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Japan's Lost Decade: A Liquidity-shock Induced Downturn

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Abstract: The last century provides three important examples of a liquidity shock spiraling into a full-blown macroeconomic crisis — the U.S. Great Depression, Japan's "Lost Decade", and the U.S. "Great Recession". Japan's lost decade provides a wealth of data and the benefit of 20 years of hindsight, and thus an ideal opportunity for exploring how a liquidity shock can feed through to banks and lead to a broad and deep economic downturn. We trace out the evidence for interpreting Japan's Lost Decade as the aftermath of a liquidity shock and show how it led to many years of sluggish growth in Japan.

Key words: Japanese economy; liquidity shock; lost Decade; financial crisis
JEL codes: G01, N25

1. Introduction

"Liquidity", or more accurately, illiquidity, has become increasingly recognized as an important element in financial and economic crises. For example, Brunnemeier traces how a shock in the mortgage market in 2007 led to a downward spiral in liquidity in financial institutions (Brunnemeier, 2010). Taylor and Williams note that liquidity was a common explanation provided by market participants for increases in the interbank lending (LIBOR) rate in 2007 (Taylor & Williams, 2009).[1] Gorton cites liquidity as a key element of the "Panic of 2007" (Gorton, 2008). More broadly, others have clarified how liquidity may be defined within individual markets, as well as explained how downward liquidity spirals are generated. For example, Chacko and Evans derive a measure for liquidity risk in the U.S. corporate bond market and relate it to the performance of the equity in financial institutions including banks and hedge funds (Chacko & Evans, 2011). Brunnemeier and Pederson describe how liquidity can suddenly decrease and how liquidity spirals are generated (Brunnemeier & Pederson, 2009).

Despite these theoretical treatments and studies focused on liquidity in financial institutions and markets, few studies have examined empirically the mechanisms via which a shock to liquidity feeds through to the macroeconomy. A major reason for this lack of coverage is that episodes of a liquidity shock spiraling into a full-blown macroeconomic crisis are few. In the last century there have been perhaps three important examples — the U.S. Great Depression, Japan's "Lost Decade" of the 1990s, and the U.S. "Great Recession". Data for the first

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[1] More specifically, Taylor and Williams report on participants' responses on the spread between the 3-month LIBOR and the Federal Reserve overnight federal funds rate (Taylor & Williams, 2009).

of these episodes exist, but lack the detail and depth that would be most useful for such an exercise. The U.S. Great provides both a wealth of data and the benefit of 20 years of hindsight, and thus an ideal opportunity for exploring how a liquidity shock can lead to a broad and deep economic downturn. In this paper, we trace out the evidence for interpreting Japan's Lost Decade as the aftermath of a liquidity shock. We show that banks, specifically bank lending, were a key transmission mechanism for the liquidity shock which led to the many years of sluggish macroeconomic growth in Japan.

1.1 Liquidity Risk and Financial Institutions

The term "liquidity" has been used in a variety of contexts, so we need to first define precisely the way in which we will be using the concept.

It is commonplace in economics and finance to refer to a single price for a good or an asset (we will refer to this as the "fundamental price" or "intrinsic price"). In real-world markets, however, there are a multiplicity of prices at which transactions occur. These prices lie both above and below the fundamental price of the asset and arise due to transaction costs. For example, an investor would pay a different price for a bond if he wished to buy 100 units of the bond versus 1000 units of the same bond. Similarly he would receive different prices for a share of stock if he were selling 1000 shares of the stock or 10,000 shares of the same stock. Therefore, at any point in time, there are a set of "buy" prices and a set of "sell" prices for an asset that depend on the quantity transacted of that asset.[2]

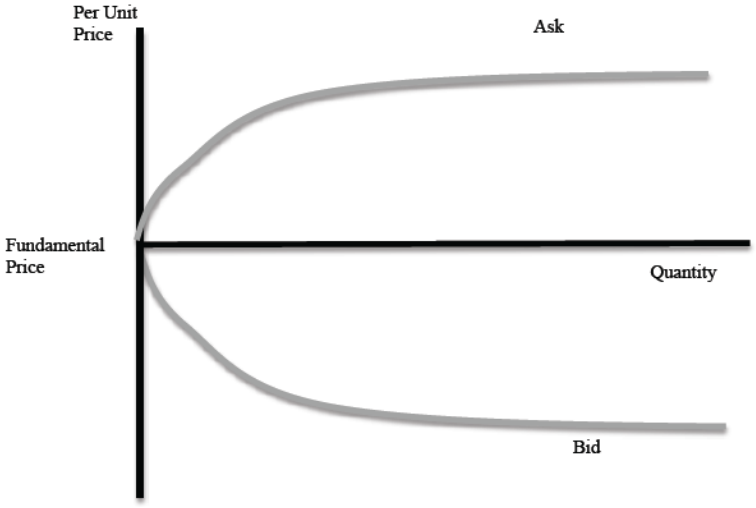

Figure 1 The Bid-Ask Curves

To set out terms, from an investor's standpoint assets have separate "buy" and "sell" assets. These prices refer to transactions that occur immediately, in other words, the purchase or sale occurs "right now", as opposed to over an extended period of time. These buy and sell prices differ for different quantities. Generally, with financial assets, bid prices decreases with quantity. Ask prices, on the other hand, increase with quantity. Chacko, Jurek,

[2] One may wonder how it is possible for a different buy and sell price to exist for the same quantity of an asset — doesn't the buyer buy a security at the same price that the seller sells it to him at? In most markets, an intermediary facilitates transactions due to the difficulty of finding both a buyer and a seller who want to transact the same quantity of an asset at the same point in time (for example, the vast majority of financial securities are traded in dealer markets). The intermediary facilitates the transaction by holding an inventory of the asset. He buys the asset into his inventory from all sellers, and sells assets from his inventory to all buyers. The dealer bears a cost for maintaining this inventory and therefore recovers this cost by charging a different price to buyers and sellers. This wedge between buy and sell prices is the dealer's fee.

and Stafford refer to this relationship between the price and the quantity of an asset purchased or sold as the quantity structures of the bid and ask prices for an asset (Chacko, Jurek, & Stafford, 2008).[3] Figure 1 illustrates these quantity structures in a bid curve (lower curve) and an ask curve (upper curve). The figure illustrates that the price at which an asset may be sold decreases with quantity, while the price at which an asset is purchased increases with quantity.

Within our context, the "liquidity spread", or simply "spread", refers to the gap between the two curves in Figure 1 at a certain quantity level, i.e., the gap between the quantity structures of the bid and ask price. More broadly, the terms "liquidity" and "illiquidity" refer to the general gap and slopes of these two curves, at all quantities, i.e., the gap between the quantity structures of the bid and ask prices at all quantities, and how quickly this gap increases with quantity. In illiquid markets, there is a large price difference between the bid and ask price and this price difference increases rapidly (generally, the bid price decreases rapidly while the ask price increases rapidly), as the quantity to be bought or sold increases. In a more liquid market, the gap between the two curves is small, and the price difference increases slowly as quantity increases.

"Liquidity risk" is another important concept for our examination of Japan's Lost Decade. Liquidity risk is a fundamental risk factor faced by all investors. Liquidity risk is defined as the dynamic uncertainty of how the quantity structures of bid and ask prices change through time.[4] Liquidity risk is the risk that when an investor goes to the market to conduct a transaction, the market is illiquid, i.e., the quantity structures of bid and ask prices have a very large gap so that he is forced to pay a very high transaction cost. Liquidity risk therefore can also be viewed as the risk that an investor may need to conduct a transaction at a particularly convenient or inconvenient time in the markets.

A final concept critical to our analysis is that of a "liquidity shock". A liquidity shock is a sudden and substantial increase in the quantity structure of ask prices and a simultaneous sudden and substantial decrease in the term structure of bid prices. Referring back to Figure 1, a liquidity shock causes the upper curve to shift higher and the lower curve to fall lower. In particular, it leads to a jump in the costs associated with selling a large quantity of an illiquid asset; a seller needing to sell an illiquid asset will be forced to accept a substantially lower price than would have been the case before the impact of the liquidity shock.

However, not all investors face the same degree of liquidity risk. Investors with long-dated liabilities, for example, face less risk of suddenly needing transaction immediacy in the short-term. Investors like these, who face little risk of requiring sudden liquidity, should then be able to collect a premium for providing liquidity to those investors who do. Thus, investors with long investment horizons (such as those with long-dated liabilities) are perfectly positioned to serve as providers of liquidity. Their immediacy, liquidity risk, is minimal. Thus, they can earn a premium, a liquidity premium, for providing liquidity services, and thereby bearing liquidity risk.[5]

Many financial institutions utilize this concept by structuring their balance sheets to provide these liquidity services (by bearing liquidity risk) in return for earning a liquidity premium. They do so by mismatching the amount of liquidity risk in their assets and liabilities, taking more liquidity risk on the asset side than the liability

[3] The phrase "quantity structure" used here is analogous to the phrase "term structure" used to describe the relationship between the yield and the time to maturity of a bond (also called a yield curve).

[4] Some papers (for example, Brunnermeier and Pedersen have attempted to differentiate between market liquidity and funding liquidity (Brunnermeier & Pedersen, 2009). However, note that the definition of liquidity used in this paper incorporates both types of liquidity.

[5] They can be viewed as earning a liquidity premium for bearing a risk that is not really as big a risk to them as it is to the investor with a short investment horizon. Thus a liquidity premium is considered by many financialinstitutions as a source of "alpha".

side. Consider a retail bank for example. The largest source of a retail bank's liabilities stems from its deposits, any of which has a low degree of liquidity risk — any deposit can be withdrawn by a depositor with no fee, or at worst a known fee, so that there is no uncertainty in the gap between the term structures of bid and ask prices for these liabilities.[6,7] On the asset side, however, retail banks take a substantially greater degree of liquidity risk through lending activities. A typical corporate or real estate loan has a huge degree of liquidity risk because these are typically private transactions rather than traded securities.[8] As a result, if a liquidity shock hits a bank's balance sheet, it will change the value of the assets of the bank by a much larger amount than the value of the liabilities. This difference naturally accrues to the equity, or capital, of the bank, resulting in a substantial reduction in bank capital and even possibly the insolvency of the bank.

The idea of mismatching liquidity risk on the asset and liability sides is not just confined to banks. It is present in most financial institutions. Insurance companies, investment funds such as endowment funds and hedge funds (many of which are referred to as shadow banks), and investment banks, all mismatch the liquidity risk.[9]

Therefore, when a systemic liquidity shock hits the global financial markets, it leads to the reduction of capital in most, if not all, the financial institutions in the economy. This reduction leads to reduced willingness to hold high liquidity risk assets, which in turn leads to lower investment activities such as lending. Reduced investment activity then leads to reduced output and as a result, what started as a shock in the financial markets propagates to the real economy. The goal of this paper is to precisely demonstrate this cascading sequence of events.

1.2 Liquidity Risk Measurement

One of the reasons that liquidity risk and liquidity shocks have not been well-studied is that it is difficult to measure liquidity risk. In this paper we modify a procedure that has recently been developed. To indicate liquidity risk in markets, much previous work has focused on examining the rate at which banks lend to each other in the very short term, i.e., the London Interbank Overnight Rate or LIBOR. In particular, the spread between the LIBOR and a comparable risk-free rate has been the most commonly used (Gorton, 2008; Michaud & Upper, 2008; Taylor & Williams, 2009; Frank & Hesse, 2009). The LIBOR rate incorporates any default and liquidity risk associated with lending between banks, so the spread between the LIBOR and the risk-free rate should jump when there is an increase in either default or liquidity risk. Research suggests that changes in bank demand for liquidity play an important role in explaining shifts in daily interbank rates, as well as that liquidity risk often explains the

[6] One might argue that deposits have a high degree of liquidity risk because the degree of transaction immediacy associated with deposits is very high — deposits can be withdrawn at a moment's notice. Banks, however, pool deposits together and thereby decrease the transaction immediacy of the total pool. While any single deposit may be withdrawn at any time and therefore have a high degree of transaction immediacy associated with it, it is unlikely that all depositors will simultaneously withdraw their deposits at the same time. Therefore at any given time, a substantial portion of the pool of deposits has a very low degree of transaction immediacy associated with it. Of course, there is still a risk that there is a "run on the bank" and a substantial fraction of the deposits are demanded simultaneously; therefore, the transaction immediacy associated with deposits is never zero.

[7] In the case of a wholesale bank, the bulk of its liabilities are typically short term financing from money markets or other sources, but because it is short-term, there is still very little liquidity risk in these liabilities.

[8] Even if the loans were in the form of traded securities, such as corporate bonds and collateralized mortgage obligations, there is much greater liquidity risk in these securities (the bid and ask term structures move by a much greater amount) than the liquidity risk in most of a typical bank's liabilities.

[9] Consider for example a convertible arbitrage hedge fund. Convertible arbitrage traded corporate loan) and short equities. While this long-short position may reduce market risk, this strategy in fact increases the proportion of liquidity risk in the portfolio and magnifies (with leverage) the total quantity of liquidity risk. The liquidity risk in the strategy comes about from the fact that corporate bonds have typically several orders of magnitude more liquidity risk than equities. Hence the long and short positions are mismatched on liquidity risk.

major share of the spread (Michaud & Upper, 2008; Frank & Hesse, 2009).

For examining the case of Japan, we incorporate two similar measures. We examine the spread between either the LIBOR yen rate or the TIBOR yen rate and the rate on Japanese government bonds (JGBs) as indicators of liquidity risk. The LIBOR yen rate is the rate charged by banks lending to each other in yen in the London market. The TIBOR, or Tokyo Interbank Overnight Rate, is the rate for interbank lending in the Tokyo overnight market. The JGB rate represents the risk-free counterpart.[10]

Both of these measures have drawbacks. The LIBOR is computed based on quotes from 16 banks, most of which are not Japanese.[11] The banks covered in the TIBOR rate are almost all Japanese, but the rate was not introduced until 1995, and is thus not available for the early years of our analysis.[12] Furthermore, as noted above, the spreads incorporate both liquidity and default risk, and thus provide less-than-precise measure of liquidity risk. However, we include information on both of these rates, in line with the existing literature.

Figures 2 and 3 provide a first look at one of these indicators. Figure 2 shows the 12-month LIBOR yen rate between 1986 and 2009, as well as the one-year JGB yield during this time period. Figure 3 shows the spread between these two rates. A few impressions stand out. First, both the LIBOR and JGB rates increased in the late 1980s and early 1990s, in comparison to other periods in the figure. Second, as shown in Figure 3, the spread between the two began to climb in 1988 and remained particularly elevated through 1991. Other spikes in the spread occurred throughout the 1990s, after which the spread was around 0 for much of the 2000s. This is a pattern such as we would expect to observe during a time of heightened liquidity risk from the late 1980s through the 1990s.[13]

Figure 4 shows the TIBOR rate and the JGB rate beginning in 1995, along with the LIBOR yen rate for purposes of comparison. The TIBOR rate was also elevated throughout the 1990s. Interestingly, there was a distinct decoupling between the TIBOR and LIBOR rates beginning in late 1997 and continuing through early 2000, with the TIBOR rate climbing above the LIBOR rate.[14] As shown in Figure 5, the TIBOR-JGB spread was indeed elevated throughout the late 1990s. In the body of this paper, we will trace out the impact of Japan's liquidity shock, referring back to these spreads as, albeit imperfect, indicators of liquidity risk.

[10] The risk-free rate often used is the Overnight Indexed Swap (OIS). Thus, the most exact comparator to the LIBOR – OIS spread would be the spread between the Tokyo Interbank Overnight Rate (TIBOR) and the Japanese OIS rate. However, the OIS market in Japan did not exist until 1997, and trading has been active only since 2006, in part because short-term interest rates were so predictably close to zero through much of the 2000s. See Oooka, Nagano, and Baba 2006.

[11] In May 2011, the banks were Bank of Tokyo-Mitsubishi UFJ Ltd, Barclays Bank plc, Citibank NA, Credit Agricole CIB, Deutsche Bank AG, HSBC, JP Morgan Chase, Lloyds Banking Group, Mizuho Corporate Bank, Rabobank, Societe Generale, Sumitomo Mitsui Banking Corporation, The Norinchukin Bank, The Royal Bank of Scotland Group, UBS AG, and West LB AG. Source: British Bankers' Association, retrieved September 1, 2011. Thus, at present the panel has only four Japanese banks out of the 16 banks on the panel. The four highest and four lowest quotes are discarded, and the average of the remaining quotes is the LIBOR rate.

[12] The TIBOR rate is calculated based on quotes from 18 banks, and the top two and bottom two are discarded from the average. In September 2011, the banks included were Mizuho Bank, Ltd., The Bank of Tokyo-Mitsubishi UFJ, Ltd., Sumitomo Mitsui Banking Corporation, Resona Bank, Ltd., Mizuho Corporate Bank, Ltd., Saitama Resona Bank, Limited, The Bank of Yokohama, Ltd., Mitsubishi UFJ Trust and Banking Corporation, Mizuho Trust and Banking Co., Ltd., The Chuo Mitsui Trust and Banking Co., Ltd., The Sumitomo Trust and Banking Co., Ltd., Shinsei Bank, Limited, Aozora Bank, Ltd., The Royal Bank of Scotland plc, BNP PARIBAS S.A., Shinkin Central Bank, The Shoko Chukin Bank and The Norinchukin Bank. Thus, 16 of the 18 banks are Japanese.

[13] Changes in financial regulations in Japan in the late 1980s may have also affected changes in the spread that we observe beginning in those years.

[14] Others have discussed the spread between the TIBOR and LIBOR rates, sometimes known as the "Japan premium". For example, see Peek and Rosengren (2001), Covrig et al. (2004), and Fukuda (2011).

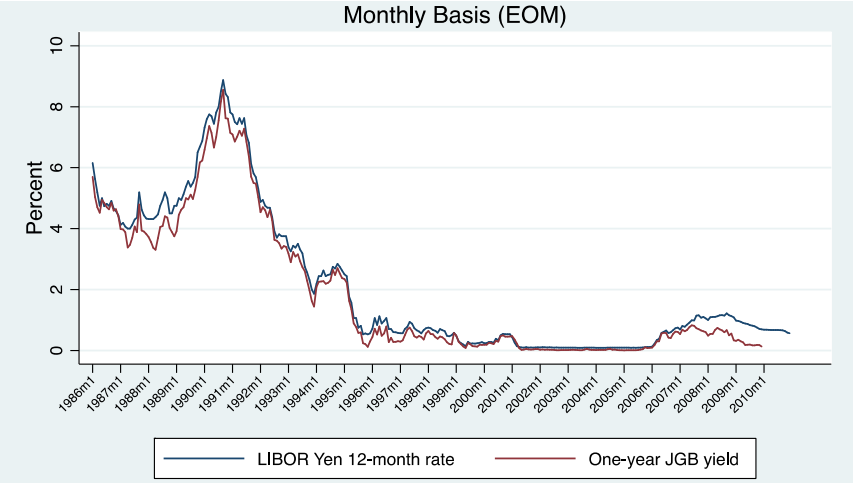

Figure 2 LIBOR Yen 12-Month Rate and JGB 1- Year Yield

Source: British Bankers Association via Global_Rates.com and Japan Ministry of Finance

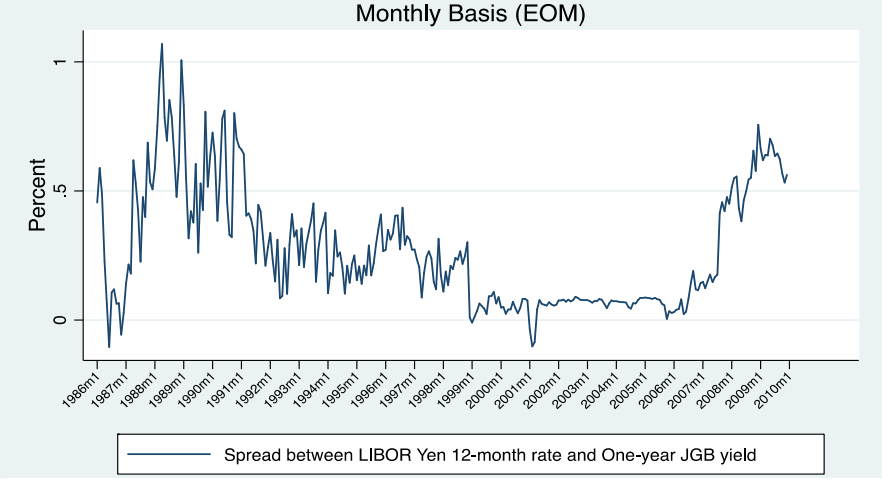

Figure 3 LIBOR Yen-JGB Spread

Source: British Bankers Association via Global_Rates.com and Japan Ministry of Finance

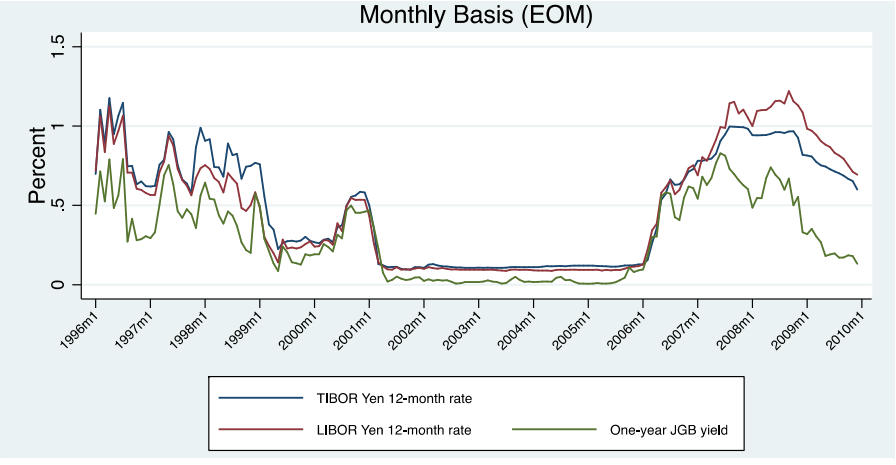

Figure 4 TIBOR Yen 12-Month Rate, LIBOR Yen 12-Month Rate, and JGB 1-Year Yield

Source: Japanese Bankers' Association, British Bankers' Association via Global_Rates.com and Japan Ministry of Finance

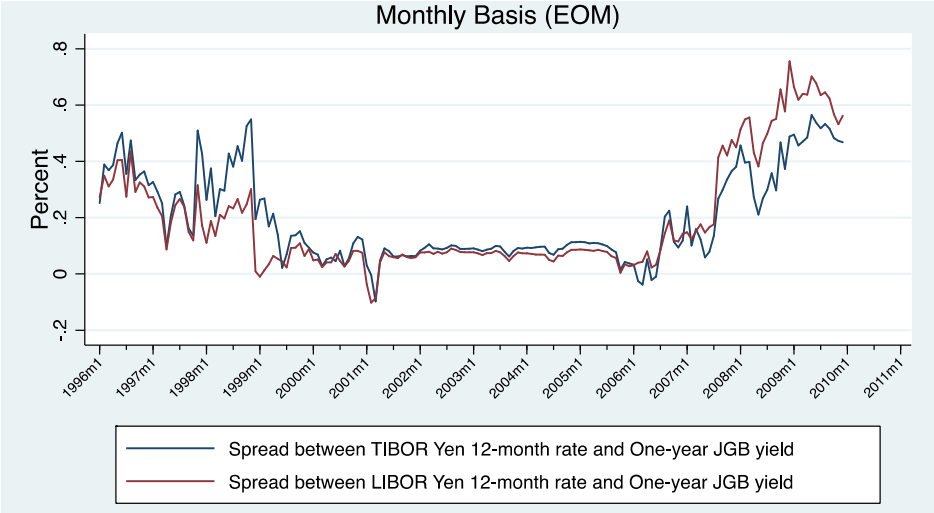

Figure 5 TIBOR Yen-JGB Spread and LIBOR Yen-JGB Spread

Source: Japanese Bankers Association, British Bankers' Association via Global_Rates.com, and Japan Ministry of Finance

1.3 Overview of Liquidity Framework

At the end of Section 1.1 above, we provided a thumbnail sketch of the cascading effects of a liquidity shock. We now develop a more detailed framework for how a liquidity shock feeds through financial institutions and leads to a macroeconomic shock; our empirical work below shows how events in Japan illustrate this process.

A stylized liquidity shock is kicked off by a "trigger". This triggering event leads to a downward shift in the "bid" curve, as shown in Figure 1, for assets with a high degree of liquidity risk. For assets with a low degree of liquidity risk (and therefore little to no volatility in the term structure of the bid and ask prices), this shift does not occur at all, or to a much lesser degree. These changes manifest themselves as a shift in the demand profile for assets throughout the economy, with an increase in demand (and therefore an increase in price) for "liquid" assets, i.e., those with low liquidity risk,[15] and a drop in demand (and therefore a decline in price) for "illiquid" assets, i.e., those with high liquidity risk.[16]

The fall in value of assets with low liquidity hits the balance sheets of banks holding such assets. At the same time, in accord with balance sheet accounting, we expect a decline in bank capital and, in some cases, a potential fall in deposits. Banks subsequently act to bolster their balance sheets by limiting new lending, calling in loans, and, in the case of Japan, "evergreening", i.e., re-extending loans to poor-quality borrowers. At this point, the liquidity shock feeds through to the real economy, as funds become less available for assets with low liquidity and wealth shifts into highly liquid assets. Ultimately, this change in availability of funds leads to the decline in economic activity that characterizes a broader economic recession. The sections that follow explain each of these stages in more detail and trace out the empirical signs of a liquidity shock in Japan.

2. The Run-up to the Shock

In the late 1980s, Japan exhibited the signs of a booming, robust economy. Quarterly growth in real GDP

[15] Liquid assets are those whose term structures of bid and ask prices have low volatility, and therefore these assets have low sensitivity to liquidity shocks.
[16] Illiquid assets are those whose term structures of bid and ask price have a high degree of sensitivity and therefore these assets have high sensitivity to liquidity shocks.

averaged around 5.25 percent between 1985 and 1988 (inclusive).[17] The Nikkei stock index exploded during this same time period, growing nearly 200 percent between January 1985 and December 1989. As shown in Figure 6, real estate prices also boomed, with the price of commercial land in the six largest urban areas (Tokyo, Yokohama, Nagoya, Kyoto, Osaka, and Kobe) growing by 28 percent in the year of 1989 alone. Such a run-up in real estate prices is a particularly important aspect of the genesis of a liquidity crisis. As mentioned in Section 1.1, loans on real estate are an asset with a great deal of liquidity risk. Thus, banks lending into an upward spiraling real estate market are potentially taking on a great deal of time when a bid curve, such as shown in Figure 1, shifts downward, they could be forced to accept a substantially lower price than would have been expected in normal times.

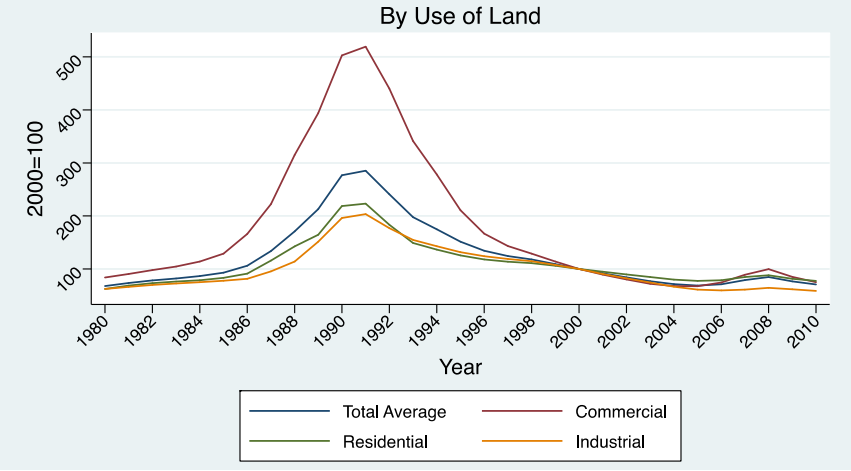

Figure 6 Urban Land Price Index, Six Large City Areas

Source: Japan Real Estate Institute and Japan Ministry of Internal Affairs and communication 6 large city areas refer to ku-area of Tokyo, Yokohama, Nagoya, Kyoto, Osaka and Kobe.

During this same period during which real estate was booming, financial regulations and financial institutions were changing in ways that exacerbated the impact of the liquidity shock.[18] Japanese banks had traditionally focused on lending to large Japanese corporations. Throughout the 1980s, however, Japan had gradually worked to deregulate its financial markets, making other channels of funding available to these large firms, including the domestic commercial paper and equity markets. Japanese banks thus chose to channel their lending into other, potentially more risky channels. Hoshi and Kahsyap note that lending to small businesses and for real estate grew substantially during the 1980s, with the share of lending to real estate nearly doubling between 1982 and 1989. Small-business and real-estate loans have a high degree of liquidity risk, so this shift in bank activities meant that banks were taking on a greater degree of liquidity risk and becoming ever more vulnerable to a liquidity shock (Hoshi & Kahsyap, 2000). Such a shock would be expected to drive down the value of these high-liquidity-risk assets substantially, while the value of their liabilities would change little.

These bubbles in real estate and in the stock market, together with the changes in financial institutions and

[17] Source: Japan Cabinet Office, http://www.esri.cao.go.jp/en/sna/qe103-2/gdemenu ea.html.
[18] Hoshi and Kashyap and Okina et al. provide extensive overviews of these changes, and we draw our information from these sources (Hoshi & Kashyap, 2000; Okina et al., 2001).

relatively easy monetary policy by the Bank of Japan set the conditions for the trigger to the liquidity shock in Japan.[19]

3. The Trigger

The trigger to Japan's liquidity crisis may be described as a series of events that led to a dramatic drop in urban real estate prices, which ultimately fed through to the subsequent broader economic impact. The first of these events was gradually tightening monetary policy. After maintaining relatively easy monetary policy throughout the late 1980s, the Bank of Japan began to increase the official discount rate in May 1989, when it was increased 75 basis points to 3.25 percent. Periodic increases continued until the rate reached 6 percent in August of 1990.[20]

Around the same time, concerned about the dramatic increase in land prices, the Japanese government took a series of steps aimed at affecting the real estate sector. For example, in December 1989, a new "Basic Act for Land" was intended to set out basic principles regarding land use and transactions. Among other aspects, it noted that land should not be used in speculative transactions and that public welfare considerations should be taken into account in the use of land.[21] In April 1990, a committee was formed to study the system of land taxation, with a report produced in November. In April 1991, a new Land Tax Law was put in place, which set out a range of increases on taxes on transferring and holding land (Ishi, 1991; Morinobu, 2006). In another move affecting land prices, in April of 1990 the Ministry of Finance implemented limits on bank lending to the real estate sector (Kanaya & Woo, 2000).

Not surprising in light of these policy changes, the tremendous growth in real estate prices began to slow in 1991, and then land prices in the six largest urban areas fell dramatically in 1992. Residential land prices in these six large cities fell by 18 percent. This plummet in land prices had a particularly heavy impact on financial institutions in Japan because of the recent changes in the lending profiles of Japanese banks. By 1991, about 12 percent of bank lending was going to the real estate sector, and nearly one-third of banks' loans were secured by real estate (Kanaya & Woo, 2000).

The series of policy changes discussed above, together with the subsequent plummet in land prices constituted the "trigger" to the liquidity event in Japan that kicked off the "Lost Decade". Referring back to Figure 3, the LIBOR-JGB spread became elevated in the late 1980s, and remained high through 1991, suggesting a premium placed on liquidity during this initial stage of the liquidity event.

4. Changes in Asset Prices

In section 1.3, we discussed how a triggering event leads to a shift in the demand profile for assets throughout the economy, with an increase in demand (and therefore an increase in price) for "liquid" assets, i.e., those with low liquidity risk, and a drop in demand (and therefore a decline in price) for "illiquid" assets, i.e., those with high liquidity risk. In the wake of the triggering events in Japan, asset prices behaved in exactly this way.

Real estate has very high liquidity risk as an asset; it is exchanged in private transactions, rather than in a

[19] See Okina, Shirawakawa, and Shiratsuka (2001). For example, the BOJ lowered the discount rate from 5 percent in January 1986 to 2.5 percent in February 1987.

[20] Source: Bank of Japan.

[21] See Asian Legal Information Institute, available online at: http://www.asianlii.org/jp/legis/laws/ba fl1989an84od221989227/. Also available online at: http://tochi.mlit.go.jp/h19hakusho/Annex/annex eng.html. Ishi provides extensive discussion of the legal changes on land taxes in Japan during this time period (Ishi, 1991).

broader market. Thus, when a liquidity shock hits, we expect prices on real estate to fall. We have already laid out the changes in real estate in the six large urban areas (Figure 6), which we identified as a part of the trigger for the Figure 7 shows urban land prices, both inside and outside the six large city areas. For the broader outside-the-six-city measure, prices were nearly flat between 1991 and 1992, despite the plunge in land prices in the six largest cities. In 1993, however, prices around the country began to fall. Comparing 1995 to the peak in 1991, the index for outside the six largest cities fell 13 percent, while the large city index fell by 47 percent.[22]

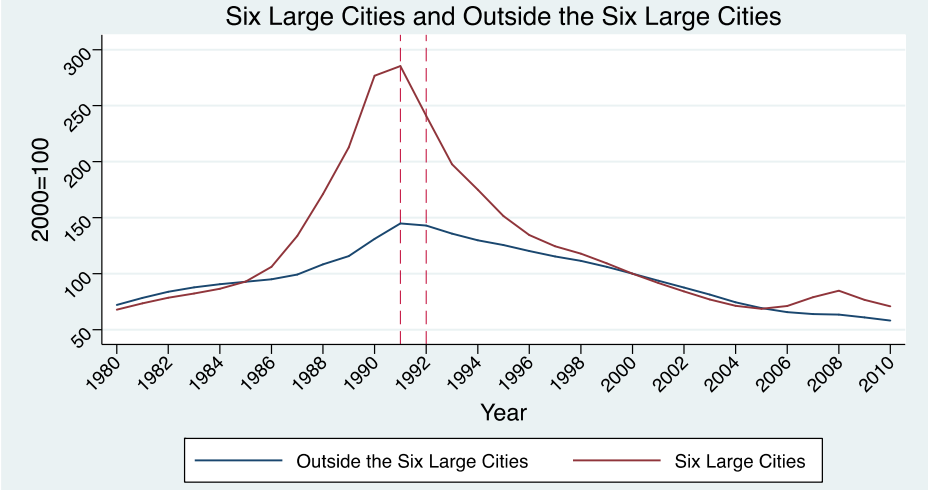

Figure 7 Urban Land Price Index

Source: Japan Real Estate Institute and Japan Ministry of Internal Affairs and Communication 6 large city areas refer to ku-area of Tokyo, Yokohama, Nagoya, Kyoto, Osaka and Kobe. The outside six large cities measure includes 217 other cities.

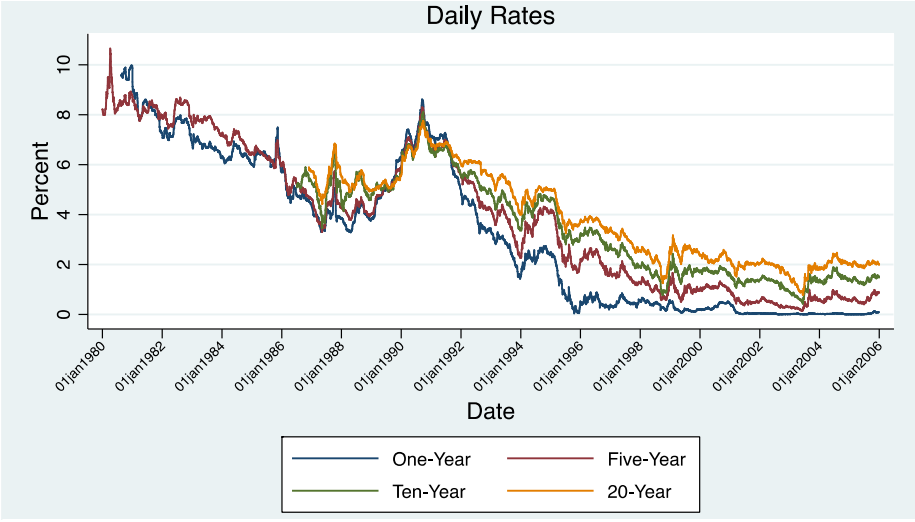

Figure 8 Japanese Government Bond (JGB) Interest Rates

Source: Ministry of Finance of Japan

As for assets with low liquidity risk, government debt instruments, for example, we expect to observe an

[22] The six large city areas are ku-area of Tokyo, Yokohama, Nagoya, Kyoto, Osaka and Kobe. The nationwide index is based on 223 cities, and the index that we show is the 223 nationwide cities less the 6 largest urban areas. See http://www.stat.go.jp/english/data/nenkan/1431-17e.htm.

increase in prices of such assets. To be precise, we would expect an increase in the fundamental or intrinsic price, as demand for such assets increases. Figure 8 shows rates on JGBs of 1, 5, 10, and 20 year maturities. These all fell just after the onset of the liquidity shock. The rate on the one-year JGB, the most liquid of these instruments, fell by 400 basis points between June 1991 and August 1992. This decline is exactly as would be expected in the initial stages of the aftermath of a liquidity shock.

5. Impact on Bank Balance Sheets

As discussed in Section 1.1, many financial institutions structure their balance sheets to earn a liquidity premium by mismatching the amount of liquidity risk in their assets and liabilities, taking more liquidity risk on the asset side than on the liability side. On the asset side, in particular, retail banks take a substantially greater degree of liquidity risk through lending activities. A typical corporate or real estate loan rather than traded securities. A liquidity shock and the subsequent fall in the prices of assets with high liquidity risk changes the value of the assets of the bank by a much larger amount than the value of the liabilities. This difference naturally accrues to the equity, or capital, of the bank, resulting in a substantial reduction in bank capital and even possibly the insolvency of the bank. The reduction in capital in turn leads to reduced willingness to hold high liquidity risk assets, which in turn leads to lower investment activities such as lending.

Thus, in the case of Japan, we would expect to observe a fall an initial fall in the value of bank loans, as the asset price changes discussed above hit the value of the assets held on banks' books. Bank deposits would either be expected to remain about the same or decline, while bank equity would also be expected to fall. Interpreting the Japanese data, however, is complicated for two reasons. First, the data are "book" value, which would not reflect declines in market prices. Furthermore, during this era the Japanese government allowed banks to choose either market or book value, and banks used the most favorable option, further complicating interpretation of the data (Hoshi & Kashyap, 2010). Second, banks also commonly engaged in "evergreening".[23] Broadly speaking, banks would extend new loans to troubled firms, which would in turn use these newly borrowed funds to continue making payments on the old loans. With this practice, the bank avoids taking a loss on its balance sheet. Banks also used this type of revolving credit for loans that were likely to soon become "nonperforming", in order to avoid setting money aside in a loan loss reserve.

As a result of these factors, the incidence and aftermath of the liquidity shock in sheets into three distinct phases — 1990 to 1993, 1993 to 1997, and late 1997 and later.

5.1 1990-1993

As discussed in Section 1.3, in the initial aftermath of a liquidity shock, we would expect to see a decline in the value of bank assets with high liquidity risk, a decline in bank capital and potentially a fall in deposits. For the case of Japan, some shifts in bank balance sheets in these early years of the crisis hint at a new premium being placed on liquidity, but larger underlying issues were hidden by the evergreening and use of book value, as mentioned above.

Changes in some of the main categories in bank balance sheets are shown in Table 1. The value of loans by domestically licensed banks grew substantially during the latter years of the 1980s, expanding by over 10 percent from the previous year from 1984 through 1989. Growth fell off distinctly, however, in 1991 and slowed further through 1993, a year in which loans grew by only about 1.25 percent from the previous year. As for the liabilities

[23] See Peek and Rosengren for extensive discussion and analysis of this practice and its effects (Peek & Rosengren, 2005).

side of the balance sheet, deposits declined in both 1991 and 1992.[24] Banks also borrowed more money (from both the Bank of Japan and other financial institutions) and increased debenture issuance (not shown in Table 1) in these years.

Table 1 Categories of Bank Assets Percent Change from the Previous Year

Year	Loans	Deposits	Borrowed Money	Capital Stock	Cash	Gov't Securities	Total Assets
1987	12.53	19.57	2.84	22.60	18.19	16.64	14.79
1988	10.18	12.46	7.04	28.54	13.62	21.19	11.41
1989	10.81	16.47	-1.19	30.52	49.03	8.63	17.10
1990	7.49	7.74	35.62	13.06	-3.04	-3.82	7.30
1991	4.36	-3.53	74.05	5.18	-29.19	-6.96	-0.14
1992	2.44	-5.20	10.50	3.19	-44.15	-2.99	-0.68
1993	1.28	0.67	-5.49	2.29	7.01	5.79	-1.61
1994	0.06	1.38	12.71	2.30	-10.03	-3.23	-0.37
1995	1.27	3.55	-12.80	-0.01	-3.51	2.02	1.91
1996	0.40	-0.25	15.69	-10.36	11.69	-0.43	0.48
1997	0.97	0.85	20.46	-0.03	-10.14	10.25	4.48
1998	-0.85	0.36	-8.56	-15.54	-18.74	0.67	-1.16
1999	-4.09	1.38	-6.60	39.51	11.35	41.85	-1.34
2000	-1.04	-0.78	-20.70	1.39	-23.50	54.29	-1.19
2001	-3.38	0.74	-10.42	3.34	4.30	-2.43	0.01
2002	-3.70	2.99	-8.27	-17.19	8.16	7.88	-3.62
2003	-4.12	1.93	-7.15	-8.43	1.31	30.03	0.52
2004	-2.38	1.25	-6.63	-1.64	-4.58	8.73	0.61
2005	1.13	1.45	-5.02	2.31	-8.61	-5.36	1.07
2006	1.72	0.50	95.90	8.05	-1.26	-8.61	0.19
2007	0.50	3.08	-4.83	5.93	0.57	-8.63	2.56
2008	4.60	2.11	49.09	6.39	4.97	15.94	5.81
2009	-1.90	2.20	-18.28	5.48	-8.00	28.55	-1.60

Note: Data are for domestically licensed banks in Japan. Source: Bank of Japan.

5.2 1993-1997

At the same time as banks slowed lending and faced a decline in deposits, there were many underlying problems in Japan's overall banking sector. Many of these were hidden in the initial stages of the crisis, but troubling signs began to emerge in 1993 in one specific type of financial institution — the *jusen*.

Created by other financial institutions, including banks, in the 1970s, *jusen* had focused on real estate lending. The downturn in land prices thus hit them particularly hard (Nakaso, 2001). Between 1993 and 1996, the Japanese government tried to rehabilitate these institutions, but liquidation eventually proved necessary, and their assets and liabilities were assumed by the new Housing Loan Administration (HLAC) in 1996. Not only did the failure of the *jusen* signal the broader problems in the financial sector that would soon follow, it also directly hit the balance sheets of banks that had founded them and/or extended loans to them. Furthermore, public outrage over the use of public funds in the rehabilitation effort may have increased the hesitance of Japanese officials to use public money for resolving future problems in the financial sector (Hoshi & Kashap, 2010; Kanaya & Woo, 2000; Nakaso, 2001). Returning to Figures 4 and 5, the spread between the TIBOR yen rate and the JGB rate is of interest.

[24] Deposits in the public Postal Savings System, however, grew substantially in both.

Throughout 1996, this spread was elevated, as the *jusen* problem evolved. Of note, several government actions to address the issue are associated with declines in the spread. More specifically, after the formation of the new HLAC in July and the creation of the Resolution and Collection Bank (RCB) (which could purchase non-performing loans from financial institutions and assume the assets and liabilities of failed credit cooperatives) in September, we see a distinct decline in the spread.[25]

During this period the value of loans on bank balance sheets was roughly flat, as the evergreening discussed above continued (see Table 1). As for the liabilities side of the balance sheet, the failure of several deposit-taking institutions at the end of 1994 and in the summer of 1995 further shook confidence in the financial system. Although a government program ensured depositors did not incur losses, deposits in 1993 and 1994 increased a bit, but never regained the losses suffered in 1991 and 1992. Deposits in domestically licensed banks again shrank in 1996 from the previous year.[26] Bank capital also fell from the previous year in both 1995 and 1996 (see Table 1).

5.3 Late 1997 and Later

A dramatic event kicked off this next stage. In November 1997, Sanyo Securities, a borrower on the interbank call market, made the first-ever in Japan default on an interbank market loan. In that same month, five additional financial institutions failed. As shown in Figure 5, the TIBOR yen-JGB spread jumped up, increasing by 37 basis points between the end of October and the end of November of 1997. At the end of November, the Minister of Finance and the Governor of the Bank of Japan, likely aiming to calm the financial system, issued the following statement:

We, the Minister of Finance and the Governor of the Bank of Japan, would like to reaffirm our strong will to fulfill the commitment to ensure the stability of interbank transactions as well as to fully protect deposits...

The financial system is the basis of the economy and society. We will take all possible measures to ensure its stability.

Therefore, we are determined to provide liquidity in a sufficient and decisive manner in order to prevent any delay in payments of deposits and other liabilities of financial institutions. We strongly request people not to be misguided by groundless rumors and to act sensibly.[27]

Another important event at this time was the plan to increase scrutiny on banks. In late 1997, inspections were being stepped up, and the new Financial Supervisory Agency was to start up in June 1998.[28] These three elements — the inter-bank market default, the failures of financial institutions, and the prospect of heightened official scrutiny — appeared to end the period of inertia, during which banks, in the immediate aftermath of the liquidity shock, did not change their behavior dramatically.

The data on bank balance sheets reflect this shift. As shown in Table 1, the value of loans on banks' books started to shrink in 1998 and continued to fall for the next six years. The magnitude of bank assets overall also declined. At the same time, the value of central government securities on banks' books grew. Figure 9 shows the

[25] See Hoshi and Kahsyap (2010) and Nakaso (2001) for information on the HLAC and the RCB.

[26] See Nakoso (2001) and Kanaya and Woo (2000). Over that same year, deposits in the postal savings system grew by just over 5 percent (Kanaya & Woo, 2000).

[27] http://www.boj.or.jp/en/announcements/press/danwa/dan9711e.htm. Joint Statement by the Minister of Finance and the Governor of the Bank of Japan. (tentative translation) November 26,1997, Ministry of Finance, Bank of Japan. (Web page: Bank of Japan Announcements > Speeches and Statements > Statements > JOINT STATEMENT by the Minister of Finance and the Governor of the Bank of Japan (tentative translation)). Accessed March 21, 2011.

[28] Japan Securities and Exchange Surveillance Commission, Annual Report, Outline of Activities July 1997-June 1998, Chapter 7: Inspections of Financial Institutions by the Financial Supervisory Agency (Minister of Finance), http://www.fsa.go.jp/sesc/english/reports/reports.htm.

shares of different types of assets in bank balance sheets. (Changes in government securities are also shown in Table 1.) The increase in the share of assets going to government securities and the decline in the share tied up in loans is exactly the pattern that we would expect as bank balance sheets started to reflect the aftermath of the liquidity shock and banks began to refrain from "evergreening" existing loans.

An additional indicator of the health of the banking sector during this time period is the extent of the non-performing loan problem.[29] According to the IMF, the ratio of non-performing to total loans held by major banks was 6.6 percent in 1995, and increased to 7.9 percent by 2000.[30]

During these years, the Japanese government moved to shore up the financial system with several recapitalization programs. ¥1.816 was injected in March 1998, but banks continued to perform poorly. The Long Term Credit Bank of Japan was nationalized in October 1998, and Nippon Credit Bank was nationalized in December 1998. Additional capital injections were made in March 1999, and this time the injection was accompanied by the requirement that banks provide a plan for improvement. The government also continued its programs of buying up troubled assets from banks (Nakoso, 2001; Hoshi & Kashyap, 2010).

Turning to the liabilities side of the balance sheet, deposits in domestically licensed banks were generally flat throughout this time period, as shown in Table 1. The capital stock of banks declined precipitously in 1998, as would be expected. (The increase in 1999 stems from government capital injections.)

As for our measure of liquidity, referring back to Figure 5, the TIBOR-JGB spread remained elevated throughout these years, with up and down movements reflecting changes in the banking sector and government policy. Not until the March 1999 capital injection, which had also required plans for changes in bank behavior, did the spread begin to fall off significantly.

6. Changes in Bank Activities to Shore up Balance Sheets

For many Japanese banks, once loan roll-overs ceased, the impact of the liquidity shock on their balance sheets began to show up, creating a need to shift operations in stemming from a liquidity shock leads to a reduced willingness on the part of banks to hold high liquidity risk assets. As the ratio of capital to assets falls, banks face pressure to either increase capital or reduce assets, both in order to meet regulatory requirements and, more importantly, to ensure their own long-term solvency.[31]

Figure 9 shows the share in total assets of a variety of categories for the full period 1989 to 2009. Taking a look at the entire period, the figure shows the clear fall off in the share in loans and the climb in the share going into central government securities after 1998. This shift is what we would expect from banks acting to increase holdings of assets with very high liquidity and reduce those with very low liquidity. This shift is also reflected in Table 1, which shows changes in values rather than shares. Indeed, banks with shrinking capital base would be expected to be reluctant about taking on assets with big liquidity risk, such as corporate and real-estate loans.

The data also suggest the impact of government activities — recapitalization and NPL purchasing programs — on bank balance sheets. When the government took bad loans off of bank balance sheets in the late 1990s,

[29] Non-performing loans are generally defined as those in need of special attention and those to firms that are bankrupt or near bankruptcy. See International Monetary Fund 2001.

[30] See IMF 2001. These numbers incorporate definitional changes made in 1997 and 1998.

[31] Interpretation of the data is again complicated by changes by the Japanese government in accounting standards; for one, in late 1997, banks were given the choice of using either book or market value for their real estate and securities assets, allowing banks to improve their apparent capital adequacy without any real change in behavior. For example, Fuji Bank went in March 1998 from 7.29 percent under the old standards to 9.41 under the new ones. See Kanaya and Woo (2000).

banks could have used the injection of public capital to make loans to worthy borrowers. However, the data show that between 1998 and 2000, loans shrank, while central government securities rose, whether measured as shares or as total amounts. This type of allocation of available funds into a very liquid asset is a classic response to a liquidity shock.

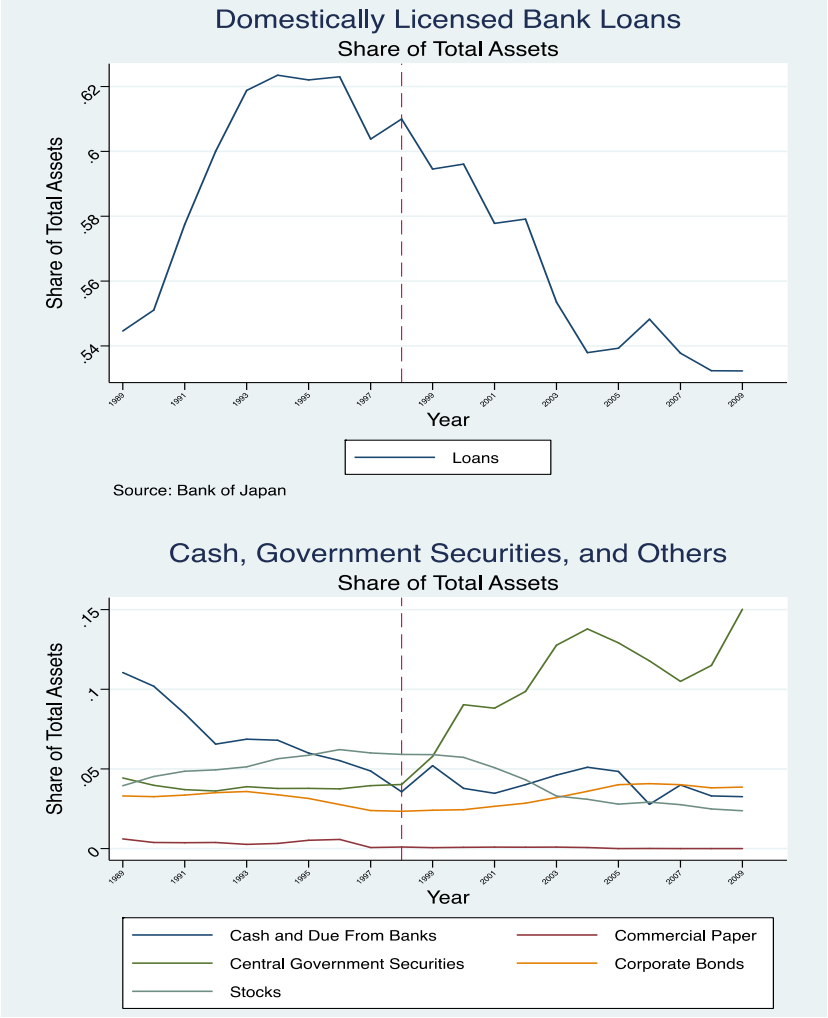

Figure 9 Domestically Licensed Bank Assets by Type of Asset

Source: Bank of Japan

7. Effect on Liquidity and Availability of Credit throughout the Economy

Although the impact of the liquidity shock on availability of credit was delayed, it clearly shows up beginning in the late 1990s. Once the turmoil hit the financial system in late 1997 and into 1998, loans extended by domestically licensed banks began to shrink, with declines recorded for all years from 1998 through 2004. Figure 10 shows the value of bank loans, broken out by sector. Loans to construction and real estate were fairly flat through 1998, after which they began to fall. After 1999, loans to the manufacturing sector also began to fall fairly dramatically. These changes illustrate how bank lending, or the lack thereof, acts as the transmission

mechanism via which the liquidity shock impacts real activity.[32]

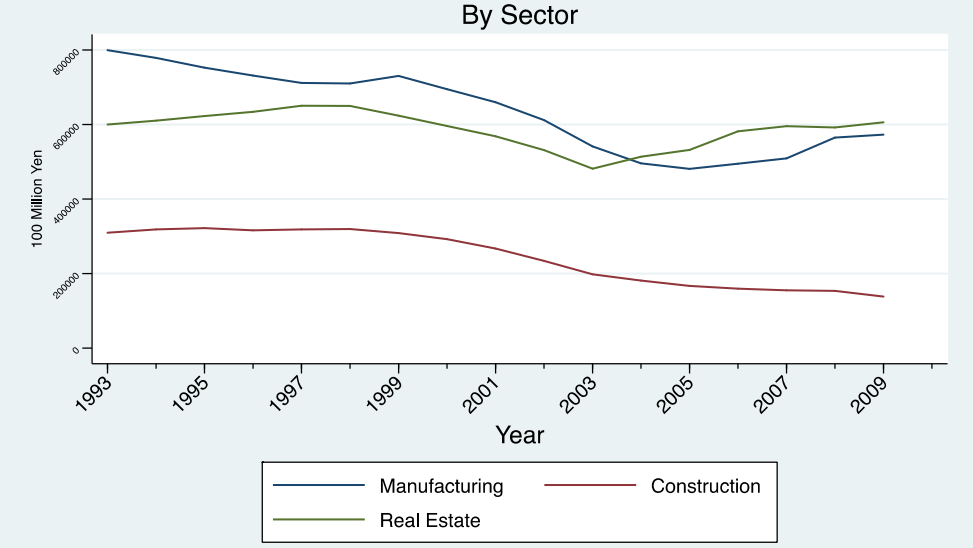

Figure 10 Loan by Domestically Licensed Banks

Source: Bank of Japan

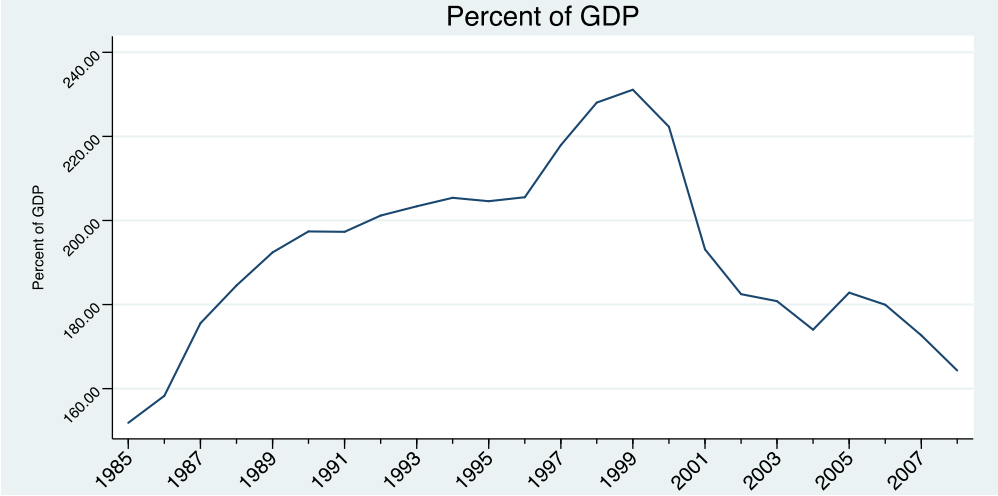

Figure 11 Domestic Credit to the Private Sector

Source: World Bank

Domestic Credit to Private Sector refers to financial resources provides to the private sector, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim of repayment.

Figure 11 provides a very broad indicator of credit availability — overall domestic credit provided to the private sector, as a percent of GDP. After increasing during the 1980s, this ratio leveled off during most of the 1990s. After government recapitalization in the late 1990s, the ratio jumps back up, although Peek and Rosengren indicate that a good portion of these funds were used to forgive the debt of poorly performing firms (Peek & Rosengren, 2005). Subsequently, once the full impact of the liquidity shock hits, domestic credit dropped

[32] The bump up in 1996 in these series likely reflects the anticipatory effects of the increase in the consumption tax due to be imposed in April of 1997. See Bank of Japan (1997) and Miyazaki (2006).

dramatically, continuing to decline through 2004.

More information on the availability of credit is provided by Bank of Japan's Tankan Survey, which polls firms on a quarterly basis. This survey includes a diffusion index which subtracts the number of respondents indicating a "severe" lending attitude in financial institutions from those responding that financial institutions are being generate loans with relatively low liquidity and also traditionally dependent on bank financing. During the evergreening of the 1990s, banks were viewed as relatively accommodative; beginning in the late 1990s, however, the index plunged, hitting a low point in the fourth quarter of 1998. It remained below zero through the first quarter of 2004.

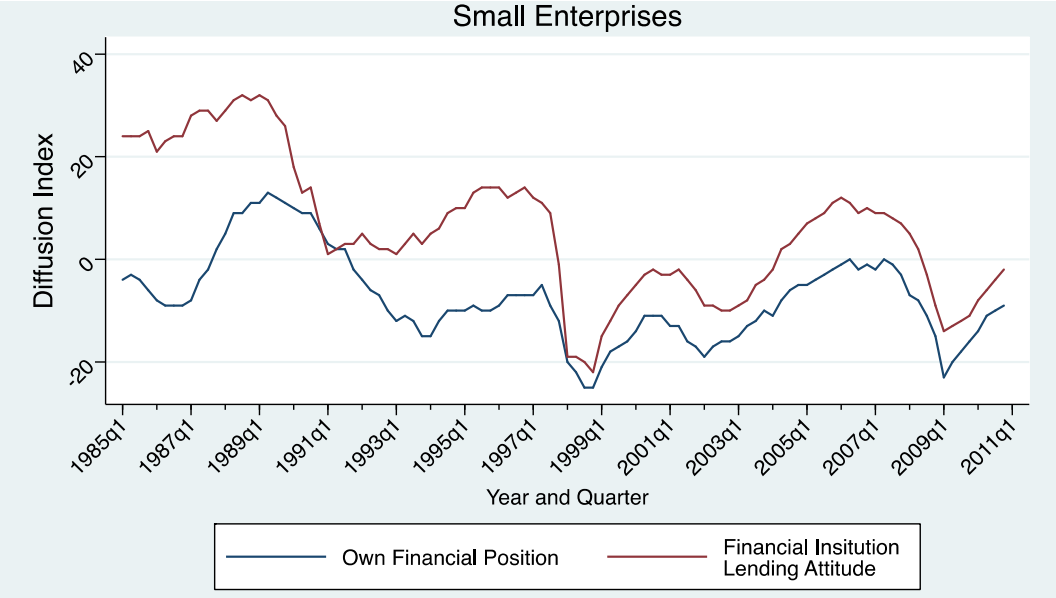

Figure 12 Firm Perception of Lender Attitude and Financial Position

Source: Bank of Japan, Tankan Survey

8. Effects of Liquidity Shock Hit the Broader Real Economy

In this final stage of the aftermath of a liquidity shock, the changes in bank behavior and availability of credit described above spread throughout the economy. At this point, the economy may look much as it would in a more common cyclical downturn. However, sectors particularly dependent on credit may be more hard hit in a recession induced by a liquidity shock. Most especially, sectors dependent on credit but that generate assets with low liquidity — such as real estate and construction — may be particularly affected.

As one indicator, Figure 13 shows construction orders received by the 50 largest construction firms, with the chart showing total domestic orders, private domestic orders, and public domestic orders. The dip in the early 1990s is followed by a leveling off during the middle part of the decade. The financial crisis of 1997 and later was accompanied by another distinct downturn in construction orders. Figure 14 shows information on public and private construction starts, and the pattern here.

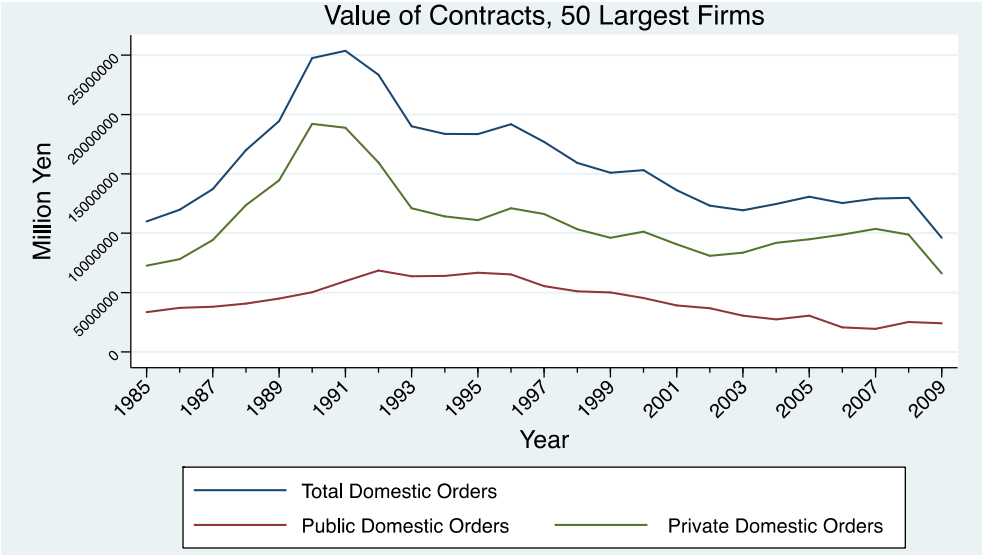

Figure 13 Construction Orders

Source: Ministry of Land, Infrastructure, Transport and Tourism

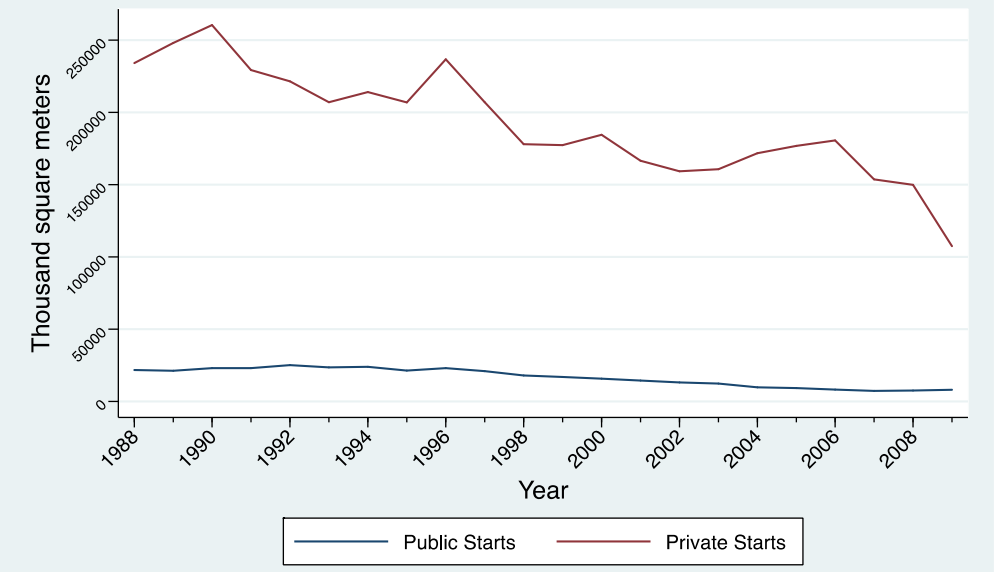

Figure 14 Construction Starts

Source: Ministry of land, Infrastructure, Transport and Tourism

Other broader indicators suggest the extent of the downturn over these years. Figure 15 shows the change in GDP from the previous quarter. On average, GDP growth was just over 4.5 percent during the 1980s, but dropped dramatically to an average of 1.33 percent over the 1990s. Growth in the 2000s remained anemic. The unemployment rate also climbed throughout the 1990s, as shown in Figure 16. Finally, over and above the decline in land prices discussed above, there were persistent declines in the overall price level into the 2000s (see Figure 17). The declines in price level could have the effect of pushing down the value of bank assets, further exacerbating the problems discussed above.

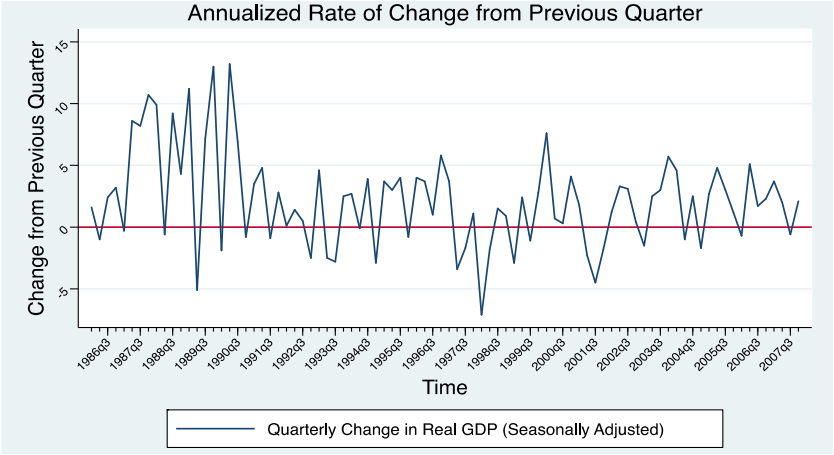

Figure 15 Real GDP

Source: Japan Cabinet Office

Figure 16 Unemployment Rate

Source: Statistics Bureau and the Director-General for Policy Planning of Japan, http://www.stat.go.jp/english/data/roudou/ingindex.htm

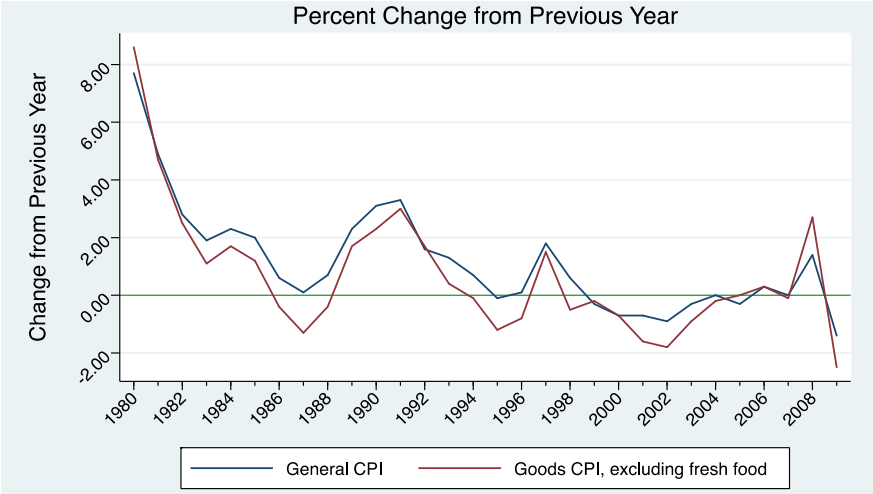

Figure 17 Consumer Price Index

Source: Japan Ministry of Internal Affairs and Communication

Based on these indicators, Japan clearly had entered a recessionary period. What made this episode different from other, more standard recessions was both the trigger and the impact on the financial sector. With a liquidity shock kicking things off, and the subsequent impact on bank balance sheets and bank activity, this downturn would prove particularly persistent and difficult to resolve. Indeed, throughout the 2000s, Japan continued to record growth rates that averaged only around 1 percent.[33]

9. Conclusions

"Liquidity" has recently received heightened attention, both in theoretical work and in studies focused on liquidity in financial institutions and markets. Few studies, however, have examined empirically the mechanisms via which a shock to liquidity feeds through to the macroeconomy. This lack of coverage is at least in part because three important examples of a liquidity shock spiraling into a full-blown macroeconomic crisis — the U.S. Great Depression, Japan's "Lost Decade" of the 1990s, and the U.S. "Great Recession". Data for the first of these episodes exist, but lack the detail and depth that would be most useful for such an exercise. The U.S. Great Recession is very recent and, arguably, still unfolding. Japan's lost decade, however, provides both a wealth of data and the benefit of 20 years of hindsight, and thus an ideal opportunity for exploring how a liquidity shock can feed through to banks and lead to a broad and deep economic downturn.

In this paper, we have traced out the evidence for interpreting Japan's Lost Decade as the aftermath of a liquidity shock. We showed that banks, specifically bank lending, were a key transmission mechanism. The onset of the liquidity shock led to a reduction of capital in financial institutions. This reduction in turn led to banks' reduced willingness to hold assets with high liquidity risk, such as corporate and real estate loans, making investment throughout the economy more difficult. Reduced investment activity then led to reduced output and, as a result, what started as a shock in the financial markets propagated to the real economy and led to many years of sluggish growth, the period known as the "Lost Decade".

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[33] Of course, as were other countries around the world, Japan was hit by the global recession of 2008 and later.

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