Central Bank Insolvency: Causes, Effects and Remedies

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This article analyzes the possibility and consequences of central bank insolvency. Sovereign insolvency may indirectly cause or aggravate problems leading to central bank insolvency. Sovereigns have a bailout guarantee, either implicitly via loans from major central banks or the IMF, or explicitly, as is the case in the Eurozone via the European Stability Mechanism. Exchange rate stability through these bail-out guarantees allows for a greater amount of foreign-denominated debt accumulation than otherwise would prove prudent, or profitable. In the event of a crisis, the currency mismatch may be problematic for a central bank trying to support its banking system. Lacking the ability to supply foreign currency in the absence of an international bailout, central banks may face insolvency as they try to support an economy indebted in foreign currency.

Keywords: Central bank insolvency; Bailout; monetary policy; IMF; sovereign state insolvency; National central banks; Recapitalization of central banks.

Introduction

Investors typically view central banks as essential institutions for the stable functioning of financial markets. Governments entrust them with the role of monetary policy and allow them discretion to fine-tune the economy to provide either price or economic stability.

They traditionally use two tools to achieve these goals. The first are monetary policy tools at the central bank's disposal through its function as the primary supplier of money in an economy. In this regard, there are three operations that allow the central bank to enact monetary policy: 1) banking system reserve requirements, 2) direct lending through the discount window, and 3) asset purchases or sales

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that alter the money supply.

The second area of policy tools involves measures the central bank can use to serve in its function as a lender of last resort. Institutions that are dangerously nearing insolvency and may cause contagion throughout the economy may be assisted directly by central bank funding. In this way, an institution's liabilities may be retired and a return to sustainability achieved.

Limitations on a central bank's ability to implement these functions are determined by the economy's financial structure. On the one hand, the degree to which private liabilities such as bonds have been denominated in foreign currencies will dictate how much funding the central bank can supply from its asset base, which includes both domestic (e.g., government bonds) and foreign-denominated assets (e.g., foreign-exchange reserves). On the other hand, in a fixed exchange-rate regime the degree to which an economy runs a positive trade balance or attracts foreign investment in turbulent times will determine the amount of foreign exchange reserves a central bank may obtain to fund the foreign liabilities of insolvent companies.[1] Indeed, due to lags in price level adjustments, flexible exchange rate regimes also allow prolonged external balances to develop into either trade surpluses or deficits.

The insolvency of a central bank is highly improbable because a large part of the central bank´s liabilities (i.e., the monetary base), are not liabilities in the usual sense; they do not imply redemption in assets other than those it can produce itself. From an accounting point of view the monetary base can be written down on the liability side, thus increasing the capital position. Losses on the asset side of a central bank also affect its capital position. However, the fact remains that a central bank may operate with a negative accounting capital

[1] Aizenman and Sun (2009) have analyzed the use of reserves during the recent financial crisis. They find that countries with access to large foreign currency reserves were able to use these reserves as a buffer, thus foregoing the normal outcome of abandoning a currency peg. In contrast, countries with no access to foreign reserves ran the risk of floating their currencies in response to the crisis.

position because the majority of its liabilities are not liabilities in the sense we normally attach to the word.[2]

The situation is different when there are foreign-denominated liabilities on its balance sheet (for example, IMF loans, swap lines or lines of credit from foreign central banks, or loans from foreign governments). In these cases, the insolvency of a central bank *is* possible. Alternatively, in light of the functions that the central bank exists to serve with regards to the private sector, a pseudo-insolvency may obtain if a lack of foreign-denominated assets exist to cover the private banking sector's foreign-denominated liabilities. Having only the ability to increase assets in the domestic currency, central banks may find themselves impotent if presented with banking sectors largely indebted in foreign currencies.

This paper will outline the conditions that endanger central bank solvency. We will see that sovereign insolvency and its current solution – namely help by international consortiums of central banks led by the IMF – have created a situation that promotes central bank insolvency. The implicit bailout guarantees generate the illusion that exchange rates may be artificially maintained which, in turn, encourages currency mismatching. The currency mismatching may then trigger an inability to sustain its banking system and lead to the eventual insolvency of a central bank if it secures foreign loans that are ultimately unable to be repaid. Repercussions of this eventuality are outlined, with the detrimental effects being broad, reaching into both the domestic as well as foreign markets. Lastly, we will look at some schemes for insuring against such an occurrence. To the degree that a central bank is viewed as being a lender of last resort, plans must consider the contingency that insolvency may render the bank ineffective at providing this function, with alternatives identified.

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[2] Perhaps now more than ever. On January 6, 2011, the Federal Reserve changed its accounting procedures to eliminate the possibility of balance sheet insolvency by balancing losses on assets against a negative remittance to the Treasury. While this accounting rule change removes the appearance of insolvency for the Fed, it only delays it as long as the Treasury is willing to continue foregoing its profit remittance.

Sovereign States and Insolvency

While the goal of organized insolvency procedures for sovereign states, as is the case with defaults on government bonds, has long been a desire of economists, politicians and investors, the reality is far from settling on a standard. Legal jurisdictions remain mired in "unusually intense" competition concerning the proper treatment of bankruptcy laws (Fletcher 1999: 10). There is considerably less consensus on international insolvency laws than there is in other areas of law (Omar 2002; Khachaturian 2007).

Some have suggested that an international institution such as the International Monetary Fund (IMF) should function as an international lender of last resort (Fischer 1999; Roubini and Setser 2004; Obstfeld 2009). In the Eurosystem, the European Stability Mechanism (ESM) has been installed to bail out illiquid or potentially insolvent governments. When rapid and substantial support is given to countries at risk of liquidity or solvency problems, investor confidence remains elevated and removes the fear of default on existing debt. The circularity of such reasoning is, unfortunately, that such a guarantee will entice investors to take on higher degrees of foreign debt *ex ante* with little risk of suffering loses *ex post*. The elevated level of investment in countries guaranteed by a lender of last resort results in an increased level of economic activity and stability, because the investor base is enlarged relative to the level it would be in the absence of this guarantee.

A secondary issue arises from the enhanced stability of a country's finances. When international investment and confidence in a country's long-term fiscal perspective are increased, foreign exchange rate volatility is commensurately reduced. Domestic investors are given the subsequent advantage of denominating debts in foreign currencies that often offer lower interest rates, and hence, secure substantial savings as compared to comparable financing denominated in the domestic currency. This shift from domestic to foreign funding sources entails a cost that may or may not be embedded in the cost of borrowing – namely, , the currency exchange risk inherent in any debt undertaking where the currency of the

income source or asset is different than that of the liability. Investors are tempted to shift the denomination of currency away from the domestic money and into relatively cheaper foreign types. Indeed, the recent Icelandic boom saw a large influx of foreign-denominated funding to take advantage of lower foreign interest rates coupled with a stable (indeed, appreciating) Icelandic króna (Bagus and Howden 2011; Howden 2013a, b).

Hirsch (1977: 251-252) delineates the two methods that a lender of last resort can curb this moral hazard problem. The first is through the "English" route of informal controls and the inculcation of a club spirit among the guaranteed members to play the game according to the established conventions. In return for this responsible and "voluntary" behavior, insurance coverage will be comprehensive and assured. The second method is for the lender of last resort to exert a counterforce on morally hazardous behavior by making no direct demands on the banking sector but rather allowing it to face the possibility of failure. Depending on the looming threat of a contagion resulting from insolvency, the peril of moral hazard cannot be completely removed. When there is a case by case decision to pursue a bail-out or not, the moral hazard problem remains, especially for banks that are so interconnected and large that they regard themselves as "too big to fail". This case by case approach has historically been the "German", and to a lesser extent, the "American" approach to reducing moral hazard, though is unable to remove it completely.[3]

Which approach to prevent or minimize moral hazard best suits an economy is a contentious topic. With so much disagreement as to whether the powers of lender of last resort should be endowed in a central bank or a government's Treasury, there is a growing movement towards allowing bankruptcy proceedings to assume this function. However, the reality of conflicting international insolvency

[3] Regardless of the implementation scheme, moral hazard cannot be effectively eliminated in the face of potential bail-outs. Institutions expecting to receive public support hold significantly smaller amounts of tangible common equity to total assets (Nier and Baumann 2006).

proceedings for sovereign nations creates problematic outcomes that may require reconciliation through a common framework.

If one wants to implement an internationally recognized procedure for insolvency proceedings, it must be undertaken via an agreed upon and voluntarily entered set of rules. The International Monetary Fund has stepped in recently to provide such an agreement though it has, unfortunately, done so in such a way that promotes large-scale liquidity crises threatening the solvency of sovereigns, and ultimately, their central banks.

Enter the IMF

In response to a number of major global financial crises throughout the 1990s, the IMF increased its role as an intermediary in these international affairs.[4] Increased calls for the IMF to function as an international lender of last resort to stave off these insolvency crises would allow for more orderly exits to normalcy (Gilpin 2000: 335). With the existence of an overseeing agency, international capital markets could function with renewed confidence that a financial crisis (such as the liquidity crisis of late 2008) would not jeopardize debt repayments – especially crises in seemingly faraway places that would normally not be considered threats, except through contagion.

One significant failing of this push for an international lender of last resort is that the more countries the IMF bails-out, the more exacerbated will be the moral hazard problem in other countries. The risks inherent in an international lender of last resort may be unnecessary in most instances. After all, sovereign nations have a built-in advantage that a central bank has the ability to inflate the money supply and retire debt obligations denominated in its own currency. This salient feature – a central bank acting as a lender of last resort – should eliminate the possibility that insolvency of the

[4] We may remind ourselves of the Mexican peso crisis, the Russian debt default crisis, the Asian crisis, the Brazilian crisis, and later the Argentine crisis, *et al*. A renewed focus on sovereign insolvency has resulted from the turmoil these episodes have caused, and the amplification of the troubles through traditional strategies to deal with debt crises (Bolton and Skeel 2004: 764).

banking system will occur.[5]

One issue is that artificially induced stability in emerging countries due to the existing perception of international bailouts has provided investors the ability to diversify funding away from the emerging country's domestic currency (which will still suffer from an embedded and elevated risk premium) and into more stable foreign currencies. The IMF has recently noted that exchange rate stability today, while vital for growth of developing economies, must be balanced against the future need for adjustment (IMF 2009: 45). These foreign funding sources allow for a lower risk premium and hence a decreased carrying cost of debt. The stable exchange rates induced by the IMF lead to an "underpricing" of risk in the form of decreased foreign exchange rate volatility. As a result, there are strong forces enticing both governments and investors to take on foreign-denominated liabilities.

Central banks operating in their function as lenders of last resort can function, however, only within certain limits. One salient and specific limitation is that a central bank has the ability to inflate the money supply only in its own domestic currency. If no currency mismatch occurs, no conflict arises between a central bank and its ability to function as a lender of last resort (Chang and Velasco 2000a, b; Goodhart and Huang 2000). However, as we will see, the extent to which liabilities are foreign-denominated hinders the effectiveness of a central bank, and may render it impotent in the face of a liquidity crisis.

Enter the National Central Bank

Private businesses are disciplined to balance the denomination of their liabilities against those of their assets or income sources. Exchange rate fluctuations create uncertainty, and add a cost to taking on liabilities or diversifying revenue streams with diverse currencies. For example, a liability may be forced into redemption in

[5] This inflationary solution ensures the solvency of the banking system through a wealth transfer from savers, and involves the use of inflation as a tax (Bagus *et al*. 2011).

a foreign currency and depending on the exchange rate prevailing at the time it could prove exceedingly costly for a firm to cover this expense. The central bank of a country is under no such constraint.

Fiat money gives the central monetary authority the advantage that its own liabilities – primarily the monetary base – will never be forced into redemption for anything other than the same nominal units they are denominated in.[6]

However, the central bank has a *raison d'être* different from other institutions. While banks typically serve the dual role of intermediating depositors and borrowers of different time horizons as well as safekeeping deposits for customers until they are requested, a central bank serves a much broader function. The task of "economic" or "price" stability is lofted onto its shoulders.

Central banks functioning as market makers rely on having assets of sufficient quality *and* quantity to swap with banking system counterparties to maintain the illusion of liquidity in an otherwise illiquid environment. An insolvent central bank would have the characteristic of lacking this market-making ability.

Typically, we view insolvency in one of two ways. First, cash flow insolvency implies an inability to pay obligations as they fall due (i.e., illiquidity). Balance sheet insolvency, on the other hand, is that condition where liabilities exceed assets. Of these two, cash flow insolvency is the more pressing concern for the banking system. The mismatch in maturities between bank liabilities (mostly deposits, and redeemable on demand) and assets (mostly loans) exposes each bank to cash flow insolvency if its assets lose sufficient value or if its liabilities are redeemed *en masse*. If liquidity cannot be maintained when cash flow insolvency looms large – such as when deposit insurance is unavailable or when lending markets freeze so that short-term funding is not available – balance sheet insolvency will set in; illiquidity of the banking system breeds insolvency if allowed to

[6] Buiter (2008: 2) and Hülsmann (2008: 162) discuss the peculiarity of central banks being forced to redeem their liabilities with increasing amounts of liabilities; i.e., funding redeemed notes through increasing amounts of note issuance.

continue.[7]

A central bank suffering from balance sheet insolvency can still service its liabilities if they are denominated in domestic currency by increasing the money supply. In principle, such a central bank could still support its banking system via liquidity injections. While this conclusion holds for cases where liabilities are denominated in domestic currency, a central bank that wants to bail out an economy indebted in foreign-denominated debt will be constrained by its foreign-exchange reserves or the ability of the central bank to sell its currency to purchase foreign currency on the open market. Hence, only in those instances where the newly created money (plus the amount of existing assets) exchanged for foreign currency is higher than the existing foreign debts of the banking system will these foreign-denominated liabilities be able to be bailed out by the central bank. That is to say, if the real value of the newly inflated money supply can stay ahead of the purchasing power losses of the existing money stock (via the declining foreign exchange rate), then a central bank will have no significant difficulty inflating its way out of an insolvency-induced predicament.

What are the remedies in the case when a central bank has insufficient foreign-exchange reserves to support the banking system´s debts, and also cannot raise foreign currency on the open market? In those cases the central bank must choose between attempting to save the banking system and preserving its own solvency. Insolvency becomes a problem for the central bank because in the process of extending liquidity to the banking sector, it must purchase the assets that originally created the liquidity troubles. As the central bank increases its holdings of illiquid assets it increases the probability of insolvency through losses on its low-quality assets. It should be pointed out that even major central banks, such as the Fed or the ECB, face at least the possibility of balance sheet insolvency (Bagus and Schiml 2009; Bagus and Howden 2009a, b). This may arise

[7] Buiter (2008: 5) and Lastra (2007) provide overviews of the conceptual differences between these two insolvency types, with the repercussions of cash flow insolvency to banking institutions.

due to losses suffered on both central banks´ low quality asset purchases throughout the crisis. A recapitalization in the case of the Fed would be straightforward, though, as the U.S. Treasury could transfer government bonds to the Fed. The Fed also faces pseudo-insolvency or inability to rescue the banking system if it tries to buy the domestic assets of the banking industry by swapping them for the higher quality assets on its own balance sheet (Bagus and Howden 2009a, b). While under this scenario the central bank has its swap operations limited by the amount and quality of its available assets, a simple solution to this eventual problem is a bailout of the central bank by the government and an ensuing monetization of the newly issued debt. In this scenario, assets that the central bank wishes to purchase that are denominated in the domestic currency (e.g., U.S. dollars) can be printed with no significant difficulty. This role is one defining characteristic of the modern central bank – namely, that it acts as a lender of last resort when the banking sector finds itself in solvency troubles.

However, what if a banking system is not saddled with debt denominated in domestic currency, but is instead primarily foreign denominated? In this case, the central monetary authority is limited in its role as a lender of last resort, as its monetary policies are limited to regulatory changes of the banking sector (i.e., reserve requirements, capital adequacy ratios, etc.), open market operations using its balance sheet assets to offset transactions, or inflating the (domestic) money supply. In this situation, foreign reserves become the linchpin to maintaining the solvency of a banking system heavily indebted in foreign currencies.

The recent crisis has illustrated how economies heavily indebted in foreign currencies were strained as global liquidity dried up. Buiter and Sibert (2008), Bagus and Howden (2011) and Howden (2013a, b) explain that the Icelandic banking system has been the most evident case of this problem. As the Central Bank of Iceland lacked the ability to inflate any currency other than the domestic króna, its banking system heavily indebted in foreign liabilities (primarily Japanese Yen and Swiss Francs) quickly succumbed to insolvency. As the central

bank moved in to perform its stated role as lender of last resort, it too was left with few policy options because it lacked foreign-denominated assets to fund the struggling financial sector.[8] In the end, currency swaps and lines of credit by friendly nations were required to mitigate its financial collapse. Currency swaps for less demanded currencies (like the Icelandic króna) become problematic as there is little demand for a central bank to hold a long-term position in an unimportant currency.

One countervailing force to this unfortunate fact is that a small country may have embedded itself so thoroughly in the global financial system that insolvency could spark a contagion. In this case, central banks may find it in their best interests to commit swap agreements against a minimally demanded currency, provided that the risk of a systematic collapse of the global system could be mitigated as a result.

One complicating factor arises when a central bank's return on its interest-bearing assets declines relative to the charges paid on its interest-bearing liabilities. Typically, central bank liabilities exist solely in one of two forms: currency and bank reserves, which together form the monetary base. While currency is not interest bearing, reserves may be remunerated as per the central bank's regulations. Assets are comprised of government debts and loans to the banking system. Depending on the maturity of the debt held as assets, a jump in interest rates could leave the central bank in the detrimental position of having to pay more interest on its liabilities than it earns on its assets. This particular case occurred in Argentina dramatically after 1987, and led the central bank to cover the difference through seigniorage via an inflated money supply (World Bank 1993: 180). The end result was the sharp depreciation of the

[8] Iceland provided a curious case of an *explicitly* stated lender of last resort function embedded in the central bank's functions (Central Bank of Iceland 2001). While this is normally only *implicitly* acknowledged in other central banks, the effects that this exerted on the moral hazard among the Icelandic banking industry must have been increased compared to other countries, partly explaining the excess of its boom (Howden 2013b).

currency, and eventually, the Argentine economy. Nor does this possibility exist only in developing countries, or those with in a currency crisis. By committing to pay interest on reserve balances while purchasing Treasury bills at record low interest rates, the Fed has opened itself to potential losses on its balance sheet (Rudebusch 2011).

Another complicating factor arises when a negative currency mismatch coexists with a trade deficit. Not only will a currency mismatch prove to be an urgent problem requiring a source of foreign currency to offset, but it will likely be an *ongoing* problem in light of a sustained trade deficit. Under a flexible exchange rate regime the currency will depreciate to compensate for the sustained deficit. In contrast, under a fixed exchange rate regime, lacking an inflow of foreign currency in excess of the outflow, a central bank will be faced with a dwindling supply of currency reserves. In times of highly liquid debt markets, this is not necessarily problematic for trustworthy borrowers (as, e.g., Iceland had been) because regardless of denomination, the existing debt can be easily rolled over. When credit conditions contract, as occurred globally in late 2008, this rollover becomes ever more difficult as lenders are reluctant to extend liquidity further.[9] As a result, many entrepreneurs as well as governments may face a liquidity crunch that can only be mitigated through the supply of foreign currency or high quality assets easily convertible to foreign currency. To the extent that a prolonged trade deficit persists, a central bank's foreign reserves may be depleted to the point where there is an inadequate supply available to mitigate a crisis, and external help must be sought.

IMF drawing rights and currency swaps can be used in these instances to provide foreign liquidity to a domestic banking system. However, in light of a global crisis freezing the credit markets, one significant issue that arises is the scarcity of credit. In particular, the

[9] McGuire and von Peter (2009: 58) assess the failure of European banks' abilities to continually roll over U.S. dollar investments during the recent crisis, thus resulting in longer-term maturity holdings in compensation. This, in turn, exacerbated the maturity mismatch, generating a U.S. dollar shortage.

IMF's drawing rights are limited, and unable to be quickly expanded.[10] Drawing rights represent a pre-paid fund that lacks the ability to replenish itself without external assistance. Swap agreements are a more scalable method to establish lines of credit in the necessary denomination. However, there are two significant drawbacks in using this option. The first is the time component necessary to arrange a politically acceptable swap. Unless there is an active pre-negotiated arrangement, requests for funding may require lengthy debate on the swap terms (i.e., the repayment agreement, the extent of the swap, currencies involved, contingencies, etc). A more salient, if latent, point is that times of global crisis place limitations on the "friendliness" of many central banks. Arranging swap agreements under the increasingly stressed conditions of a liquidity crisis becomes more questionable than during more normal times.[11]

Losses may result due to exchange rate fluctuations and the real appreciation of the swaps. Moreover, these swaps may entail interest payments denominated in foreign currency. The possibility of cash flow insolvency for the banking system looms large, primarily due to foreign-denominated liabilities, and represents a commitment too large for a recapitalization by the government to be feasible.

Recapitalization of Insolvent Central Banks

Having seen that it is possible in special circumstances for central banks to become insolvent, we may ask the secondary question of what to do about it. Central banks are viewed, in many developed countries, as *de jure* independent of the states they function within. In the American case of the Fed, this independence can be seen as tenuous. The Fed holds on its balance sheet government debt issued through the Treasury. This interest-bearing asset provides the central bank with the financing required for day-to-day operations. At year-

[10] Lipton (2000) suggests that pooling IMF special drawing rights into a "crisis fund", to be used when combating systemic threats, would increase the efficiency of their implementation, and hence, allow for quicker interventions.

[11] Indeed, Jónsson (2009: 138) discusses Iceland's lack of aid from its former "friends" during its recent crisis in the form of required foreign liquidity, which was not forthcoming.

end, the Fed remits to the Treasury its net-operating profit which amounts to the interest income earned on this Treasury debt less its operating expenses. This amounts to a tax on the central bank, as the amount of this payment is determined (and enforced) through the Treasury (Buiter 2008: 6).

However, we may note that this transfer payment need not always be positive. As a central bank nears insolvency, this payment can be made negative. The result is that a mechanism is introduced whereby the central bank can be recapitalized with no structural changes to its operating procedure, nor significant legislative changes to its scope of operations. Notably, this need not be only a one-time occurrence. Because economic turbulence may introduce a strain on the central bank's liquidity and solvency, a recurring transfer payment back to the Treasury may be halted (or reduced) with the result that the central bank's budget constraint is considerably slackened.[12] This method amounts to a bailout by the Treasury.[13]

As the central bank's liabilities are generally (though not always) non-interest bearing and non-redeemable, it may be able to prolong its own solvency. Reducing its operating expenses is the typical way that any other firm would promote solvency. The central bank has the structural advantage that it may inflate its money issuance, and earn a

[12] Buiter (2004; 2005; 2007; 2008), Ize (2005) and Sims (2004; 2005) provided detailed analyses of this mechanism to recapitalize the central bank by shifting its intertemporal budget constraint. As Buiter (2008) details, this makes it possible for a central bank's present net worth to be negative, while maintaining solvency provided the present value of future seigniorage is greater than the sum of the future transfer payments to the Treasury and operating expenses. With the possibility of a negative transfer payment to the Treasury, a central bank's net worth will allow for continued operations.

[13] While a Treasury- induced bail-out is a fairly straight forward objective within the Federal Reserve System, the Eurosystem entails a much more daunting task. The lender of last resort function in the EMU is assumed by each national central bank. Hence, complications arise when the centralized ECB requires recapitalization (Lastra 2000). Buiter (2008: 9-10) and Bagus and Howden (2009a) explore the difficulties in recapitalizing the European Central Bank that come from these national sharing arrangements. To head off this eventuality, the ECB has taken strides to increase its capital in the wake of losses in December 2010.

positive seigniorage income in doing so. Hence, the present value of the future seigniorage stream allows for maintained solvency, provided debts are domestically denominated and not inflation indexed. A central bank may bail itself out, then, in cases of certain insolvencies. However, two limitations hinder this process.

The first is the existence of index-linked (i.e., inflation adjusted) liabilities. Inflating the money supply in an attempt to generate seigniorage revenue may entail increased price inflation. If a central bank's mandate includes an element of price stability, this may be a political limitation on this policy's pursuit. More critically, even if this path of action were politically feasible, it relies on the inflation premium on debt to increase at a slower rate than the increase in the money supply. Central bank transparency and its effects on investor expectations become crucial as they will determine to what degree inflationary expectations will counter the monetary expansion the central bank uses to bail itself out.

The second limitation is the degree of foreign-denominated debt on the central bank's balance sheet. Inflating base money to retire foreign-denominated liabilities will function only so long as the exchange rate is not affected adversely. As investors price this inflation into the exchange rate, the real value of these liabilities will increase. To the extent that investors price in the inflationary bailout premium faster than the nominal increase in the money supply, this form of bailout will prove to be sterile in retiring foreign-denominated debts. Lacking an external lender to provide a line of credit or swap arrangement, a central bank will not be able to meet its own funding needs from its resources. The result would entail either a failed hyper-inflationary policy, and/or central bank insolvency (Buiter 2008: 8).[14]

Analyzing the implications between the two options for an international lender of last resort to recapitalize insolvent banks, Jeanne and Wyplosz (2003) discover two irreconcilable difficulties.

[14] Buiter and Sibert (2008: appendix 1) derive a simple model demonstrating the upper-limit on foreign-currency seigniorage that may be produced by inflating the domestic money supply to exchange for foreign currency.

The first is that as the resources of an international lender of last resort must be carried out by the issuer of the necessary currency, the possibility for a crisis-inducing panic cannot be removed completely. In fact, a dependence on one lender of last resort will always involve an uncertain element as to whether the adequate bailout will be forthcoming.

Consequently, reliance on a single producer of currency will leave uncertainty concerning the expectation that a bailout will obtain. Alternatively, if the lender of last resort function is carried out by a limited fund's backing the domestic banking sector's safety nets, then the resources need not be larger than the liquidity gap of the domestic banking sector (the difference between the short-term foreign-denominated liabilities and the foreign-denominated liquid assets). While this second approach is more practical than the first, the aforementioned moral hazard and agency problems arise because of the need for an "international banking fund" to provide such services. Eichengreen (1999) and Rogoff (1999) argue that this particular lender of last resort would require an amount of hard currency that, although finite, is unrealistically large. As a consequence of this lack of an international lender of last resort, banking systems heavily indebted in foreign-denominated or inflation-indexed debt expose their own central banks to insolvency.

Conclusion

Recently, the European debt crisis has brought into focus the question of how best to deal with banking and sovereign debt crises. In this article we provide the link between sovereign insolvency, its prescribed medicine (international bail-outs) and the potentiality of central bank insolvencies and collapses of banking systems. Sovereign insolvency has led to more engagement and help via the IMF. This implicit bailout guarantee on the part of the IMF has provided increased exchange rate stability. This increased stability entices investors to take on more foreign-denominated debt *ex ante*, necessitating IMF aid *ex post* to align market conditions with their former expectations.

Normally market conditions provide a disincentive to investors

and governments to take on excessive amounts of foreign-denominated debts via the risk premium of exchange rate volatility. This premium can be reduced through actions affecting the default options in cases of sovereign default. For example, the IMF's recent role as a lender of last resort has given otherwise turbulent economies an exogenous source of stability. One benefit to this action has been the promotion and prolonging of economic growth. However, there are hidden costs involved which are only now becoming apparent.

This period of increased stability not only reduces the risk premium on the debt from these affected countries. It has also been manifested as increased stability in the respective exchange rates. As a direct result, investors and governments are inclined to take advantage of these stable exchange rates by financing debt in foreign currencies. Benefits are received through reduced debt payments via lower interest charges (themselves reflecting lower risk premia). While this process works well while global money markets remain liquid, in the midst of a crisis this liquidity can be removed.

As the banking system accumulates foreign-denominated liabilities, the central bank potentially finds itself in a difficult position as a lender of last resort. In fact, to fulfill this role the central bank must indebt *itself* in foreign currency. This, in turn, opens the possibility for its own insolvency as it obtains debt denominated in a currency it cannot produce. Thus, we see the importance of the quality of the assets of a central bank in relation to its liabilities, the potential needs of the financial system it supports, and ultimately its currency.

Only endowed with the ability to inflate in the domestic currency, a central bank must rely on its foreign exchange reserves to retire foreign-denominated liabilities. As previous prolonged trade deficits may have reduced these reserves, central banks may find themselves especially impotent in the face of liquidity crises. As foreign-denominated liabilities overwhelm a central bank's reserves, it is left with no options with which to ensure liquidity in the system – it is rendered impotent and may even face insolvency.

Focus on insolvency procedures concerning insolvent sovereign

states has overlooked the salient point of why this insolvency occurs in the first place. To the extent that liabilities are foreign-denominated and a central bank lacks the foreign exchange reserves to retire these liabilities, the state and the central bank run the risk of insolvency.

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