financial arrangements a very important issue. For example, the confederative-like nature of the ESCB determines that Target-related balances accrue interest as opposed to Inter-district Settlement Accounts enabling settlement between

[66] Neither, the ESCB or the Federal Reserve System are legal persons. However, in the political parlance one should speak of the Federal Reserve System as of a purely federal system, whereas the ESCB is a sort of confederation one. The ultimate difference lies obviously in the multiplicity of sovereigns involved in the latter.

[67] In addition to the mechanism that will be described in this section, also banknote issuance, cost-sharing agreements or shared investments cause financial inter-linkages between central banks of monetary federation to arise. For example, central banks belonging to the Eurosystem formally issued banknotes according to their respective capital keys in the ECB. However, the actual placement of currency by each national central bank has respected existing demand in its country. The difference between both figures leads to intra-system credits. Importantly, the presence of this system of intra-system credits determines a risk-sharing mechanism between member central banks with regard to the impact on their financial independence from developments in banknotes migration inside the area (see comments on central banks "scale" risk in section 4.1.1.1).

[68] FOMC in the Federal Reserve System, or the Governing Council in the ESCB.

[69] Fedwire, in the Federal Reserve System, or Target in the ESCB.

districts in the Federal Reserve System[70] [71]. In the same vein, as ECB does not itself put "its" euro banknotes in circulation it is not possible that assets covering them grow automatically out of operational mechanisms as described in section 4.1.1.1. Rather, Eurosystem national central banks do this for the ECB and, consequently, the ECB holds remunerated intra-Eurosystem claims on national central banks.

Having impact on earnings, it is evident that intra-system accounts are also relevant from a central bank capital perspective. However, restricting the relevance of intra-system accounts on central bank capital issues operating via an accumulation/depletion mechanism fails to consider an extremely important alternative channel. In other words, central bank members must be, not only equipped with the appropriate means to ensure that their system-related tasks can be properly performed, but also they must be prepared to meet with autonomy the exposure to different intra-system originated risks.

Garber (1998) has given a lucid albeit gloomy view of the intra-system sort of risks faced in a confederative central bank system. The reciprocal credit provided between central banks so as to achieve the perfection of a cross border payment likens during a crisis period the nature of the funding mechanism underlying the Very Short Term Financing Facility (VSTFF) under the European Exchange Rate Mechanism (ERM) for currency crisis restraint. A crisis in both contexts amounts to a sudden outflow of money from one area to the rest. The similitude lies in the fact that in both systems central banks from countries or districts not affected by the crisis are responsible for providing credit to the central bank facing difficulties[72]. The relevant question now, as it also was in the past under the ERM, is the following one: are there no actual limits to the otherwise theoretically unlimited amount of intra-system credit granted to central banks facing problems in a federal system?

The force of unpredictable events can never be underestimated and it is always advisable to put oneself on the safe side. Reasoning along this conservative line, the situation of concern one must consider in a confederative system as a stress-testing exercise is one where sovereign governments put under question their willingness to permit their national central banks to provide each other unlimited credit in a crisis scenario. The maintenance of a capital buffer by central banks in a confederative system for such stress scenarios should contribute positively to create a confidence climate necessary to manage cooperatively local crisis episodes.

It is important to emphasize that the need of such a capital buffer arises out of the consideration of sudden increases in intra-system credit in hypothetical crisis contexts. Intra-system credit per se should not be a problem if its size is contained or if it is regularly settled. In the Federal Reserve System the cumulated claims against or obligations to the Interdistrict Settlement Account of each central bank are settled once per year in April with the redistribution of gold certificates from district Feds with a negative cumulated net payment position to those with a positive position. In addition, the settlement is combined with the determination of each Bank's share of the System Open Market Account (SOMA)[73].

[70] The Interdistrict Settlement Account (ISA) is the account used by Reserve Banks to clear transactions. At the close of business each day, all Reserve Banks assemble the payments due to or from other Reserve Banks as a result of transactions involving accounts residing in other Districts that occurred during the day's operations. Such transactions may include funds settlement, check clearing, Federal Reserve Note shipments and automated clearinghouse operations. The cumulative net amount due to or from other Reserve Banks is reported as the "Inter-district settlement account." The balance in this account represents a Bank's net asset or liability position with the other 11 Reserve Banks. Although it is reported in the asset section on the individual district balance sheet, this account can be either an asset or liability, depending on whether it has a debit or credit balance. System-wide, the sum of all 12 Reserve Banks' ISA must equal zero.

[71] As it will be mentioned later, ISA balances determine nonetheless the share of each district Fed in the SOMA account and therefore the profits earned.

[72] The gloomy part of Garber's exercise is the identification of different causes of crisis.

[73] See Meulendyke (1998).

4.4.3. Services provision issues

Central banks across the world tend to be involved in other lines of activity, in addition to the ones described so far. The purpose of this section is not to address the contentious issue of the scope of central bank functions. It is not intended to discuss issues on efficient supply either. The uniqueness of some of the activities of central banking, the difficulty in measuring some of the central banking outputs, and the multiplicity of objectives pursued by central banks complicates the application of standard efficiency measurement techniques[74]. Benchmarking and other efficiency measurement techniques are certainly very important in a financial independence set up. As already advanced in the introduction, accountability is outside the scope of this paper. Rather, the intention here is to highlight some challenges raised by central bank financial independence in respect of issues pertaining to the supply of services by central banks.

Central banks are typically closely involved in the operation of parts of the national payment system. This is almost always the case as regards wholesale payment systems and in some cases this involvement also extends to retail payment systems. The Federal Reserve System is a significant case in that regard. According to the Rivlin report of 1998, the twelve Federal Reserve Banks processed about one-third of the estimated 45 billion checks transferred between banks in the United States in 1996, in addition to wholesale and other payment services. Central banks, especially in transition countries, may also experience the need to provide infrastructure for general markets development. More importantly, central banks exercising supervisory powers must decide how to fund their supervision operations.

Normally, the financial muscle of central banks determines that funding the expenses incurred in the provision of services does not entail any material difficulty. Nevertheless, when this is not the case, budgetary transparency is advised as a mean to alleviate any financial independence concern. As mentioned, the realistic problem is rather one of excess of resources. Actually, over time the development of financial systems quite often determines that funding the services provided by central banks for historical reasons becomes a cross-subsidization problem, if alternative providers of the services are affected by the privileged funding of a central bank. Let us illustrate the issue with two cases affecting the Federal Reserve System.

Green, Lopez and Wang (2003) describes how until 1980, the prices the Federal Reserve charged for payment services were not systematically linked to its costs[75]. That year, in an effort to promote a more efficient national payments system, US Congress passed the Monetary Control Act (MCA), with the aim of encouraging more competition between the Federal Reserve and private sector providers of payments services. The MCA now requires the Federal Reserve Banks to charge fees for their payment services that will recover all direct and indirect costs of services provision. The MCA also requires now that Federal Reserve Banks recover imputed costs –i.e., the costs that would be paid if the services were provided by a private firm, which include items such as the cost of capital.

A similar problem was recently highlighted by the Comptroller of the Currency before the US Senate Committee on Banking[76]. The head of the supervisory body of the US national system of banks complaints about the continuing incentive of this group of banks to convert to the "state charter" status with the intent to fall under the umbrella of either the Federal Reserve or

[74] Mester (2003) deals with the specifics of efficiency measurement in a central banking environment.

[75] Some commentators hint the potential danger of such policy in terms of dynamical inefficiency of the US retail payment system [see Lacker and Weinberg (1998)].

[76] Statement before US Senate Committee on Banking, Housing and Urban Affairs complying with 12 US paragraph 250, April 23 2002.

the FDIC, which allegedly price modestly supervision services because of their alternative earnings sources.

Being these unfair competition problems important, because of their potentially reputational costs, they are nevertheless out of the scope of this paper as well as financial accountability issues. However, as regards the pricing of central bank exclusive services directly aimed at financial institutions, section 5 will support the view of a cost recovery approach with an imputed cost of capital equal to the interest costs of government debt.

4.5. Conclusions reminder

So far we have seen that a central bank should normally make a profit because of its monopolistic position in the supply of currency. However, we have also considered various reasons that may lead it to experience financial distress. Sections 5 and 6 will, respectively, deal with the connected problems of how to finance such loses and distribute profits. In order to facilitate the exposition of the arguments in these sections, let us summarize the most relevant conclusions so far, especially as regards the sources of central bank earnings and their sensitivity.

In a market value accounting benchmark, central bank earnings Π obtained in the exercise of its mandate can be conceptually separated in three different categories: normal earnings (Π_n), capital gains & losses (Π_s) and extraordinary items (Π_e). In annex 1, the explicit form of this decomposition is derived in terms of information on balance sheet and rates contained in tables 1 and 2, as well as other information on central bank costs and fees.

It has to be stressed that such decomposition is not just an accounting truism but it is intended as a practical tool. Drawing on the results of annex 1, the decomposition helps to convey two important conclusions with regard to central banks' return on assets (r_A):

$$r_A = a_y \cdot \left(\frac{B}{A_y} i_g + \frac{RF}{A_y} i_r \right) + a_{qf} \cdot \left(\frac{L}{A_{qf}} i_l + \frac{Q}{A_{qf}} i_q \right) - l_c \cdot \left(\frac{P}{L_c} i_p + \frac{R}{L_c} i_d \right) + \frac{I_s - E_s}{A} + \frac{E_n}{A}$$

$$+$$

$$a_y \cdot \left(\frac{B}{A_y} \Delta b + \frac{F}{A_y} \Delta s + \frac{i_f \cdot F \cdot s}{A_y} \right) + a_{ny} \left(\frac{G}{A_{ny}} \Delta g \right)$$

$$+$$

$$i_o - e_a - ch_r - ch_p$$

namely,

- On a market value basis, returns are modulated by movements of exchange rates and bond yields, possibly leading to central bank losses if exposures are large enough. As a matter of fact, central bank exposure is typically such that they must face high financial risks and earn a relatively modest expected return.

- On average, return on central bank assets normally entails a discount (d) over the financing cost of government debt (i_g). The reason lies in the combined effect of several factors: the presence

of non-yielding assets, the on average positive slope of the yield curve (i.e., $i_g > i_r$), subsidies granted in services provision etc. Notice that consistent with the assumption of a (statistical) validity of the uncovered interest parity theory, interest from foreign investments must be reputed for the current purposes as yield the domestic interest rate. Chart 3 shows the magnitude of such discount for the Federal Reserve System, a central bank that exhibits a bias toward higher returns because the whole government debt yield curve is eligible as fiat cover and which, additionally, has a low exposure to fx risk.

Another advantage of the decomposition delineated before lies in the fact that it endows structure to any effort to project central bank end-on-period earnings and capital needs. Although the ultimate benefits of such decomposition will be clearer in next section, its intermediate benefits in terms of budgeting of central bank financial resources must still be stressed. Precisely, the goal of section 4 has been, to a large extent, to elaborate on the financial budgeting implications of the diversity of central bank functions. Due to the density of arguments displayed across the section, it will be useful to highlight some of them as a reminder:

- Government debt naturally covers fiat money. However, it is not the only solution, hence the diversity of central bank balance sheet profiles.

- Reputational capital concerns limit the scope of credit instruments as cover of fiat money.

- Stability of central bank returns is fostered by a high proportion of assets yielding fixed income.

- On a long-term horizon, capital gains and losses of debt and fx holdings tend to be smoothed away. Holding debt to maturity and the (statistical) validity of the uncovered interest parity hypothesis are the conceptual conditions for such central banks' earnings cycles.

- The commitment to elastically provide currency leaves the scale variable for total assets outside the central bank control. Thus, forecasts on payment system technology, currency substitution or migration developments should assist central bank planning.

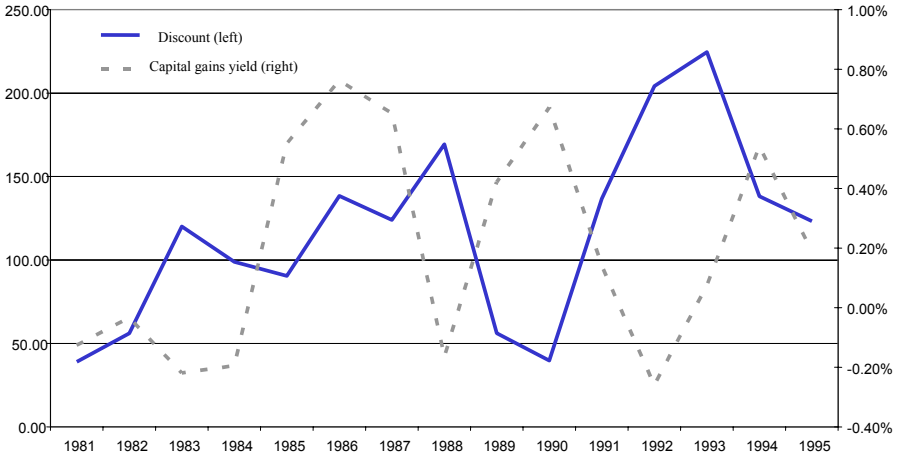
- Both on-balance and off-balance items need to be considered.

- Various quasi-fiscal operations or financial stability driven outlays may end up sweeping seignorage income in extreme situations. Accordingly, transparency, budgeting and contingent coverage schemes belong naturally to central bank financial planning.

- Institutional design matters. The precise content of central bank mandate, the specifics of the deposit insurance scheme in place, the central bank title on foreign reserves, the national, federal or confederal legal nature of the monetary authority, the size of the banking system etc. determine markedly different central bank financial profiles.

Chart 3

Federal Reserve Return on Assets Discount and Capital Gains & Losses Yield



Source: Annual Report of the Board of Governors, OECD Economic Outlook Statistics and own calculations.

5. A Simple Model of Central Bank Capital And Practical Considerations

5.1. The model

For the purposes of this section, the main conclusions from the previous section are twofold: firstly, it can not be excluded that central banks are financially vulnerable and, secondly, there is a structural bias for central banks' return on assets to be lower that the cost of public debt on average. More specifically as regards financial vulnerability, it has been concluded that, on a market-value basis, central banks' profit statements exhibit a noticeable responsiveness to exchange rates and portfolio assets' values as well as to extraordinary events. Exposure to market and non-market risks thus determines a possible source of central banks' solvency impairment. Certainly, central banks do normally not undergo bankruptcy procedures[77]. However, financial distress may damage the performance of their monetary policy mandate. The aim of this section is to discuss a quantitative approach to endow central banks with a robust financial structure. However, a realistic application of the methodology requires incorporating the institutional issues discussed in previous section.

Blejer and Schumacher (1998) have pointed out the usefulness of VAR-like methodologies to assess central banks' vulnerability in connection with market risk exposures. However, their approach misses two points. First, they do not recognize the adequacy of that methodology not just for the assessment of central bank solvency in loose terms, but also to establish a benchmark for central bank financial strength. Second, their assessment of solvency is partial because they adopt an incomplete view of central banks' financial position, by not taking into account their earnings generation capacity.

[77] However, there are exceptions among central banks having private shareholders. For example, the National Bank of Belgium envisages in its Statute (art.11) that it must be dissolved automatically if the losses recorded in the balance sheet exceed one half of the capital stock.

Against that background, this section intends to establish a simple benchmark for central bank financial strength, i.e. a yardstick for a balance sheet magnitude reflective of financial resources available to operate away from distress conditions. Although very much depending on the specifics of accounting practice, financial strength will be understood to be equivalent to a metrics of effective financial cushion against shocks that comprises primary equity, retained earnings, revaluation reserves and, eventually, other items like certain provisions in a general accounting setting. Obviously, under a full market value accounting scheme revaluation reserves are zero. The need for such a model has emerged recently in several fronts. Ernhangen *et al.* (2003) pointed out differences of opinion in the Swedish Parliament as regards the capitalization of the central bank. In Finland, the central bank has publicly opposed government plans to withdraw capital[78]. In Japan, it has been claimed that a successful program of reflation in that country faces a restriction, based on the alleged weakening of the institutional position of the central bank that would ensue if the program happened to erode its capital base[79]. The recent trend toward a market value accounting standard also touches upon the capitalization problem, as will be discussed in section 6.

Two aspects of the model must be stressed beforehand. Firstly, it is intentionally simple. The rich financial structure underlying central banking operations described in 4 can be incorporated in more complex versions. In particular, the model assumes that financial assets other than foreign assets holdings do not entail market risks. This assumption can be relaxed, as pointed out below in this section. Anyway, as described in section 6 and annex 2, there are accounting reasons that support the emphasis on differences between market risk from holdings of foreign asset and government debt. Secondly, and most importantly, its formulation adopts the perspective of a social optimizer concerned with both the effects of a lack central bank financial independence, in a context of insufficient central bank financial strength, and the costs of excessive central bank capitalization.

The former type of costs is modelled in a rather crude way. The earnings generation capacity and riskiness of the central bank balance sheet determine the probability α that a capital shortfall eventually takes place. Under such circumstances, the central bank would eventually need a capital injection in order to avoid social or reputational costs. Obviously, this is more the case the more transparent is the accounting regime in place. Social costs arise in such context if the government can not overcome the temptation to make the capital injection conditional on some central bank concessions, such as directing central bank decision making. Alternatively, social costs might arise if the central bank practices self-restraint with regard to otherwise needed policy making decisions, just because they might drive it to a (costly) situation of distress. Anyway, it is assumed here that recapitalization requests by the central bank or an inefficient avoidance thereof entail a social cost (χ) equal to the lost benefits of central bank independence[80].

The costs of excessive central bank capitalization comprise any net expenses to the government due to the additional public debt that it must issue to finance its holdings of supplementary financial assets, i.e. the discount of return on central bank assets over the cost of government debt. It must be emphasized that the central bank financial strength problem is well-posed only if the government faces net positive costs from maintaining financial resources as central bank own funds. Otherwise, no disincentive for the government to maintain resources in the central bank would arise[81].

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[78] See Bank of Finland press release 8th May 2003.

[79] See remarks by Federal Reserve Board Governor Ben Bernanke of May 31 before the Japan Society of Monetary Economics in Tokyo criticizing that argument.

[80] Unlike what happens when the capital shortfall leads a private company to legal proceedings, no bankruptcy costs arise in a central bank context. However, one can liken the social cost to the franchise value lost.

[81] This component of the problem is not an academic one. In the central banking domain, Ungern-Sternberg (2002) has made a strong partisan case against too much capitalization of the Swiss National Bank. The Swiss social democratic party commissioned a report to Professor Thomas von Ungern-Sternberg on profit distribution practices followed in the Swiss National Bank. The core argument of that partisan criticism relates the high level of total capitalization achieved due to an allegedly low level of dividend payments. More

Ultimately, the central bank financial independence problem can be seen as just a peculiar sort of asset-liability management problem. Their policy mandate determines that central banks typically must assume high financial risks and earn relatively low expected returns. The optimal level of central bank capital amounts to be a sort of (costly) self-insurance by the government against the potential costs of a time-inconsistent behaviour on its side as regards central bank policy issues[82].

As a matter of fact, the central bank financial independence problem has two components. Self-insurance must operate both over a short and a medium term horizon. We have seen in section 4 that the uncovered interest parity theory may act as an inter-temporal risk mitigating mechanism. Consequently, the level of short-term self-insurance may prove to be excessive from a medium term perspective. In other words, the interplay between risks in the short and in the long term determines, respectively, a higher and a lower level of optimal central bank capital. Thus a band of optimal capitalization emerges as the solution to the problem of central bank financial strength.

Mathematically, the short term social optimizer problem can be formulated as follows. Let us consider the profit decomposition introduced in section 4. If the minimum operational base for total capital is considered to be K_o, the probability of an end-of-period shortfall is

$$\alpha = P(\Pi + K \leq K_o) = P(\Pi_e + \Pi_n + \Pi_s - D_e + K \leq K_o) \quad (1)$$

where end-of-period expected or budgeted values for Π_n and Π_e are considered to enter this expression. A more structural approach should posit a model for the conditional probability that a shortfall would actually lead to social costs. D_e represents a measure of firmly expected dividend pay-out to the government. The monopolist position of central banks on note issuance and the seignorage obtained thereof normally underpin such strong expectations. D_e can be formulated informally, incorporated in the formal government budget or even enshrined in law. It can be specified as an absolute quantity or as a proportion of annual profits. No matter its institutional background, the relevant fact modelled by D_e is a restriction for a central bank to be able to endow itself with the desired level of financial strength. In this regard, a particularly perverse situation arises when advances of dividends are paid before the completion of the period. In that case dividends paid out may happen to exceed total central bank earnings, even if for involuntary reasons[83].

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precisely, the report reacts critically to the decision by the SNB in March 2002 to increase profit distribution from 1.5 to 2.5 billion Swiss francs and to maintain that constant level during the next 10 years, judging it insufficient.

[82] It is relevant to notice that the cost of the self-insurance can be somewhat controlled. Thus, some central banks have established so-called own fund portfolios with the goal to obtain a yield-pick up for central bank capital over the overall return on assets that would otherwise be achieved. Therefore, broadly speaking it can be said that the composition of such portfolio favours spread over liquidity more than it is the case with the rest of the central bank portfolio of financial assets.

[83] The Bank of Japan is obliged to pay a part of the final amount to be paid to the government at the end of the fiscal year by the end of November, in line with a guideline set by the Minister of Finance and based on the Bank's projection of net income. As an example of the type of situation described here, in fiscal year 2002 the policy Board decided not to make such preliminary payment because there was a possibility that the Bank would make an excessive payment having due regard of the volatility expected for the second half of fiscal year 2002 [see Bank of Japan (2003)].

The central bank capital benchmark K is then the solution to the following optimization problem

$$\begin{aligned} &\min_{K}\left[\gamma \cdot \chi \cdot \alpha(K) + d \cdot K\right] \\ &\text{s.t. } K > 0 \end{aligned} \tag{2}$$

where the meaning of γ will be clear shortly. In the mean time, let us think of γ as being equal to 1.

The achievement of analytical tractability leads us to temporarily assume that central bank earnings-at-risk obeys a normal law. Just to simplify a little bit further, let us assume that the only source of revaluation risk are exchange rate movements acting on foreign reserve holdings. Assuming D_e is formulated as an absolute quantity, drawing on (1) and the expression for Π_s, the optimization problem for the case where D_e is an absolute value becomes:

$$\begin{aligned} &\min_{K}\left[\gamma \cdot \chi \cdot \Phi\left(\frac{K_o - K - \Pi_n - \Pi_e + D_e}{F \cdot (1+i_f) \cdot s_0 \cdot \sigma}\right) + d \cdot K\right] \\ &\text{s.t. } k > 0 \end{aligned} \tag{3}$$

where σ is the (proportional) volatility of the exchange rate s and s_0 is the exchange rate at the capital budgeting time.

Bearing in mind the possibility of a corner solution, the solution K^* to this problem is:

$$\begin{aligned} K^* &= \begin{cases} 0 & \text{if} \quad \Pi_n + \Pi_e - K_0 - D_e > C^* \\ K_0 - (\Pi_n + \Pi_e - D_e) + C^* & \text{otherwise} \end{cases} \\ \text{where} \quad C^* &= \sqrt{2} \cdot F \cdot (1+i_f) \cdot s_0 \cdot \sigma \cdot \left(\text{Abs}\left[\text{Ln} \frac{\gamma \cdot \chi}{d \cdot F(1+i_f) \cdot s_0} \right] \right)^{1/2} \end{aligned} \tag{4}$$

The normality assumption can now be relaxed to also consider finite variance distributions by setting some value to parameter γ. Stahl (1997) justifies the choice γ=3 for the Basel market risk rules[84].

The solution C* is increasing in the exposure and volatility. Interestingly, the solution exhibits economies of scale with regard to distress costs, i.e. the analogue to Basel risk-weights are decreasing with the level of exposure. Ultimately, this can be attributed to the peculiar nature of distress situations of central banks. Unlike what happens with a commercial firm, where liquidation of assets in bankruptcy would most probably entail costs proportional to their size, the distress situation considered in this paper excludes liquidation. The fixed annual cost of deficient continuity justifies the economies of scale of risk exposure.

The corner solution deserves some clarification. If the appropriation of profits by the central bank were guaranteed to be always high enough, the central bank could operate in this simplified model

[84] The goal of this adjustment factor is to allow coping with that fact that financial asset returns are "leptokurtic", that is there are more "fat tail" events at the extreme of the distribution bell curve than a normal distribution would suggest.

without capital at all. Otherwise, capital should statistically supplement appropriated profits (if any) by a term reflecting risk exposure, volatility and costs of underperformance. Notice that if profits are negative, i.e. if the central bank faces running losses the solution also dictates that a capital injection should finance them.

There is no analytical solution for the case of dividends proportional to total (positive) profits. However, this modality is deficient by definition, because it leads to automatic distribution of capital gains without regard for their possible reversal in the future.

The full economic sense of the model depends on a specification for γ. It is not straightforward to offer an estimate for γ both on conceptual and technical grounds. However, a good proxy for those costs can be built on the basis of the recurrent benefits of going from high to low inflation that could be lost if central bank has finally to yield to political power. The basis for such identification is the well documented opinion that central bank independence must be credited with much of the merits of such transition. Dolado, González-Páramo and Viñals (1997) quantify the recurrent benefits of independence as between 0.7 and 1.3% of GDP per year. Accumulated cost should typically exceed the one-off impact. It is sensible to think that any incumbent having the temptation to influence the central bank will try to exploit his power as much time as possible. From this perspective, total costs could reasonably be defined as the yearly costs scaled by a measure of term in office.

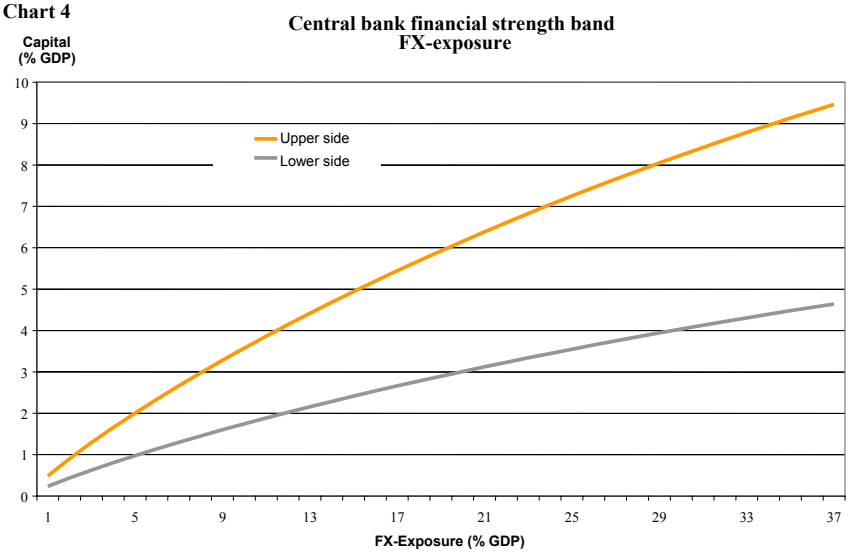
The medium term component of the social optimizer problem is the version of (2) adapted to incorporate the earnings smoothing impact of the uncovered interest theory. The floor to central bank capitalization K^f across the cycle that results follows the following expression

$$K^f = \begin{cases} 0 & \text{if} \quad \Pi_n + \Pi_e - K_0 - D_e > C_f \\ K_0 - (\Pi_n + \Pi_e + F \cdot s_0 \cdot i_g - D_e) + C_f & \text{otherwise} \end{cases}$$
$$\text{where} \quad C_f = \sqrt{2} \cdot F \cdot s_0 \cdot \sigma^{uoi} \cdot \left(\text{Abs}\left[\text{Ln} \frac{\gamma \cdot \chi}{d \cdot F \cdot s_0} \right] \right)^{1/2} \tag{5}$$

where σ^{uoi} is the volatility measuring the degree of statistical validity of the uncovered interest of parity over the averaging horizon considered, i.e. the volatility of the residuals of a regression of fx returns over interest differentials. Notice that the relevant fact for the reduction of capital requirements across a natural cycle is the condition that σ^{uoi} is much smaller than σ.

Chart 4 exhibits the upper and lower limits of the central bank capital band for γ= 1%, σ = 15% per annum and inter-temporal smoothing coefficient= 50%. Notice that the width of the bank increases with the level of exposure.

Chart 4



As warned before, the model assumes that government debt does not contribute to market risks. Annex 2 discusses the link between this assumption, decisions to hold investments to maturity and the accounting regime in place. If government debt holdings are managed according to some benchmarking strategy, the risk of capital losses can not be discarded. Analytically, the problem becomes more involved because total risk results also from the impact of the adequacy of rebalancing decisions. Therefore, one must resort to Montecarlo methods to simulate the risk of end-of-period capital losses in model (2). Importantly, the impact of a decision to manage quasi-actively holdings of government debt leads to artificially boost short-term risk if it disqualifies for a smoother accounting regime.

5.2. Practical implications

The crudeness of the approach followed to determine the amount capital buffer hinders drawing strong quantitative conclusions. The set of risks faced by a central bank is more complex than just those arising out of exchange rate gyrations. However, the methodology employed is amenable to more realistic situations. Nevertheless, a set of important conclusions can already be extracted from the simple exercise carried out before.

1. As pointed out by the governor of the Bank of Japan, a central bank should be concerned about the soundness of its capital base. A central bank should take risks commensurate with the capital backing its operations as commercial banks do[85]. If enjoying instrumental or strategic flexibility on the central bank side depends on having the ability to assume exposure to certain risks, the previous conclusion implies that government must back the delegation of powers with capital.

2. As a corollary of previous conclusion, an inefficient central bank balance sheet structure may lead to a costly freeze of public capital. If this is the case, balance sheet restructuring should be undertaken. In particular, central banks own funds should be managed so as to

[85] See Fukui (2003).

minimize government disincentives to maintain them. This calls for separate investment policies.

3. In an analogous way of thinking, inefficient central bank assets management should be discouraged by capital budgeting reflecting the strategic flexibility sought with those assets.

4. The size of the optimal capital buffer depends on how central bank profits Π are allocated at the end of the period. If some amount of profits D_e cannot engross retained reserves, primary capital or reserves should be grossed up correspondingly. More precisely, in a scenario where D_e totally absorbs normal and extraordinary profits, C* offers coverage to capital shortfall costs. Notice that C* is an absolute value increasing less than proportionally with risk exposure.

5. Capital shortfall risk has a short-term and a medium term-dimension. If inter-temporal smoothing of profits is allowed for, the medium-term capital coverage C^f is lower than the short-term one C*. From a different perspective, both measures would collapse to C^f if accounting were responsive to underlying economics. In other words, the gap between them is due to a measure of artificial vulnerability. Consequently, C* and C^f can be interpreted as measures of maximum and minimum capital.

6. Financial strength requirements are responsive to the accounting regime. Conversely, adherence to conditions that allow qualifying for some accounting standard has an impact in terms of capital requirements that goes beyond the real risk profile of investment strategies permitted.

7. From a worst case perspective, central bank total capitalization should be calculated having due regard of any justifiable safety margins for Π_n and Π_e, as suggested by Ernhangen, Vesterlund and Viotti (2002)[86]. The budgeting methods delineated in section 4 for potential losses arising in refinancing operations or in financial stability ones should form the basis for an estimate of Π_e. As regards Π_n, the Bank of Sweden considers a safety margin in their calculation of capital that is identified as a situation of loss of seignorage because of technology developments in the e-money domain.

8. Institutional risk mitigation techniques alleviate the need of central bank capital. For example, the fact that capital losses on the issue department portfolio of the Bank of England do not show up in the central bank's P&L but do in the National Loans Fund[87], diminishes the capital requirements for the central bank.

9. In case of expected losses in recurrent and extraordinary operations, central bank capital should automatically be increased to cope with them.

10. Provision of non-priced services leads to a need of capital if the resulting underperformance of profits hinders reaching the optimal level of total capital. A cost recovery policy for services pricing is fully justified on central bank capital grounds. Further to this point, capital budgeting in central banks' services provision also implies a services pricing policy

[86] Although the argument is correct on its own, the economic background where the principle has been formulated does not correspond to the setting of this paper. As pointed out in section 4.7, central bank equity has somewhat replaced the role of commercial bank capital as a complement to fiscal policy measures in the long standing effort to reflate the economy. The setting is thus one closer to one of cooperation between monetary and fiscal policy makers. From a similar standpoint, Bernanke (2003) has downplayed the appropriateness of central bank capitalization demands in such setting.

[87] In the UK, the National Loans Fund (NLF) is one of the main funds on which the Treasury operate. It has as functions to receive the proceeds and finance the repayment of all Central Government borrowing and the Exchange Equalisation Account, and to make repayable loans to various statutory public sector bodies. Profits from the Issue Department are also transferred to the NLF.

mindful of the cost of central bank capital. From this perspective, it is questionable the standard of cost described by Green *et al.* (2003) for the Federal Reserve System based on commercial banks' cost of capital unless the fed competes with the banking sector in that area.

Drawing on practical item number 6, it is relevant to remark that budgetary provisions mandating automatic supply of funds to the central bank in distress could be, from a theoretical perspective, substitutes of central bank capital. However, the political difficulties of such a solution seem to be big. As a way of example, just 13% of central banks that responded to the Survey conducted by Central Banking Publications had in place provisions for recapitalization in case of distress. None mentioned flow-like solutions.

Quite often capitalization measures are perceived as a substitute of other institutional steps. In particular, section 4 has identified situations where the poor financial performance of the central bank is due to monetary operations entailing quasi-fiscal costs. Institutional solutions to the problem have also been pointed out. However, arguably transparency as regards the origin of the deteriorated situation is just a temporary substitute of unconditional measures to strengthen solvency. Institutional measures can be a (second-best) substitute of central bank capitalization if they lead to an enforceable provision of (contingent) capital. In other words, the legal wording of arrangements substitutive of central bank capital should lead to similar economic outcomes. In particular, it should lead to more symmetry between the consequences for the government of central bank profits and losses. Ultimately, institutional measures aimed at substituting central bank capital should be cast in a broader context, namely the overall framework for the resolution of government-central bank conflicts. However, in practice central bank law design has seldom paid attention to contingent capital provision. Actually, central bank financial profile is still not paid too much importance in qualified opinions on optimal central bank law design [see Poole (2003)].

6. Rules On Profit Distribution, Accounting Standards and Financial Strength

Section 5 has dealt with the efficient coverage of potential central bank losses. Adequate central bank capitalization turns out to be one of the mechanisms. Central banks financial strength depends on D_e, i.e. on pay-out policy, because profit retention is a key mechanism to build up a capital buffer. Therefore, the relevant question now is how to distribute central bank profits, in order to make compatible the legitimate rights of its shareholders to receive dividends and central bank financial strength.

6.1. Compatibility

In order to discuss this question, it is useful to identify profit distribution mechanisms that might lead either to outright incompatibility or to a suboptimal outcome. Generally speaking, incompatibility between dividend payments and capitalization arises whenever the amount of profits devoted to the former is considered to exhibit an unconditional priority. In other words, incompatibility outcomes emerge whenever dividend payments are made irrespective of the quantity and the quality of the profits. We will later elaborate further on the precise meaning of quantity and quality conditions for profit distribution.

The way the quantity of profits should limit dividend pay-out is obvious: distribution should take place just if the profits exceed the amount allocated to the volume of reserves needed to comply with existing financial strength goals. However, the distribution formula is not a simple one based on a trigger level for profits. The fact that central bank financial strength has been formulated in section 5 in terms of a maximum and a minimum for central bank capital slightly complicates the

pay-out formula. Profit distribution policy amounts to a control problem of a state variable (capital) inside an admissible band. A level of capital over the upper border of the band (C*) is excessive and, consequently, accumulation of own funds out of earnings should be halted. As long as the state of financial strength exceeds the lower border (C^f), there is some margin to pay out dividends without impairing the medium-term central bank financial strength condition. However, some compromise must be found because distribution inside the band faces as an alternative allocation the improvement of the short-term financial condition. For example, one may prioritize on the short-term financial condition imposing that no allocation to distributable profits is made before C* is safeguarded. Alternatively, some other solvency point between C* and C^f might be preferred.

Moreover, the size of any pay-out must be consistent with the fact that profits make an approximate cyclical "excursion" around some stable level. In other words, pay-out policy inside the band is constrained by quality of profits considerations. As it will shortly be clear, this constraint imposes determining dividends as a time average of past profits. So far we have always worked under a market value accounting benchmark. A full fair value approach treats equally any source of income, thus disregarding any differences between accrued income and capital gains as regards their reversibility, for example. Therefore, a market value based metrics for central bank profit determination fails to restrain the distribution as dividends of profits that exhibit some reverting behaviour, unless such is the will of the shareholder. In other words, a full market value approach to calculate distributable profits fails to automatically recognize the smoothness of central bank earnings over a long enough horizon, as pointed out in section 4[88].

Two types of costs can be expected from the adoption of an unrestrained full fair market value as accounting standard determining central banks' dividend payment capacity. Firstly, the artificial image of instability of central bank earnings may act as a reputational charge. Secondly, the costs incurred in the reversion of the consequences of dividend payments whose amount turns out to be unjustified ex-post should also be considered in the bill. In this category are included the costs incurred to revert any inflationary effect that might be triggered by the distribution as dividends of unrealized capital gains[89]. The second concern becomes especially significant, if the probability is large, that an excessive distribution of profits might later lead to an ex-ante unneeded recapitalization.

It is important to emphasize that these criticisms on full fair market value as standalone metrics for distributable profits has in essence nothing to do with the choice of market value as accounting standard. Similarly to the capital buffer problem dealt with in section 5, any metrics for dividend pay-out should be responsive to the accounting regime in place and to reflect the underlying economics. The application of this insight to the central bank pay-out policy problem leads to the conclusion that averaging of earnings across the cycle is needed to correct for the excess of volatility that unrestrained market value accounting might lead to.

Let us now see with an example pertaining to the central bank's domestic portfolio why an inter-temporal analysis of the financial strength problem leads to lower capital needs. Certainly, central banks' government debt holdings may cause large swings to their P&L account on market value basis. However, from a consolidated perspective government debt holdings are no asset for the Treasury. Therefore, the impact of central banks' government debt holdings on dividends received by the government is due either to time of trading effects or to the vagaries of accounting.

[88] Sweden is an example of a country where the allocation of profits entails an average over 5 year's of Riksbank's earnings excluding exchange rate and gold valuation effects. 80 per cent of that average is distributed yearly to the Treasury.

[89] Let us illustrate the importance of this argument with a striking real case. Namely, fixed exchange rate regimes that turn out to be unsustainable and are the object of speculative attack may end up having the government as the surprising winner in terms of earnings. If no regard were paid to quality of profits considerations, incentives to commit to hard pegs would be much looser and the ensuing spending spree could be significant.

To be more specific, if debt is assumed to be held to maturity –so that time of trade effects can be discarded– an interest rate swap between the central bank and the Treasury, whose overall effect is that the former ends up receiving floating over his entire portfolio, leads to a situation where capital gains and losses are no longer a threat for the central bank. Therefore, its financial strength problem is much lower. Instead, the Treasury assumes a floating rate based stream of dividends.

6.2. Optimality

In the previous subsection, it has been concluded that D_e should respond to some time average of past profits. Optimality restrictions should help to propose some concrete functional form. A sensible definition of optimal profit distribution mechanisms should take into account any distorting effect of the distribution standard on the behaviour of either the dividends payer or on the recipient[90]. From this public policy perspective, optimal profit distribution mechanisms should exhibit several properties.

Firstly, absence of distortional effects on fiscal policy is expected to impose the condition that no margin exists for active discretional decision powers on the government side on how to allocate profits. Baltersperger and Jordan (1998) make a similar argument. In other words, either a rule or the central bank should decide on the distribution of the excess profits over capital coverage requirements. Avoidance of risk of being perceived as a partisan institution argues in favour of the former option.

Secondly, avoidance of incentives by the government to passively leverage on recent financial markets developments, even if they are outside its own influence, suggests the need to decouple profits distribution from current profit generation. In other words, distributed profits should average current and past earnings. Thus, a different line of reasoning also leads to a profits smoothing proposal.

A third important optimality condition on the profits distribution rule should be one aimed at limiting any distorting consequence that a smoothing mechanism might itself cause. Namely, the distribution rule should be calibrated to the statistical properties of the earnings generation process so that central bank total capitalization does not end up being excessive.

It is worth discussing the third condition in this section about pay-out policy optimality, because in practice earnings generation cycles are not perfect ones, i.e. the excursion that profits are supposed to make across a cycle might drive total capital over C* at some point. As a consequence of this, setting a fixed upper bound to central bank total capital eventually involves the delicate problem of handing out extraordinary dividends to a government in office, so that capitalization is restored to some acceptable lower level. The scope of this problem can however somewhat be mitigated by an adequate design of the profits averaging procedure. Once achieved the capitalization objective, a quick build up of reserves could take place if the dividend formula fails to be sufficiently responsive to the level of recent profits. Averaging over a too long period is a rule prone to exhibit such sort of problems. Thus, a subtle trade-off between the upper bound for reserves and the length of the running window entering the dividends smoothing rule must be considered.

In mathematical terms, if the priority is placed on the short-term financial solvency condition the dividend pay-out (D_t) should follow a rule that instructs the build up of an averaging fund (F) on the basis of the existing excess of profits Π^{ex} (over the level needed to maintain some level of solvency).

[90] One could equivalently subsume the compatibility requirement on the profit distribution rule as an optimality condition as regards its (neutrality) effects on some aspects central bank behaviour.

One possible rule looks as follows

$$\Pi_t^{ex} = H_{k<C^*} \cdot \max((\Pi_t - (k - C^*)),0) + H_{k \geq C^*} \cdot \max(\Pi_t,0)$$

$$F_t = H_{k>C^f}(F_{t-1} + (\Pi_t - \Pi_t^{ex})) - H_{k \leq C^f} \min(F_{t-1}, C^* - k - (\Pi_t - \Pi_t^{ex}))$$

$$D_t = \frac{F_t}{l}$$

where H_x is the Heaviside function valued at condition x, i.e. H_x=1, if condition x is valid and cero otherwise; l is length of the running window over which average profits are calculated and k is the capitalization state.

If negative profits ever exhaust the capital buffer down to C^f some capital injection to restore solvency to the solvency level prioritized. Existing funds in the averaging fund could eventually serve for that purpose. This is the role of the second term for F in the previous expression.

Norway constitutes an example of a country where a similar formula is applied. Allocations are made from Norges Bank to the so called Adjustment Fund until it contains 40 per cent of the Bank's net foreign exposure and 5 per cent of its Norwegian securities holdings. If the Adjustment Fund ever exceeds that level, the surplus shall be reversed to the profit and loss accounts. If the Adjustment Fund falls below 25 per cent of the Bank's net foreign exposure, a so called Transfer Fund is drawn until the Adjustment Fund is at its full size. The so called Transfer Fund is built up out of any surplus after provisions for or transfers from the Adjustment Fund. Every year a third of the capital in the Transfer Fund is transferred to the Treasury[91]. Effectively, the averaging period in Norway is three years.

It has been pointed out before that setting an effective cap on total capital may be a subtle issue from an applied perspective. Extraordinary dividends might be needed to solve the imbalance. Another solution to mitigate problems from an excessive accumulation in an averaging fund is to establish separate investment policies for it, so that the yield discount problem pointed out in section 5 can be overcome. An extreme alternative of this solution could be the externalization of the averaging fund.

6.3. The role of accounting standards

The full fair value benchmark considered so far has revealed problematic for profit distribution purposes. These problems have lead to the proposal that central bank payable dividends should be mechanistically determined, so that certain total capitalization and quality of dividends goals are fulfilled. However, it is also noteworthy to remind that market value has also been recognized as an acceptable benchmark for central bank accounting purposes. It is time to reconcile both apparently contradictory statements.

A first observation illuminating such exercise of reconciliation is the recognition of the intrinsically different purposes of general accounting standards and the ones needed for an independent central bank. Whereas general purpose accounting principles are aimed at serving decision taking by managers and shareholders, the very definition of an independent central bank, based on the negation of government involvement in its operations, supports the construction of a profit metrics that allows an harmonious coexistence of the legitimate rights of the government to receive dividends and the control of the central bank over its own financial strength. Ultimately this

[91] The net foreign exchange reserves computed exclude the portion of reserves that are directly credited/debited to the Treasury. See Norges Bank Annual Report (2002).

argument sets all conventional accounting standards on an equal footing as regards their applicability to central banking. In other words, some departure from ordinary standards is needed under market value accounting as much as is required under any other accounting convention. In accordance with previous discussion, the main elements of such departure are profit smoothing across exercises and priority on appropriation of central bank income for financial strength purposes.

As a second observation, it is also crucial to notice that no accounting solution for central bank operations should ever hinder their financial accountability. From this perspective, market value based accounting standards may enhance financial accountability of central banks, approximately as much as they do for the case of corporations. Market value accounting thus increases financial transparency by disallowing the built-up and management of hidden reserves.

Based on both observations, one is tempted to conclude that some adjusted fair value accounting benchmark is capable of delivering the tool to reconcile central bank financial independence and accountability requirements. The crucial point for such reconciliation is the adaptation of the income generation and allocation metrics to match the financial strength and dividend pay-out formulae delineated in previous sections. In other words, explicit smoothing solutions like the ones proposed make compatible central bank financial independence and accountability under market value accounting. Annex 2 briefly discusses to what extent other market value oriented proposals for financial instruments accounting, like IAS, allow for smoothing in income recognition from government debt holdings (under the available-for-sale category). However, foreign asset holdings are normally not granted such treatment.

As advanced before, Norges Bank can be said to follow a market value based financial reporting framework with smoothing provisions. Other central banks having adhered to some market value accounting specification *a la IAS* have also altered it to some extent. For example, the ESCB has adopted a modified fair value accounting scheme. Karrer (2000) describes the differences between the reporting and accounting principles in the ESCB and the international accounting standards. One of the main issues where divergence arises is the treatment of unrealized gains and losses. In that regard, the ESCB has been driven by prudence arguments to adopt an asymmetric approach: whereas unrealized gains are posted for each asset class to a revaluation account in the liability side, unrealized losses are irreversibly recorded in the P&L when market prices fall below average acquisition cost for each class of security. Notice the emphasis in irreversible, i.e. no reversal of losses across exercises is allowed. The asymmetric approach to unrealised P&L recognition has the virtue of matching the asymmetric position of a typical central bank in relation with the government as regards its ability to control its financial strength.

Notwithstanding the need for adjustments, the virtues of accountability provided seem to definitively favour currently market value based accounting standards. Some convergence can be detected in that direction under the auspices of multilateral institutions [see García Hernando (2002) and Kurtzig (2003)]. On the other hand, the need of adjustments also highlights the lack unicity as regards a definitive central bank accounting standard. Generally speaking, various accounting standards could be moulded to deliver acceptable solutions to the independence-accountability trade-off, if the central bank had the authority to reflect its financial specificities in it and an appropriate accountability setup is envisaged too. In practice, alternative accounting solutions to market value ones are those based on implicit smoothing schemes –mostly for holdings of government debt– that alleviate the pressure on short-term capital requirements. For example, the Federal Reserve System and the Bank of England still stick to proprietary accounting principles based on an amortized cost approach[92].

[92] The Federal Reserve prepares its financial statements in accordance with the so called Financial Accounting Manual that are believed to be more appropriate to the nature and functions of a central bank than GAAP.

In summary, the underlying economics of central banking precludes the blind translation of financial reporting schemes developed for the commercial world. The approach followed to adapt it to central bank reality may be diverse. Profit smoothing may be achieved either explicitly or implicitly. Appropriation of income for capitalization purposes may take place through special provisioning accounts, specific reserves or other instrumental means. The choice will be dictated by a myriad of institutional factors. However, theoretically speaking the different accounting alternatives can be compared and their equivalency tested if due account is paid of any hidden reserves, as integral part of the financial strength buffer of the central bank, and if the volatility of earnings is appropriately scaled down in accordance with the smoothing mechanisms followed.

7. Conclusions

Central bank independence has become one of the central concepts in monetary theory and policy. Practice and academic literature are almost unanimous in assessing central bank independence on the basis of a number of key factors, financial independence being one of them. However, limited attention has been paid to determinants of central bank financial independence. This paper has intended to make a contribution to fill this gap.

A financially independent central bank is considered to be one that exhibits the adequate balance sheet structure and earnings generation to efficiently perform its core functions. From a long-term perspective, as far as the demand for banknotes is maintained seignorage waters down any central bank financial independence concern in developed countries. However, from a short-term perspective central bank financial vulnerability may condition its effective independence. Loss of independence may be due to explicit or implicit influence on decision making. One example of the latter can be self-restraint on the central bank side with regard to the adoption of otherwise needed monetary policy measures which might negatively affect its financial position.

A part of the paper is devoted to the identification of the main financial risks to central bank independence. Another part is devoted to propose solutions to enhance central banks' financial strength. The main conclusions gained in the analysis can be broadly summarized as follows. Central banks balance sheet structure is relevant both on operational and financial independence grounds. The systematic discussion of risks to central bank financial independence ultimately can be used as a methodology for central banks capital budgeting. As a specific application of these ideas, a Basel-like model for central bank financial strength and a formula for dividend distribution are proposed. Both elements are aimed at ensuring optimal consistency between the legitimate rights of the government to receive dividends from the central bank and the government commitment to guarantee central bank independence. Alternatively, the paper also admits as a second-best solution institutional arrangements whose economic effect is the provision of (contingent) capital to the central bank and, therefore, put the government in a more symmetric position with regard to central bank profits and losses; in other words, institutional arrangements whose economic effects conditional on capital shortfalls are equivalent to outright capitalization. Obviously, one pre-requisite for those institutional arrangements is enforceability. Thus legal aspects, and in particular, adequate central bank law design with regard to central bank financial issues become a basic ingredient of central bank financial independence both under an outright capitalization or a contingent-capitalization solution to central bank financial strength.

The underlying presumption throughout the paper is the idea that, even if legally independent, a central bank in a financially vulnerable position may happen to require fiscal support. If that ever happens, the risk exists that the government can not overcome the temptation to bargain and influence central bank decisions, thus leading to waste the social benefits of independence.

Alternatively, the central bank might not implement needed monetary policy measures if they could end up driving its own financial position close to distress. Thus, commitment to central bank independence should ultimately entail also a financial dimension: the central bank should have enough resources to cope on its own with selected shocks to its finances. The emphasis on the "selected shocks" intends to reflect the caveat that, in addition to the benefits of central bank independence, society may also rate positively and wish to safeguard the special abilities of central banks in extreme systemic crisis situations.

Resources underpinning central bank financial strength should not be just commensurate with risks assumed, but also with the costs for the government of holding an excess of financial assets and with the social costs of central bank distress. Risks are assumed to be exogenously determined by the central bank mandate. Costs for the government of holding an excess of financial assets in the form of central bank shares typically result from the almost inevitable discount that central bank return on assets exhibit over the financing cost of government debt. The discount of stable central bank return on assets reflects its variety of functions, the composition of its assets portfolio and a myriad of institutional factors systematically discussed in the first part of the paper. Finally, the costs of central bank financial distress are quantified as the lost benefits of central bank independence. Notice that unlike Basel like models, this approach is not a percentile-based one. As a consequence of this, the capitalization solution exhibits decreasing returns to scale on risk.

Among the issues pertaining to the risk-return profile of central bank assets discussed in the first part of the paper, the reverting behaviour of risk of fx holdings and the one of government debt held to maturity decisively shape the conclusions of the paper. Namely, the (statistical) validity of the uncovered interest parity theory defines a short-term volatility and a (lower) medium-term one that shape the risk profile of the central bank. Consequently, a wedge emerges between short-term and medium-term central bank financial vulnerability. Market value accounting schemes exaggerate such wedge and impose a premium on short-term central bank capital over the medium-term one. The argument can similarly be applied to holdings to maturity of government debt. In other words, the capital buffer to be held by a central bank should optimally be inside the confines of a band.

Typically, the "shadow" base of capital that central bank exhibit, i.e. earnings from note issuance, suffices to cover even against short-term shocks if profits can be appropriated by the central bank. However, such solution transfers the excess of volatility to the government. Moreover, central bank financial independence calls for control on the central bank side on how to allocate its profits so that an acceptable level of solvency can be safeguarded.

As a consequence of these arguments, together with the capitalization proposal put forward in the paper, the elements of a dividend distribution policy are delineated which would lead to optimal consistency between financial strength preservation and entitlement over profits. Contingent capitalization solutions based on institutional arrangements should be equivalent in terms of their economic protection to the outright capitalization one. The dividends distribution scheme derived exhibits two features that depart from conventional practice.

Firstly, profits available for distribution do not necessarily encompass all income generated so that the capitalization optimum is feasible. Notice that unlike what happens with general purpose accounting principles aimed at serving decision taking by managers and shareholders, the very definition on an independent central bank, based on the negation of government involvement in its operations, supports the construction of a distributable profit metrics that leaves no margin for the erosion of central bank strength.

Secondly, the suggested scheme follows a smoothing pattern. Such feature, already practiced by some central banks, arises out of two reasons. Firstly, central banks' profit smoothing is neutral

with incumbent governments. Secondly, and more importantly, smoothing is consistent with the assumed natural cycles of central banks' earnings generation. In other words, quantity and quality of profits considerations recommend profit smoothing.

Smoothing has implicitly been practiced by central banks resorting to historical or cost-amortized accounting schemes. The recent prominence of smoothing as some extraordinary accounting device has emerged out of the trend towards market value accounting benchmarks. Certainly, market value accounting leads to higher levels of transparency and accountability on the financial domain. However, these benefits must be pondered against the premium on capital that it places, due to the short-term artificial vulnerability that it may unleash. In addition, the direct link between monetary policy actions and central bank financial position enabled by such accounting convention may also operate perversely on central bank decision making.

Annex 1

Combining tables 1 and 2, containing respectively the balance sheet and the P & L of a central bank it is immediate to obtain

$$\Pi = I_d + I_f + I_s + I_o - I_e + R_d + R_f + R_o - E_s - E_n - E_a - Ch_r - Ch_p$$

that becomes

$$\Pi = \Pi_n + \Pi_s + \Pi_e$$

after allocating the different items in three terms, i.e. normal recurrent profits, earnings subject to revaluation risk and a residual component

$$\Pi_n = I_d - I_e + I_s - E_s - E_n$$
$$\Pi_s = R_d + R_f + R_o + I_f$$
$$\Pi_e = I_o - E_a - Ch_r - Ch_p$$

where

$$I_d = B \cdot i_g + RF \cdot i + L \cdot i_l + Q \cdot i_q$$
$$I_e = P \cdot i_p + R \cdot i_d$$
$$I_f = F \cdot i_f \cdot s$$
$$R_f = F \cdot \Delta s$$
$$R_d = B \cdot \Delta b$$
$$R_o = G \cdot \Delta g$$

All in all one obtains the following decomposition of earnings that focuses on the proportion of yielding and non - yielding assets as well as costly liabilities :

$$\Pi_n = A\left[a_y \cdot \left(\frac{B}{A_y} i_g + \frac{RF}{A_y} i\right) + a_{qf} \cdot \left(\frac{L}{A_{qf}} i_l + \frac{Q}{A_{qf}} i_q\right) - l_c \cdot \left(\frac{P}{L_c} i_p + \frac{R}{L_c} i_d\right) + \frac{I_s - E_s}{A} + \frac{E_n}{A}\right]$$
$$\Pi_s = A\left[a_y \cdot \left(\frac{B}{A_y} \Delta b + \frac{F}{A_y} \Delta s + \frac{i_f \cdot F \cdot s}{A_y}\right) + a_{ny}\left(\frac{G}{A_{ny}} \Delta g\right)\right]$$
$$\Pi_e = A\left[i_o - e_a - ch_r - ch_p\right]$$

Annex 2

The contrast between the short-term and medium-term risk profile of a buy-and-hold strategy on a government debt security is striking. Although prices may oscillate wildly on the short-term, there is a well defined drift for the clean price of the security from the outset. Whenever accounting conditions for buy-and-hold investments are satisfied, investment-to-maturity accounting allows removing short-term risk. However, held-to-maturity accounting criteria are strict ones and, more importantly, they can not be satisfied by most central banks' financial assets almost by definition. For example, IAS-39 requires a positive intent to hold the financial asset to maturity before it can be classified in the held-to-maturity portfolio. Central banks commitment to elastically provide liquidity sets a profound limitation for them to benefit from the smooth accounting regime provided by amortized cost procedures and, consequently, from an ensuing lower level of risks.

The alternative categories envisaged by IAS-39 to classify financial holdings are held-for-trading portfolio and available-for-sale assets. Generally speaking, central banks' government debt holdings cannot be reputed as assets belonging to a trading portfolio. By definition, a trading portfolio is one intended to generate short-term gains through buys and sales, something that clashes with the essence of central banks' mandate. The only remaining accounting category is the available-for-sale assets one.

The available-for-sale category may fit the intent of holdings of government debt by some central banks. The option is available under this category to defer unrealised gains and losses on bond holdings and to recycle them to the income statement when assets are sold. Thus, smoothing is effectively allowed for government debt holdings in the domestic currency. However, in meantime fair value accounting must be applied. Notice that foreign exposure does not benefit of any smoothing mechanism.

Available for sale accounting thus fits the potential and real activism of some central banks in the interest rate market as frequently expressed in terms of benchmarking strategies around a duration target. Management activism is usually expressed in terms of an admissible band for the portfolio duration around the central target. Benchmarking trades thus obey two basic motives: rebalancing transactions and interest rate bets.

The central bank capitalization model in section 5 has assumed for expositional convenience that government debt does not affect central bank financial vulnerability. This assumption amounts to accept a buy-and-hold investment strategy, i.e. one where recovery of principal is guaranteed. Let us briefly discuss how a benchmarking strategy based on zero-coupon bonds sequentially matching (i.e. at successive rebalancing dates) the duration target can be fitted into the formalism.

It is interesting to start with the following observation. If the yield curve happened to evolve across time in accordance with its shape at the inception of the benchmarking strategy, the return of that strategy over a horizon equal to the duration target equals the return of one consisting of rollovers of investments to maturity (i.e. to the target duration). It is important to emphasize that the comparison term is a dynamic one, a sequence of investments to maturity. In a real situation, risk and yield pick-up over the one rollover strategy arise from the effect of discontinuous rebalancing and from success or failure of bets on yield curve movements. Notice that medium term risk from a benchmarking strategy on government bonds enters problem (2) in section 5 in differential terms over the risk of a buy-and-hold one. As a hint that medium term risk is lower than short-term one, notice that under one-off shocks to the yield curve the return from pure rebalancing effects amounts exactly the same to the one obtained from following the rollover strategy of buy-and-hold investments. In the most general case, the risk add-on of a benchmarking strategy over a repeated buy-and-hold one is certainly not a straightforward expression. However, its size is still lower than

the short-term risk. However, an institutional consequence of the permanent activism in the market is the inability to qualify for amortized cost accounting, i.e. an exposure to artificial risks not unlike the ones analyzed in the main text for foreign assets holdings.

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