The Price Theory of Money, Prospero's Liquidity Trap, and Sudden Stop

Back to Basics and Back

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Abstract. Fiat money contains the seeds of its own destruction. It has no intrinsic value and, yet, it can be exchanged for valuable consumption and production goods. As Hahn (1965) shows, this situation puts fiat money's market value or *liquidity premium* at the brink of collapse. In this paper I will argue that (1) sticky prices, especially when staggered, provide output backing to fiat money, helping to sustain fiat money's liquidity premium and, thus, lowering the risk of a liquidity meltdown. I call this view the *Price Theory of Money*; (2) fixed-income assets linked to fiat money, especially if they are perceived to have low counter-party risk (like US Treasury bills, AAA bonds or Asset-Backed Securities) can take advantage of point (1) to become quasi-moneys; (3) this gives incentives to the private sector to create those assets; (4) however, unless protected by a Lender of Last Resort, the new assets' liquidity premium can quickly and massively evaporate in what I call (with a wink to the Bard) a *Prospero's Liquidity Trap*; (5) the latter lowers the market value of loan collateral and clogs the credit channel, bringing about a credit event or Sudden Stop, with severe output and employment consequences. Hence, this approach shows that the creation of money is the original sin that comes back to haunt us in different, more sophisticated and insidious forms by the hand of the financial sector. These insights are employed to shed new light on, among other things, the perils of floating exchange rates at national and global levels.

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"[...] *the fact that contracts are fixed, and wages are usually somewhat stable in terms of money, unquestionably plays a large part in attracting to money so high a liquidity-premium*" Keynes (1961, Chapter 17, p. 236)

I. Introduction

The subprime crisis shattered old certainties, and is prompting economists to revise the notions of money and liquidity that were taken for granted. The crisis has brought those issues to the fore only to make us aware of our astounding ignorance. Monetary theory, for instance, succeeded in obliterating money from its elegant models (for a discussion see Calvo (2011 b)). Fortunately, the situation is improving noticeably thanks to a veritable flood of new papers that attempt to bridge the gap between macro and finance – a task that requires taking more explicit account of financial issues in macro models, but also requires that finance theory incorporates principal-agent problems of the sort that became apparent in the course of the present crisis.[2]

These notes collect some of my thoughts on these issues. Initially, it was an attempt at *compte rendu*, but as the text evolved I realized that the pieces of a puzzle generated by a rich literature on monetary economics – especially material which is relevant for understanding the current crisis – did not blend with each other in a smooth and faultless fashion. I found some gaps in the literature that raised long forgotten or simply disregarded questions, which, when taken into account, shed new light on topical theoretical and policy issues. That is why the subtitle to the paper starts with the phrase "back to basics." However, if that was the point of destination of these notes, they would be of interest to other monks that spend their waking hours splitting hairs, but hardly anyone else. Fortunately, it turns out that a return from the center of the earth, still blinded by the bright colors, one can make out patterns that are too vague for the eye accustomed to the lively and colorful prairie. The current events can be seen under a new perspective, potentially pregnant with new insights – that is why the subtitle ends with the words "and back."

The general design of the paper is such that current events are the main motivation and pop up along the text, but instead of exploring every nook and cranny served to us by those events, I will attempt to keep the analysis tightly linked to the "basics" in the hope that this will eventually help us to see the layout of the forest in high definition. But, to ensure that the

[2] An avowedly partial list would include Allen (2011), Fostel and Geanakoplos (2012), Shin (2010 and 2012), Stein (2012), Calvo (2005).

analysis does not lose touch with reality, I will occasionally employ the intuitions gathered underground to address some relevant and/or topical policy issues.

Money and liquidity are concepts that cannot be ignored in any credible narrative of current events. In fact, the intuition that set me off this route is that money and liquidity are fundamental for sustaining a modern and increasingly globalized economy, but their own grounds – their *fundamentals* if you wish – are extremely flaky. If we continue treating money and liquidity as if they were regular "goods," we run the risk of repeating the same mistakes that led us to the current crisis. Thus, I will start by discussing a basic question that has bedeviled economists for many years and that, perhaps out of frustration, the profession tends to ignore, namely, What makes money valuable in terms of output? A satisfactory answer to this question must precede any serious attempt to explain financial crisis that exhibits a major liquidity component.

Hahn (1965) threw a wrench into monetary theory by showing that, if you take your theory seriously, a barter equilibrium cannot be easily ruled out. In this paper I argue that standard answers to the riddle leave a lot to be desired, and put forward a conjecture that has strong support in price-setting mechanisms in modern economies (especially in retailing and labor markets). I am referring, in particular, to nominal *price/wage stickiness*. Under nominal stickiness suppliers broadcast, far and wide, their willingness to take fiat money in exchange for the wares and services they own. Moreover, they reaffirm their willingness to do so over extended stretches of time (consider labor contracts in non-inflationary economies, for example). I will christen this approach the *Price Theory of Money* (PTM). [3]

No doubt, government support in the form of legal-tender regulations and requirements to defray taxes in fiat money, provide further anchors, but price-setting validates the output worth of fiat money over the whole expanse of the market, and on a regular, even boring, basis. This leads me to surmise that price/wage stickiness can do the job even though government's buttressing is completely absent. True, a full rationale for this conjecture should be able to identify the factors behind that peculiar way of posting prices and wages. We are still not there yet, which forces the analysis to take price-setting mechanisms as axioms, determined outside the model. However, a strong appeal of the PTM is that price/wage stickiness has a strong empirical support and, perhaps more to the point, that the conventional approach in monetary theory also relies on assumptions that are ad-hoc in the context of the standard general equilibrium model (which is grounded on utility and production functions), and that, as shown in Hahn (1965), the conventional approach is seriously incomplete. Price stickiness, blamed by

[3] A germ of this approach can be found in the *General Theory*. See quotation at the outset.

macroeconomists for mass unemployment, can now raise its head in triumph as the savior of money, nothing less!

Under this optic, for example, one can start answering questions that are high in the public policy debate. For example, will the euro survive the onslaught of current crisis? The PTM suggests that, in addition to the EU willingness to keep the euro circulating, its survival may depend on whether a significant share of European firms and individuals keep posting their prices in terms of euro. Under those circumstances, and unless fiscal deficits become rampant, the euro could still hold its own as a reserve currency even though the EU economy dives into deep recession.[4] On the other hand, the ever-present candidate for making a stellar comeback, i.e., gold, may not succeed in debunking the US dollar, for example, unless gold becomes a unit of account and, more to the point, a substantial share of prices and wages are quoted in terms of gold.

Moreover, under this perspective, factors that reduce price stickiness may make fiat money less "safe" in terms of output.[5] Floating exchange rates is a case in point. Financial crises in Emerging Market economies (EMs) in the 1990s led the IMF and the Washington establishment to conclude that floating exchange rates should be the choice system for EMs. The basis for this conclusion is highly debatable, starting from the fact that floating exchange rates are highly unpredictable (see, e.g., Mussa (1990)). The PTM sheds further doubts on floating exchange rates, especially if the currency in question does not have global acceptability as a medium of exchange. I will argue that this may help to give a fundamental rationale for Fear of Floating (see Calvo and Reinhart (2002)). But, in addition, I will show that if the central bank conducts monetary policy by employing as an instrument a short-term interest rate and agents are subject to short-sale constraints, the economy may display multiple equilibriums even though Hahn's problem can be ruled out – a fact, by the way, that has not been sufficiently emphasized in conventional theory.

Fiat money helps to lay the groundwork for payments systems. Means of payments are assets that help to settle trade and financial obligations. Holders of these assets are, of course, attentive to their rates of return, but the primary reason for holding these assets is to carry out

[4] Borrowing Krugman (2012, chapter 12) neologism – Eurodämmerung might see Europe's high columns and artful friezes collapse, but euro coins could still be able to shine brightly and unpolluted under the sun, like in the opera!

[5] Henceforth, I will somewhat imprecisely employ the word "safe" to indicate assets whose output price are relatively stable and predictable for a significant set of market agents. This does not rule out assets which output prices are expected to change over time before expiration, as long as they are highly predictable. Safe assets play a key role as credit market collateral (see Gorton et al (2012)), an issue that will be discussed in Section IV.

"payments" or "transactions." In contrast with standard general equilibrium theory, in real-life markets the act of "paying" could be very costly, because the payee needs to be able to assess the market value of the payment instrument. The cost of assessing the market value of a means of payment can easily overwhelm its rate of return. Therefore, as stressed by Gorton et al (2012), dominant means of payments tend to be *information-insensitive*. Fiat money with a stable output value is a paradigmatic example. Moreover, if fiat money is firmly anchored on output, it makes it possible to create other means of payment linked to fiat money, e.g., fixed-income assets like short-term bonds and repos denominated in fiat money. New banking practices have extended the payments system across the world and beyond standard devices (see Gorton and Metrick (2010), Shin (2012)). Moreover, I will argue that a nascent means of payment that gradually spreads across sectors and economies may get extra *real* backing, beyond that provided by price stickiness: just the expectation that new pockets in the economy will start employing the new instrument makes the latter more reliable means of payment in real terms. This implies, somewhat paradoxically, that, as the market for the new instruments mature and reaches a plateau, their perceived output backing declines, and the instruments become more vulnerable to runs – which suggests, incidentally, that a possible reason why the dotcom crisis was just a hiccup, while the subprime carried major consequences was that "shadow banking" was much more mature in 2007 than in 2001.

Even though fiat money is well anchored to output, this does not preclude assets linked to fiat money to be subject to runs. This is a fact amply evidenced by a large number of bank-run episodes along financial history. A bank run destroys liquidity. It is a supply-side destruction of liquidity that is *per se* conducive to an excess demand for liquidity, making the reduced-form of a bank run observationally equivalent to a Keynes's *Liquidity Trap*, which is a demand-side phenomenon. However, a bank run is different from the latter and, more importantly, it has radically different policy implications than a Keynes's Liquidity Trap. Thus, to avoid confusion, I will coin a new term (with a wink to the Bard): *Prospero's Liquidity Trap* – defined as a massive collapse in the nominal price of a significant number of means of payments. Moreover, I will require that the trap does not result from *mischievous* animal spirits but is, instead, fully consistent with rationality.[6] Drawing on previous work (e.g., Calvo (2012)), I will argue that a Prospero's Liquidity Trap has effects on *relative prices* and, thus, real wealth (which helps to rationalize the current *safe-asset shortage*, recently highlighted in IMF (2012), Barclays (2012)). In particular, it undermines the (output) safety of loan collaterals and, as a result, lowers credit

[6] *Mischievous* animal spirits misguide, *rational* animal spirits coordinate a true, although possibly "bad," equilibrium. Hence, rational animal spirits "live" in models displaying multiple equilibriums. To "kill" them, all policymakers have to do is to generate conditions that rule out equilibrium multiplicity, ideally only keeping the "good" equilibrium.

flows. This is the point at which *Wall Street* and *Main Street* enter into contact. The decline in credit flows has an immediate effect on output and employment, which cannot be easily undone, unless, in an act of improbable magnanimity, Prospero restores liquidity illusion, or the government can replace lost liquidity with a sufficiently large infusion of new safe assets (e.g., a swap of "toxic assets" for base money, a form of *Quantitative Easing*).

I will start the paper in Section II with a discussion of Hahn's problem for fiat money. I will argue that the problem is not confined to fiat money, it also holds for commodity money (e.g., gold), and show that 19th century bank notes were an early form of Asset-Backed securities. In Section III, which contains the most innovative part of the paper, I will argue that staggered prices and gradual monetization could help to reinforce the output value of money, thereby enhancing other fixed-income financial assets in their role as means of payments – the central insight of the Price Theory of Money. Section III will also show that floating exchange rates may weaken money's output anchor and, realistically, increase exchange rate volatility or sheer indeterminacy. In Section IV I will show how money that is firmly anchored to output can help to open up the credit channel, but at the cost of increasing the severity of Prospero's Liquidity Trap. The latter, in turn, may abruptly close the credit gates and generate a Sudden Stop episode (see Calvo et al (2008)). I will argue that fixing this situation calls for heterodox policies in order to bring about a fast and effective reopening of the credit channel. Compared to that, fiscal expansionary policy may be a temporary palliative, but its effect on the credit channel is indirect, and likely feeble and time consuming. The paper is closed in Section V (which can be read right after this section without loss of continuity) with some highly speculative reflections on the international monetary system. An Appendix presents some empirical evidence on a phenomenon central to the paralysis of the credit channel in the current crisis, namely, the massive destruction of "safe" assets.

II. Hahn's Problem

The value of money in terms of goods is an issue that has troubled economists since they attempted to integrate money into the classical theory of value. Macroeconomists have dealt with this issue by taking shortcuts like including money in the utility function (e.g., Patinkin (1965)), or assuming that expenditure is subject to a Clower-Lucas cash-in-advance constraint (e.g., Lucas (1980)). However, as pointed out in Hahn (1965), these tricks may not be enough to prevent the existence of barter equilibrium in which money has zero value.

To illustrate, consider the case of *fiat money*, e.g., dollar bills, that has no intrinsic output value, i.e., such that if, say, dollar bills are no longer accepted as medium of exchange (MOE), their equilibrium market value in terms of output would be nil. Let M and Q denote, respectively, the stock of dollar bills and the price of M in terms of output, i.e., the inverse of the price level.

Assume that the utility of money in terms of output (or *real monetary balances*) is separable from the utility of goods and denoted by $v(MQ)$;[7] function v is defined and twice differentiable on the non-negative real line, strictly concave, and $v'(0) > 0$. I further assume that $v(0) > -\infty$, and $lim\ v'(MQ) < \infty$ as $MQ \to 0$. The latter – which I will call "anti-Inada conditions" – are technical assumptions that have substantive implications, though, as will become apparent in the ensuing discussion.

Under these conditions, it trivially follows that there is an equilibrium solution in which the output value of fiat money is zero, i.e., $Q = 0$. This is so because if $Q = 0$, then $MQ = 0$, independently of M. Thus, money becomes useless as a MOE and, since there is not cost in holding or disposing of M, the demand for money is undetermined and could be equal to any non-negative number; in particular, setting M = supply of M shows that equilibrium in the money market can be achieved for $Q = 0$. Since the utility of money is separable, equilibrium in the real side of the economy is invariant to money market conditions (i.e., money *super-neutrality* holds) and, thus, general equilibrium can be ensured by standard general-equilibrium assumptions in non-monetary models. Note that this result is very general and does not rely on super-neutrality (see Hahn (1965)). However, anti-Inada conditions are essential for the proof because if, for instance, $lim\ v(MQ) \to -\infty$ as $MQ \to 0$, barter equilibrium would be ruled out *by assumption*. Inada conditions are typically assumed in the literature to simplify the analysis by ruling out corner solutions. They are not intended to rule out relevant equilibrium solutions, as it would be the case if assumed in the present instance. In the present context, Inada conditions would be much like saying that fiat money has positive output value in equilibrium because a situation in which fiat money loses its effectiveness as a MOE would be "unthinkable" – or, more to the point, saying that fiat money has positive output value in equilibrium because its value cannot possibly be zero – a vacuous proposition.

The output price of fiat money, Q, can be identified with what Keynes in the quotation at the outset calls "liquidity premium," i.e., the difference between the market output value of fiat money and its intrinsic value (= 0 in this case). Thus, Hahn's problem can be rephrased by saying that there is an equilibrium in which the liquidity premium of fiat money equals zero (and the economy reverts to barter).

Note that Hahn's problem, despite its simplicity, involves deep issues linked to the fact that fiat money is a MOE. If fiat money was a regular good, then we would write its utility as $v(M)$,

[7] In the literature MQ is usually identified with "real monetary balances."

excluding its price, Q, from the utility function;[8] in which case, and as a general rule, the demand for M would be *positive*, and possibly unbounded, if its relative price $Q = 0$. Therefore, $Q = 0$ would, in general, not be consistent with equilibrium in the money market.

Fiat money is a useful instrument on which to focus the discussion about liquidity premium, but the result that its output price could be zero in equilibrium may be hard to swallow on "realism" grounds, since it is not easy to find examples in which the price of fiat money is suddenly driven down to zero. There are several post-WWI dramatic hyperinflation episodes in which the value of fiat money was positive until monetary reform was implemented. At that point, the unwieldy currency was substituted by a more stable alternative, but this occurred in coordination with government, not as a result of the market autonomously shifting to the zero-price equilibrium.

However, Hahn's problem is not confined to fiat money. Consider the case of gold, for example. Let Q and q denote the output price of gold as a MOE, e.g., gold coins, and for consumption (e.g., jewelry), respectively. Assuming that gold can be transformed into these two applications on a one-to-one basis, i.e., one ounce of gold as a MOE can be transformed into one ounce of gold for jewelry at no cost, then, if gold is simultaneously used for both applications, we have $Q = q$ in equilibrium. But $Q = 0$ could also be consistent with equilibrium. For, under those circumstances, individuals will have no incentive to use gold as a MOE and, as in the case of fiat money, the marginal utility of gold for MOE purposes is zero, making demand for gold as MOE equal to zero.[9] If $Q = 0$, the price of gold for consumption q will likely fall relative to its value when gold is also used as a MOE but it will not be zero, i.e., gold will display a positive intrinsic value. This shows that when gold is used as a MOE it may exhibit a positive liquidity premium even though, unlike fiat money, its intrinsic output value is positive.[10]

History shows that gold gave rise to other "liquid" assets. US banks in the 19th century, for example, were able to issue bank notes partially backed by gold. These notes are an early example of Asset-Backed securities. The sustainability of those notes was partially ensured by

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[8] Goods which prices also enter utility functions are sometimes called "status" goods. However, money, as usually modeled, would not rank as a status good if, in addition, it is required that its demand *increases* with its relative price. Consider Cagan's demand for money: $M = exp(-\alpha i)/Q$, were parameter $\alpha > 0$, and i is the nominal interest rate. Clearly, the demand for M falls with its price Q.

[9] Unlike the case of fiat money, the demand for gold as a MOE is zero if the marginal utility of gold consumption is positive.

[10] Notice that $q < Q$ implies that the whole stock of gold will be utilized as MOE. This equilibrium is also possible but adds nothing to the discussion in the text and will, thus, be skipped.

the *law of large numbers* which, under normal circumstances, ensured a stable demand for those notes; however, they were subject to runs and loss of market value, much as in the case of Hahn's problem. These runs and associated disruptions in the credit market are very much like the problems encountered in the current crisis, as will be discussed later on in this note.

Legal Tender and Taxes. An objection to the relevance of Hahn's problem is that it is common for national fiat monies to be "legal tender," i.e., mandatory MOE within national boundaries. There is no doubt that legal tender regulations must make the $Q > 0$ equilibrium more resilient, but it is unlikely for this regulation to prevent the private sector from employing the national fiat money as a unit of account *and* holding another asset, e.g., gold, to carry out future payments. In the limit, this would drive Q to zero, because the demand for fiat money would be nil. In practice, however, equilibrium Q is likely to be positive but, given that stocks would be held for regulatory reasons, demand could be highly volatile, particularly if other highly liquid assets are available (giving rise to "currency substitution," which will be later discussed in this note). Thus, Q would be subject to unstable probability distributions and large variations, unless the government fixes its exchange rate vis-à-vis another stable currency, for example. The latter, by the way, could result in a stable real value of fiat money but it does not invalidate Hahn's problem, because the value of money would be derived from anchoring to a stable liquid asset with positive output value. Q unpredictability undermines fiat money as a MOE. Therefore, although legal tender might help to overcome Hahn's problem, it presents us with an equally disturbing, and certainly more realistic, problem which, for lack of a better name, I will call Hahn's Knightian problem, in reference to Knight (1971). I should clarify that the volatility that I am referring to here, is not the normal price volatility that characterizes an efficient market economy. My focus is on volatility provoked by cracks in the market mechanism due to factors having to do with market regulations, and the difficulty in anticipating or hedging against those factors, and that seriously undermines fiat money as a MOE.[11]

Fiat money's positive output value can also be buttressed by requiring taxes to be paid in terms of fiat money. However, Starr (1974) shows that this condition is not enough to rule out a zero output price of fiat money, even if it is declared legal tender and, still more relevant, the price of money is assumed to be the same for defraying taxes or buying goods. If the latter assumption is dropped, a situation akin to the zero-price equilibrium might arise. To illustrate, consider the case in which taxes in terms of fiat money are τ/q, where τ is a positive parameter and q is the output value of fiat money when it is *exclusively* employed for defraying taxes. If

[11] I am thankful to Fernando Alvarez and Aaron Tornell for highlighting the importance of distinguishing between these types of volatilities.

taxes are the only reason for holding fiat money, we have, in equilibrium, that money supply $M = \tau/q$; hence, the price of money $q = \tau/M > 0$, if $M > 0$. But if fiat money is also employed as a MOE, quite possibly its output price, denoted by Q, exceeds q, i.e., $Q > q$. The liquidity premium would be $Q - q > 0$ = liquidity premium if, otherwise, money is only accepted for defraying taxes. Therefore, as in Hahn's problem, the model displays a barter equilibrium in which fiat money is only used for paying taxes, and a true monetary equilibrium in which, in addition, money is held for other private sector transactions.[12]

Finally, legal tender requirements are much harder to implement for international transactions. Nothing, in principle, prevents international traders to invoice and make payments in US dollar, euro or yen.

III. Anchoring Money: Staggered Prices

The central implication of Hahn's problems is that the output price of fiat money could be zero or volatile in an unpredictable way, which seriously imperils the functionality of fiat money as MOE.[13] The situation might be substantially different if the private sector posted prices (and wages) in terms of M, held on to those prices for some period of time, and was prepared to accommodate supply to demand to ensure equilibrium in the output market. This is the framework assumed in popular New Keynesian monetary models (e.g., Woodford (2003)). Under those circumstances, it is clear that $Q > 0$ is more likely to hold in equilibrium, because (1) suppliers would be indicating, through the price-setting mechanism, and around the clock, that they are willing to take fiat money in exchange for their produce at preannounced prices,[14] and (2) prices are set in a milieu where a large number of prices are predetermined in terms of fiat money and, hence, the chances of all prices being set in terms of another unit of account would be negligible, at least in the short run. Moreover, staggered pricing helps to prevent Hahn's Knightian problem. To see this, notice that if, contrariwise, all prices are simultaneously

[12] Notice the parallels between this discussion and the gold example presented above.

[13] Obstfeld and Rogoff (1983 and 1986) show that a zero output price on money (and hyperinflation) could be ruled out if the central bank sets a lower bound to the output value of total money supply (= 1 peanut, say). However, this result relies on assuming Inada conditions. If, instead, anti-Inada conditions hold, $Q = 0$ would still be consistent with general equilibrium. Suppose $Q = 0$. Then, individuals would gladly go to the government's warehouse and exchange M for one peanut. The supply of M will now be nil, but this will cause no excess demand for fiat money because the latter serves no useful purpose – and equilibrium prevails.

[14] This makes this case radically different from the peanut example in previous footnote, in which the government accepts fiat money in exchange for output (one peanut), given that the government announcement does not ensure that the private sector is willing to follow suit.

set for one period, say, the equilibrium one-period-ahead *Q* could be highly volatile (and even zero).

This discussion suggests that price stickiness may play an important role that has so far not been duly acknowledged in the literature, namely, providing a *real* or output anchor for money. I believe that an appropriate label for this approach would be the *Price Theory of Money* (PTM), and that the protean Mr. Keynes should be given some credit for the idea (see quotation at the outset). The PTM attaches a role to price setting which is sharply different from that in conventional theory. In conventional closed-economy theory, for example, money is seen as a *nominal* anchor for prices, and sticky prices as a nuisance that makes it difficult to achieve full-employment equilibrium.[15] However, the two approaches are complementary to one another. Combining the PTM with standard monetary theory suggests that there might be a tradeoff between the stability of fiat money in real terms and the speed with which the economy restores full-employment equilibrium. An economy bereft of nominal flexibility may offer a strong real anchor to fiat money, but it might be ill-suited to accommodate large changes in relative prices – while an economy that displays a high degree of nominal flexibility might be ill-suited to withstand severe challenges to the output value of its currency.

The role of nominal stickiness in buttressing the real value of money is not taken into account in conventional monetary theory. In the canonical model, for example, the demand for money is assumed to be a function of the nominal interest rate and consumption. The degree of nominal stickiness is completely ignored. Thus, for instance, a shift from fixed to floating exchange rates has no effect on the demand for domestic money, even though floating exchange rates remove some of domestic money's output anchor (see next subsection for further discussion). Moreover, inflation itself could weaken the output anchor, since the frequency of price changes appears to increase with higher inflation (see Alvarez et al (2011)), which, arguably, lowers money's output backing. This effect goes beyond what is accounted for by the conventional link between inflation and the demand for money, and helps to explain why, after an inflationary spike, the demand for money fails to recover even though inflation goes back to pre-spike levels. [16]

[15] New Keynesian models determine future prices by manipulating a short-run interest rates subject, for instance, to a Taylor rule, but still sticky prices are a roadblock to full employment.

[16] I am thankful to Carmen Reinhart for this observation. Uribe (1997) offers a complementary rationale for money-demand hysteresis, which does not rely on price stickiness, and instead focuses on currency substitution and network effects.

The PTM is not a theory for all seasons. It may be highly powerful for crisis-free, low volatility periods, like the *Great Moderation*, but it may fail in economies undergoing bankruptcies and institutional instability. More research is necessary to establish these limits. Nevertheless, the mere consideration of these issues already suggests that easy money policy – a currently widespread policy stance in advanced economies and some EMs – could be helpful in triggering recovery from a slump or even finance the fiscal deficit under low inflation conditions, but it may suddenly snap and send the economy into an inflationary tailspin.[17]

Subject to the above caveats, I believe that price stickiness is a very appealing explanation for the positive output value of fiat money, because it involves a substantial number of decision makers who are ready to exchange their riches for intrinsically worthless script. Tax collectors may guarantee a positive price of fiat money but, if that is all there is, Hahn's Knightian problem may prevail, and monetary policy is likely to be largely inconsequential. PTM does not replace the conventional approach (i.e., the monetary theory of the price level), but it helps to reinforce the latter's weak micro-foundations, as clearly shown in the discussion about Hahn's problems.[18]

Gradual Adoption of a MOE. Consider a "gradual monetization" episode in which fiat money is not adopted as a MOE by everybody at the same time, but its use as a MOE gradually spreads across different agents and regions in the economy. A possible scenario is the case in which fiat money is adopted first in a large urban center, and agents living outside that center learn about its use as a MOE as they get in touch with the center or, eventually, through agents outside the center who have adopted the fiat money as a MOE. If the process is anticipated by agents located at the center, will that make Hahn's problems less likely? This question cannot be answered without a model (a task that falls outside the scope of these notes; for some steps in that direction, see Calvo (2011 b)), but let me start the discussion with some intuitive remarks. If agents at the center expect that new entrants will be willing to hold fiat money in exchange for goods, they will likely feel more secured that fiat money will exhibit a positive output value. The new-entrants' effect is somewhat similar to price setting, except that it works on the

[17] This phenomenon appears to have played a role in Germany's hyperinflation after WWI. Right after the war speculators expected that the Mark would display sharp appreciation, which led to an expansion in the demand for Marks around the world. It allowed the government to finance the fiscal deficit without causing a major rise in the rate of inflation. This idyllic period came to an abrupt end, after which inflation reached unprecedented heights (see Bresciani-Turroni (1937), Mendershausen (1957)).

[18] The microfoundations literature on the demand for money offers interesting insights, like the existence of potential multiple units of account and associated MOEs; see, e.g., Menger (1892), Kiyotaki and Wright (1989). The PTM and the conventional macro approaches do not help to overcome the fundamental equilibrium multiplicity problem, but suggest factors that help to, or detract from, anchoring a MOE, *once it is established*.

demand side, not the supply side, of the fiat money market. This issue is interesting because fiat money has given rise to quasi-monies with much the same characteristics as fiat money, a phenomenon that has taken flight thanks to the breakdown of Bretton Woods in early 1970s, and financial innovation in the last twenty odd years (these topics will be taken up in Section V). Conceivably, the adoption of the new techniques and instruments, e.g., mortgage-backed securities, took time to spread across the economy. Hence, their gradual adoption may have strengthened the real anchor of the new fiat-money denominated financial instruments. However, once markets for these new assets mature, the flow of new entrants declines, which may undermine their safety as MOE, a phenomenon that may help to explain that Prospero's Liquidity Traps pop up long after the new assets have been created. More concretely, this effect may help to rationalize the fact that the dotcom crisis was much less severe than the subprime crisis: conceivably assets associated with "shadow banking" were much more mature in 2007 than in 2001.

The conjecture is also relevant for gradual capital-inflow episodes in EMs, as argued in Calvo (2011 b). Savvy investors will be encouraged to keep on expanding those inflows due to the perception that there is a queue of potential investors after them. However, when the adjustment process comes to an end, gravitational forces become weaker and the chances of a credit episode may go up.

Floating Exchange Rates. From the PTM perspective, floating exchange rates weaken the output backing of local fiat money, especially for fiat monies that are not invoice currencies in international transactions,[19] like national EM fiat monies. Exchange rates have a direct impact on local currency prices of (internationally) *tradable* goods. Thus, floating exchange rates remove some of the "stickiness" in tradable good prices in terms of local fiat money which, in line with the PTM, helps to explain the large number of EMs in which foreign currencies circulate side by side with local fiat money, a phenomenon called "currency substitution."[20] A complementary reason for currency substitution is that, as a general rule, those foreign currencies are reserve currencies, i.e., fiat monies that, compared to EM currencies, are seen as having a strong global output backing.

[19] Notice, however, that invoice currencies in international transactions, like the US dollar, get some output backing à la PTM due to the invoicing mechanism.

[20] See Calvo and Vegh (1996) for a discussion of Currency Substitution, and IMF (1999) for a discussion of monetary policy in dollarized economies. Here I emphasize the Transactions Motive, but currency substitution has also implications for the Store of Value and Speculative Motives for holding money.

Nevertheless, as long as a substantial share of prices are set in terms of domestic fiat money, Hahn's zero-price problem may be ruled out. Not so Hahn's Knightian problem, though – particularly if foreign currencies play a large role as MOE (for case studies, see IMF (1999)). Therefore, it is not surprising to see that central banks in EMs have accumulated substantial amounts of International Reserves in order to attenuate the effects of a run on local currency, especially after the 1990s systemic financial crises. It should be noted, though, that International Reserves put a damper on exchange rate volatility, giving rise to *Fear of Floating*, i.e., a situation in which the government intervenes, directly or indirectly, in the foreign exchange market to keep the domestic currency within relatively narrow bands, see Calvo and Reinhart (2002).[21] Therefore, a floating exchange rate regime may produce its own antibodies that attenuate exchange rate volatility and push the system back to some form of exchange rate *pegging*. The PTM helps to rationalize this outcome as an attempt to ensuring a stable output price of national fiat money (or stable Q, in our notation).

Exchange rate pegging is an example in which, given the tradeoff between flexibility and stickiness mentioned in the Introduction, the latter is given the upper hand. Unfortunately, pegging is not trouble-free, as the large literature on Exchange-Rate Stabilization programs testifies (see, e.g., Calvo and Végh (1999)).

Floating Exchange Rates and Inflation Targeting.[22] Another reason for Fear of Floating that is worth highlighting is that a monetary policy instrument that has become increasingly popular, namely, some short-term interest rate, may prove to be a weak nominal anchor if the system is subject to lack of credibility (for details, see Calvo (2006 and 2007)). Moreover, even if credibility or Hahn's problems are not critical issues, an interest-rate anchor may become ineffective if capital markets are less than perfect. I will illustrate this point by focusing on the realistic case in which individuals are subject to short-sale constraints, a common financial market imperfection.

Consider, for example, a New Keynesian representative-individual model in which the central bank sets a one-period policy interest rate, denoted by i, at which the private sector can lend to, but it is not allowed to borrow from, the public sector. The latter is a simple way to capture the short-sale constraint. Assuming perfect foresight and that the international one-period interest rate equals zero, we have that at an interior equilibrium the following interest-rate-parity condition must hold:

[21] The word *Fear* is prompted by the fact that many economies exhibiting the phenomenon identify themselves as "Free Floaters." Thus, these "floaters" could be claimed to be "peggers in the shadows."

[22] This section can be skipped without loss of continuity.

$$i_t = \frac{E_{t+1} - E_t}{E_t}, \quad (1)$$

where *E* stands for the price of "foreign exchange" in terms of domestic currency. Equation (1) states that at an interior equilibrium the one-period interest rate must be equal to the expected rate of devaluation. However, under the short-sale constraint, a rate of devaluation that is larger than interest rate *i* might also be consistent with equilibrium. Clearly, if *i* is less that the expected rate of devaluation, individuals will dump their one-period public debt holdings in favor of foreign bonds. This may also involve lowering money holdings, but this is no problem because the central bank would be ready to sell public bonds (which the representative individual will quickly exchange for foreign bonds) for domestic currency. Finally, the larger devaluation might change the demand for nontradables but, again, that is no problem in a conventional staggered-prices context because supply is demand-determined. Therefore, the interest rate instrument would stop being effective, because at a corner solution the market interest rate will be equal to the expected rate of devaluation which, by assumption, exceeds *i.*

For further illustration, consider a model in which the central bank follows a Taylor rule, relies entirely on the interest rate as an instrument and, as a result, stationary equilibrium is dynamically unstable (see Galí and Monacelli (2005), Calvo (2007)). If equilibrium solutions are constrained to be interior paths, then the stable manifold is the unique equilibrium. However, if corner solutions cannot be ruled out, as in the above example, one can easily show that there are rational equilibriums in which the real exchange rate steadily appreciates for a while, away from the stationary manifold, until it reaches a point in time in which the currency suffers an *anticipated* devaluation that brings the system back to the stationary equilibrium. Individuals cannot take advantage of this arbitrage opportunity because they are subject to short-sale constraints.

I picked this example, among many others, because this kind of phenomenon has been repeatedly observed in EMs during capital-inflow episodes that ended in major devaluation. Not surprisingly, then, many seasoned EM policymakers resort to foreign exchange intervention when their currencies show clear signs of misalignment. Anticipation of foreign exchange intervention may help to constraint the set of equilibriums, providing another rationale for Fear of Floating in the context of conventional monetary policy. It is worth pointing out that, to avoid burdening the private sector with additional policy uncertainties, it might be preferable that the government announces that it will intervene in the foreign exchange market in case of serious exchange rate misalignment.

IV. Payment System: From Safe Money to Safe Credit to Sudden Stop, and After

The payment system is at the heart of a modern economy. Payment instruments are, as a general rule, not goods that go directly into utility or production functions. The quintessential payment instrument is fiat money, especially when it displays a strong output anchor and is subject to a low rate of inflation. To underline the existence of these features, I will label it "safe fiat money." Modern economies employ other payment instruments that share some of money's safety features, e.g., government-guaranteed bank deposits, Treasury bills, AAA bonds, fixed-income securities, which payoff is specified in terms of money. Their prices may vary in response to, for instance, changes in the rate of interest, but at each point in time they have a well-defined market price and are largely free from counterparty or idiosyncratic risk. Table 1 in the Appendix shows an estimate of safe assets derived from Barclays (2012). These assets can be employed to settle accounts or to back up other payment instruments that would otherwise not be deemed safe, e.g., a personal IOU. Hence, safe assets are directly or indirectly key components of the payment system. A massive destruction of safe assets, as witnessed after the 2008 Lehman episode (see the Appendix), would bring about a sudden cut in aggregate demand, because at pre-crisis prices the stock of payment instruments will be in dramatically short supply. I will argue that safe assets may be subject to massive destruction due to their inherent fragility. Thus, safe assets, one of the greatest unsung discoveries of humankind, helps to oil the wheels of the payment system but contains the seeds of its own destruction, leaving in its wake a trail of output and employment destruction. At the end of the day, a safe-asset catastrophe is very similar to a Keynesian impasse, but if a dearth of payment instruments is at the root of these problems, aggregate demand policies may be wide of the mark or counterproductive: the eye of the policy sharpshooter should rather be aimed at restoring the stock of safe assets and credit.

A. From Safe Money to Safe Credit

Fiat money that exhibits high price stability in terms of output ("safe" fiat money) offers an attractive base for the creation of other financial assets denominated in that unit of account. Bank deposits is a classical and prominent example. It illustrates the possibility that the new assets could even become MOE despite involving obligations that are redeemable by the issuer, because their refinancing could be largely taken for granted.[23] Assets denominated in "safe" fiat money piggy-back on the latter's safety characteristics, and if they are free from counterparty risk they will also be seen as safe (in terms of output), e.g., US Treasury bills.[24] In

[23] Several countries have opted for deposit insurance, which makes refinancing even more of a sure thing.

[24] See Krishnamurthy and Vissing-Jorgensen (2012) for evidence about the liquidity and safety of US Treasury bills.

the last twenty odd years financial engineering, with the help of cooperating rating agencies and laxer regulations, has produced a host of new safe assets. Not all of these assets qualify as MOE, but still serve a useful role as guarantees or "collateral" against loan default. As Gary B. Gorton has pointed out in several papers, safe assets remove some of the need to learn about borrowers' idiosyncratic risks, which might dramatically lower lending costs (see, e.g., Gorton et al (2012) and IMF (2012)). In case of default, for instance, lenders can attach the associated collateral and dispose of it in the market. If the collateral is composed of safe assets, the proceeds of the sale in terms of output would be highly predictable and, above all, independent of the borrowers' idiosyncratic risks and manipulations. Lower lending costs help to open the gates of the credit market, and give rise to what one might call "safe credit." Notice that this line of causation starts from the creation of safe MOE, which in advanced modern economies takes the form of an easily identifiable fiat money (e.g., dollar, euro, yen), highlighting the relevance of the previous discussion about the factors that explain the liquidity premium of fiat money. Arguably, this evolution from safe assets to safe credit is a good turn of events but it is, by no means, risk free; for, safe assets are largely free from idiosyncratic risk, but may still be subject to "systemic" risk.

B. From Safe Credit to Sudden Stop

Safe credit also makes *borrowers* who post collateral in the form of safe assets feel assured that the loan can easily be *refinanced*, encouraging them to invest in *illiquid* ventures, i.e., projects that are not safe or easily "salable."[25] This may give rise to a socially beneficial (e.g., Pareto improving) allocation of resources. However, all of this is based on a liquidity component that has all the markings of a *mirage*: it could be long lasting, but it could also evaporate in the blink of an eye (akin to Hahn's problem, or an old-fashioned bank run). Fiat money's liquidity premium, as the previous discussion reminds us, is also a mirage, but staggered pricing and other underpinnings like legal tender and taxation makes it more solid than the liquidity premium of the rest of the associated nominal forest.[26] Some bank deposits are an example of this privileged class, but many other safe assets are less protected (recall the meltdown of asset-backed securities in the current crisis). If their prices fall, the supply of safe assets also falls. If the fall is large, the gates of the credit market will fast shut off because safe collateral will shrink. This will likely give rise to a "credit event" or Sudden Stop (Calvo et al (2008)). This phenomenon is akin to Hahn's problem, but its implications are likely more serious – because

[25] Menger (1892), one of the founders of the Austrian School of Economics, considered "salability" one salient feature of *liquid assets*.

[26] Unless there is a Lender of Last Resort that is ready to monetize their debt obligations in case of stress, in which case, of course, those assets would be indistinguishable from fiat money.

the destruction of safe assets stops credit flows in their tracks and could have severe consequences on the *real* economy: output and employment, for example. These effects may get worse if prices are sticky, but the credit shock occurs even if prices are perfectly flexible, because (1) the fall in collaterals' *output* values is a *real* shock, not a mere monetary adjustment: it makes *real* credit more costly; and (2) it may trigger Irving Fisher's (1933) Debt Deflation.[27] By the way, it is not unusual to hear from bankers in the middle of financial crisis that the problem is not *lack of credit* (more precisely, Sudden Stop), but *lack of demand for credit*. Some analysts conclude from this that the crisis stems from a Keynesian fall in aggregate demand driven by (*mischievous*) *animal spirits*. But there is an alternative explanation that is fully in line with the above discussion: the initial Sudden Stop lowers aggregate demand as savings fail to reach dissavers; the latter leads sectors awash with liquidity (e.g., the US corporate sector in the present crisis) to cut investment projects and lower their demand for credit, even though the credit channel is wide open for them. Therefore, both "lack of credit" and "lack of demand for credit" are phenomena that could perfectly occur in the course of a financial crisis. Nevertheless, I strongly believe that the primary shock comes from a Prospero's Liquidity Trap cum Sudden Stop.

The government can palliate the effects of safe-asset shock. Debt Deflation could be forestalled, for example, by easy monetary policy that staves off price level deflation. However, this would not necessarily be enough to restore some key relative prices, like real estate prices (see Calvo (2012) for a model). To prevent major relative price swings, which may seriously impair collateral real values, the government may have to engage in "toxic" asset purchases and other heterodox policies.[28] These purchases may have to be large to make a difference. The Appendix below suggests that to restore safe assets to pre-crisis levels may call for purchases that are 170 percent higher than those that occurred during the period 2007-2011. Moreover, heterodox policies require highly qualified and incorruptible civil servants, which are typically in short supply. Even if suitable civil servants become available, their effectiveness would likely be seriously impaired by lack of information. Financial crises make financial markets dysfunctional,

[27] Debt Deflation occurs when debts are denominated in fiat money and prices fall, increasing the output value of debt obligations, and possibly giving rise to massive default. In economies in which debts are denominated in terms of foreign currencies (a phenomenon called *Liability Dollarization*), a real currency devaluation episode may generate a shock akin to Debt Deflation, and hits borrowers who have invested in nontradables. This shock is common in many EM financial crises, even though it is typically accompanied by price inflation in domestic currency. See, e.g., Calvo (2005).

[28] For the present discussion, "toxic" assets should be thought as illiquid or non-safe assets. Purchases of US Treasury bills, for example, may not resolve any of these issues, given the high substitutability of Treasury bills and money. See Krishnamurthy and Vissing-Jorgensen (2012).

and to offset their *real* effects, the government must be able to collect a massive amount of information in the short run – a truly herculean task!

Can Higher Prices of Safe Assets offset Safe-Asset Shortage? An important detour. The destruction of safe assets associated with the Lehman episode has resulted in a large fall in interest rates on safe assets that were relatively unscathed during that episode, e.g., US Treasury bills and German bunds. This, of course, implied that the market price of those safe assets went up, tending to offset the fall in the value of the other pre-crisis safe assets, e.g., asset-backed securities. Could the price rise of what one might call *super safe* assets fully offset the fall of the others, keeping the stock of safe assets largely unchanged? Conventional monetary theory suggest an affirmative answer. Suppose that a fire consumes 50 percent of the supply of fiat money. At initial money price Q_0, there will be a *shortage* of money. But, according to conventional theory, equilibrium will be restored and money shortage eliminated if $Q = 2Q_0$ (equivalent to 50 deflation of the price level). This price-level deflation mechanism was not observed in the present crisis because central banks increased *M* in order to prevent price level deflation or inflation. Thus, under these circumstances, the offset mechanism should rely on a rise of non-fiat-money super safe asset prices. According to available estimates, e.g., Barclays (2012) and IMF (2012), this has, by far, not happened.[29] Why?

One plausible explanation is that, unlike *Q*, central banks are not committed to preventing large swings in the money price of super safe assets. Governments only commit to *service* the string of payments associated with public sector super safe assets. Their price *before* maturity is market determined. Suppose that individuals believe that current interest rates are low relative to what they will be when economies go back to normal. This implies that as the price of a super safe asset rises, the size of potential capital loss (that would materialize the moment economies go back to normal) also goes up. If the timing of transition to normal is unknown, the rise in the price of super safe assets may make these assets less safe, particularly as loan collaterals. Therefore, their safety may be subject to an upper bound. Notice, once again, that this type safety loss would not apply to fiat money if the government is committed to ensure the real value of fiat money supply, a commitment which is implicit in Inflation Targeting policy, for example.

[29] The Appendix below suggests that safe assets have fallen by 15 percent of world GDP during the period 2007-2011, despite massive advanced-economies central banks' Quantitative Easing.

In a nutshell, nominally stable economies that display nominal price stickiness spawn a forest of nominal contracts (e.g., nominal bonds) that are classified as "safe," because their output price is expected to be stable and predictable, and are free from idiosyncratic risk. Safe assets help to open up the credit channel. However, there are few truly safe assets, and no automatic mechanism to restore their supply in real terms, especially when price level deflation is ruled out. The forest of nominal contracts beyond those that are closely grounded on wages and retail goods may suddenly be subject to a *Prospero's Liquidity Trap*, and collapse to the ground. A Prospero's Liquidity Trap is a supply-side shock because the supply of safe assets shrinks. This contrasts with Keynes's Liquidity Trap in which scared savers prefer to hold money rather than investing or lending, giving rise to a demand-side shock. The case emphasized in this note is that in which Prospero's Trap is the *initial cause* and Keynes's Trap the *initial effect* (although this does not rule out feedback going in the opposite direction). A Lender of Last Resort (LOLR) may help to restore safe assets but, unless it gets involved in microeconomic policymaking or large "toxic asset" purchases, it cannot prevent a sharp fall of some key prices. This may depress collateral output values, helping to clog the credit channel and giving rise to a credit event or Sudden Stop. Timely unclogging of the credit market requires heterodox monetary or fiscal policy, for which the public sector is not well suited. This helps to explain the snail's pace of recovery from financial crisis that has been shown in a number of empirical studies (e.g., Reinhart and Rogoff (2009), Reinhart and Reinhart (2010), Calvo, Coricelli and Ottonello (2012)).

C. After Sudden Stop

High debts and fiscal deficits are typically associated with Sudden Stop episodes. It is common to blame profligate governments, opportunistic lenders or silly borrowers for those problems, ignoring that most of them may be casualties of a Prospero's trick. A brief discussion of these and other related issues follows.

Overindebtedness. Sudden Stop forces some borrowers to default or reschedule their debt obligations, a situation that is usually called "overindebtedness" (OI). OI becomes rampant if Sudden Stop comes after a boom of credit or capital inflows. Thus, many observers jump to the conclusion that OI is *caused* by those booms. Unless carefully qualified, I find this conclusion very hard to swallow. This is not an event in which only a few individuals or firms are involved. It is a massive event. Therefore, blaming previous credit booms for massive OI would imply that the financial sector is incredibly incompetent or corrupt, and that borrowers are hopelessly unsophisticated. There are, no doubt, many examples of that sort, but I do not find the evidence strong enough to support the view that these examples gave rise to the present global financial crisis. Actually, the examples may to some extent be the result of futile attempts to

cover up the deleterious *effects* of the financial crisis (e.g., the recent Libor scandal, see FT (2012)).

In contrast, the approach presented here is based on the fact that liquidity premium is, except in special cases, subject to a meltdown. Not because of *mischievous animal spirits* but because it is in the very nature of liquidity. From this note's perspective, OI may largely be a consequence of Prospero's Liquidity Trap and insufficient backing by a LOLR.[30] A great advantage of this approach is that it is consistent with rationality. Therefore, under this perspective, proposals for preventing future financial crises can be analyzed taking into account constraints and incentives that are regular staple in conventional economics: a visit to your corner fortune-teller can be left for another occasion!

Stagflation. Inflation could be a powerful instrument for redressing unsustainable deficits and disequilibria after Sudden Stop. Calvo, Coricelli and Ottonello (2012) show that inflation after financial crisis helps to lower real wages and, if inflation is high enough, prevent *jobless* recovery, i.e., a situation in which jobs lag behind output.[31] Moreover, inflation could have a sizable impact on the real value of outstanding debt obligations, e.g., Aizenman and Marion (2009), through a mechanism which is a mirror image of Debt Deflation (should we call it Debt *Inflation*?). Finally, expected inflation may alleviate the effects of Keynes's Liquidity Trap by lowering the demand for money (and close substitutes like Treasury bills) and increasing aggregate demand for goods and services. Should we conclude that inflation is the road out of financial crisis?

I have no strong argument against the benefits underlined above, especially if the experiment consists of implementing a *credible* once-and-for-all increase in the price level (i.e., a once-and-for-all fall in *Q*, in the above notation). But the main point that I would like to stress is that inflation is *not* a regular tax. The government controls interest rates and money supply, but inflation is determined by the private sector. There is no mechanical relationship between instruments and inflation, and this may impair the safety of safe assets. For example, there is strong empirical evidence supporting the view that inflation and relative price *volatility* are positively correlated (see Friedman (1977), Blejer and Leiderman (1980)). Thus, one could appeal to the PTM to argue that higher inflation may weaken the output anchor of nominal

[30] This view is forcefully put forward in Gorton (2010) in the context of the subprime crisis. See Calvo (2012) for a formal model along these lines.

[31] Inflation is not a cure-all, though. It cure unemployment but at the cost of lower real wages. See Calvo, Coricelli and Ottonello (2002).

assets. This lowers the market value of safe assets, clogs the credit channel and fuels stagflation.[32]

V. International Trade and Finance

The previous discussion touched upon some international topics but only as a sideline. It is now time to address some of those issues head on. The main insight derived from the PTM that I will highlight in this section is that free-floating exchange rates, especially among major currencies like the US dollar and the euro, may thwart international trade and help to regenerate risky financial instruments.

First off, it is worth recalling that the Bretton Woods (BW) period did not exhibit deep financial crisis episodes like the Great Depression or Recession (see Obstfeld and Taylor (2004)). Crises during that period were relatively localized and most of them took place in less-developed economies due to inconsistency between fiscal and exchange rate policies. Moreover, the US dollar was king, financial instruments were rather primitive, and countries were largely free to impose controls on international and, in countries like the US and Germany, even interregional capital mobility. Some observers conclude from these facts that financial liberalization is largely responsible for *systemic* financial crises (Rodrik (2011)). It is hard to disagree with this statement, partly because it is somewhat tautological: a tightly fettered financial sector cannot possibly give rise to systemic financial crises! However, it may contain a grain of truth that I will try to articulate in what follows.

The breakdown of BW replaced a system of fixed but intermittently adjustable exchange rates vis-à-vis the US dollar, by a system in which exchange rates are market-determined (although not necessarily free from *unilateral* government intervention). Moreover, restrictions on capital mobility among advanced economies were gradually lifted, and had virtually disappeared before the recent crisis. All in all, the new system exhibited much higher exchange rate volatility, both in nominal and real terms. During BW, agents were somewhat indifferent between setting their prices in US dollars or German marks, for example, but the situation became markedly different after the 1970s (see Mussa (1990)). This generated a demand for financial instruments to help easing the currency mismatch that emerged in international market transactions. The financial sector reacted by creating those instruments and, in fact, the new financial instruments could be claimed to have been "effective," because empirical analyses support the view that, until the recent crisis, trade flows were not severely affected by exchange rate volatility in developed economies (see Calvo and Reinhart (2005) for a survey of

[32] The hypothesis discussed here to rationalize stagflation is complementary to the ones put forward in Friedman (1977) and Blejer and Leiderman (1980), which are based on the deterioration of price signals under high inflation.

the literature). However, a consequence of the new arrangement is that the private sector started to have much greater *direct* control and management of the new international payments system. During BW the official sector (national governments, the IMF) had virtual monopoly over the global payments system. In the post-BW era, in contrast, the official sector gained control over individual countries' monetary policy but at the expense of generating greater price-denomination mismatch and diminished control on the international payments system.[33]

As a result, even major currencies may be seen as less safe. At the margin, different fiat monies, especially the ones actively used as invoice currencies for international trade, are highly substitutable and, therefore, their relative price (i.e., exchange rates) could be *excessively* volatile, in the sense of becoming highly sensitive to shocks that are hard to observe (a phenomenon akin to what I called above Hahn's Knightian problem).[34] This likely opened up arbitrage opportunities that did not exist during the BW period which, combined with a fast-growing Theory of Finance in the second half of the 20th century, arguably gave incentives for the creation of new financial instruments to deal with the currency-denomination mismatch and supported cross-border investments that exacerbated denomination mismatch (for evidence linked to the Great Recession, see Acharya and Schnabl (2012), Borio (2011)). Following the banking tradition, many of these instruments, took advantage of the law of large numbers, making them relatively safe. The main problem is that, while these instruments help to get rid of idiosyncratic risk, they are subject to systemic shocks.

In short, the above discussion supports the conjecture that the breakdown of BW gave rise to a large forest of safe assets.[35] Their resiliency to shocks may even have temporarily increased because the new instruments were likely gradually adopted across economies and sectors (recall Section III). Now the house of cards has collapsed, bringing us back much closer to the inception of the post-BW period. If nothing substantial is done to reform the system, trade and credit will continue to suffer, and growth and instability may be the rule of the day. Moreover, unless the financial sector is tightly regulated, a new forest of safe assets will come to life.

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[33] Some countries found monetary autarky too risky and unilaterally went back to BW by pegging their currencies to some currency like the US dollar, which was at the center of the payments system during BW (Fear of Floating).

[34] Exchange rate indetermination is discussed in Kareken and Wallace (1981). Their benchmark case could be considered a bit extreme if not special, but I believe the paper points to a substantive problem. Indetermination may not hold in practice, but their paper's insights could be employed to argue that exchange rates of globally relevant fiat monies could be highly volatile, and unhinged from standard *fundamentals*.

[35] This does not rule out other factors like financial deregulation. See Obstfeld and Taylor (2004) for a balanced discussion of international financial issues in a historical perspective.

Given the knowledge accumulated during the last boom, the new instruments are likely to be spawned much faster than in the past, and a new systemic crisis could be at our doorsteps in a few years (for recent evidence supporting this conjecture, see The Economist (2012)). This is not a promising scenario.

Alternatively, the official sector may seize back the reins of the payment system and set up a new BW, BW21 (for the 21st century). This is not the place to present a complete proposal or even a sketch of a proposal. But it seems clear to me that, at present, freely floating exchange rates are a luxury the world can hardly afford. This may sound somewhat crazy under the present circumstances in which the eurozone is teetering on the brink. But, of course, I do not have in mind a currency area as today's eurozone, where basically the only institution in common is the European Central Bank (ECB). My model is the US with a well-established fiscal union. Granted, this is an unattainable objective in the short run, but that does not prevent us from walking in that direction. Moreover, the crisis itself may give policymakers incentives to reach agreements that may help to thwart excessive currency volatility. The evidence is already clear. For example, prompted by ties between US and EU banks, the Fed has rapidly come to the rescue of the ECB by extending multi-billion currency swaps (see Acharya and Schnabl (2010)). Moreover, US branches of European banks were the largest beneficiaries of new Fed liquidity funding during the Lehman episode. Countries are collaborating with each other motivated by self interest, which gives some hope these types of policies will continue in the future and help to build the political consensus for BW21 from the ground up.

I am afraid, though, that BW21 will come too late to prevent further deepening of the current crisis. The crisis is not subsiding, fiscal policy has run its course and central banks are the only institutions that can stop further derailment. However, uncoordinated action by central banks could evoke the specter of competitive devaluation or trigger additional counterproductive exchange rate volatility. This may drive central bankers into inaction or, otherwise, foster protectionist policies to insulate economies from currency appreciation – which might take us back not just to the start of BW, but to the start of WWII!

Appendix: Safe Assets[36]

The Table below shows an estimate of safe assets following the criterion of Barclays (2012, Figure 18). The only difference is that I added the US dollar equivalent of the Monetary Base of the US, UK, Eurozone and Japan. The shortfall of safe assets in 2011 compared to 2007 exceeds USD 5 trillion, around 90 percent the aggregate monetary base in 2011, despite the large expansion of monetary base between 2007 and 2011. Interestingly, full restoration of safe assets would require another round of monetary base expansion more than 1.7 times higher than that in the 2007-2011 period.

List of Safe Assets: pre and post crisis

	Billion USD		% of World GDP	
	2007	2011	2007	2011
US Federal government debt held by the public	5,137	10,692	9.2	15.8
Held by the Federal Reserve	736	1,700	1.3	2.5
Held by Private Investors	4,401	8,992	7.9	13.3
GSE obligations	2,910	~~2,023~~	5.2	~~3.0~~
Agency and GSE-backed mortgage pools	4,464	~~6,283~~	8.0	~~9.3~~
Private-issue ABS	3,901	~~1,277~~	7.0	~~1.9~~
German and French government debt	2,492	3,270	4.5	4.8
Italian and Spanish government debt	2,380	~~3,143~~	4.3	~~4.7~~
Monetary Base	2,870	5,867	5.1	8.7
United States	852	2,532	1.5	3.7
Euro Zone	1,117	1,583	2.0	2.3
United Kingdom	135	314	0.2	0.5
Japan	766	1,439	1.4	2.1
Safe Assets	**23,418**	**18,129**	**41.9**	**26.8**

Note: Numbers are struck through if they are believed to have lost their 'safe haven' status after 2007.
Source: Bank of England, Federal Reserve Flow of Funds, Haver Analytics, IMF, Barclays Capital.

[36] I am grateful to Michael Gavin for alerting me of the relevance of these issues and the existence of the Barclay's study.

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