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Notes on Liquidity

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These notes look into liquidity from various angles – the structure of sectoral balance sheets with an emphasis on historical changes and comparisons between rich and poor countries, long-term movements in indicators of liquidity for the US non-financial sector, current relationships between real and financial sectors, and a simple model of the role of securitization in driving asset price changes. The emphasis is on how the concept of liquidity has shifted over the 20th century, and the role it played in the financial events of 2007-08.

Sectoral Balance Sheets

The financial side of an economy undergoes structural change. There is no strict progression of financial development and initial conditions matter. But broadly speaking, new financial structures are created in stages that have been observed worldwide. It is instructive to trace through five of them. Table 1 illustrates using balance sheets for different collective financial actors.

The underlying accounting concepts are a mix of the flows of funds (the unavoidable data base for macroeconomic modeling) and more traditional approaches. The main distinction lies in the treatment of "equity" or "net worth." In flows of funds

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accounts consolidated economy-wide the net worth of the business sector has to be the value of its assets less liabilities which include debt *plus* the market value of its outstanding shares. The alternative is to define equity as the value of assets minus debt. In the late 1990s in the US during the stock market boom, business net worth was negative by the former definition but of course positive by the latter (both are positive as of 2007).

Table 1

The entries in the table represent values of *stocks* of financial claims. They change in two ways. One is through *flow* accumulation or decumulation over time of the stocks in response to net lending or borrowing by different actors. The other mechanism applies to outstanding shares and foreign loans which have explicit asset prices (a price index for equity and the exchange rate respectively) so their values can jump "instantaneously" due to capital gains or losses.

There are five sectors – private non-financial actors, the banks, the government, a non-bank financial sector, and the rest of the world.[1] The table is helpful for thinking about how finance functions, the key point being that the instruments and transactions available during any stage impose limitations on macroeconomic policy maneuver.

"Stage I" of financial change broadly represents the situation in the advanced economies around the turn of the 20th century; it still applies in a significant number of developing countries. The system pivots around the upper left-hand balance sheet (or

[1] A natural extension would be to split the private sector into households and business. To simplify the exposition it is not pursued here.

"T-account") for the private non-financial sector and its connections with the banking system, government, and rest of the world.

In Stage I the only private assets are the value of tangible capital $P_K K$ with *K* as the existing stock at historical or replacement cost and P_K as its asset price. "Money" *H* is the sole liability of the banking system.[2]

There is no significant market in bonds, so private holdings of government securities (B_P) are negligible. On the liability side, private business may borrow L_P from the banks but loans from abroad eL_P^* and the value of equity outstanding $P_V V$ are negligible or effectively non-traded. Private net worth Ω_P is given by assets minus debt, or $\Omega_P = P_K K + H - L_P$.

Following common practice, in Table 1 the central and commercial banks are consolidated into a single balance sheet. The system's assets are loans *L* (at this stage only L_P to the private sector), bonds B_B which the government has in one way or another placed with the banks, and international reserves eR^* with R^* as the value of reserves in foreign currency and *e* as the exchange rate (units of local currency per unit of foreign currency). Bank assets add up to determine the money supply *H.*

The government's total borrowing is $B = B_B$ from the banking system. The corresponding asset is its "full faith and credit"Γ. International reserves are a liability for the rest of the world, and it holds no liabilities issued by local actors. None of the remaining entries in the table matter at this stage. Adding up the balance sheets and

[2] As is often the case in macroeconomic modeling bank equity is omitted, though it will figure centrally in the discussion of leverage below.

consolidating gives a wealth identity $P_K K + \Gamma = \Omega_P + e\Omega_R^*$ with $e\Omega_R^*$ as net worth of the rest of the world.[3] At this stage $e\Omega_R^* = -eR^*$.

Liquidity is often interpreted as a measure of the financial flexibility of an individual actor, group of actors, or the financial system as whole. It represents the resources readily available for purposes of capital formation or financial transactions. For the private sector in Stage I, liquidity takes the form of one *asset*, namely money. Nothing else is at hand.[4]

The accounting framework just sketched puts strict limitations on policy options. First, it is the preferred arena for the IMF's venerable version of open economy monetarism. Suppose that money demand is described by the equation of exchange $HV = PX$ with *P* as the price level, *X* as output, and *V* as an institutionally determined constant called "velocity." If *X* is set by "full employment" and *P* comes from an inflation forecast, then money demand must follow.

If loans L_P to the private sector are set by needs of production, the sum of bank loans to the government and reserves is determined from the banking system's balance sheet: $B_B + eR^* = H - L_P$. If reserves are targeted to increase as the current account or inflow of foreign net borrowing improves then government debt must fall via a larger

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[3] Including Γ as part of wealth requires a Keynesian perspective – demand-driven growth can generate tax revenues which the government can use to back its debt. Under assumed full employment, if the private sector adjusts its saving to offset taxes, Ricardian equivalence applies and the capital stock would be the sole component of wealth.

[4] Government liabilities in the form of coin and currency are omitted from the present discussion but were key components of the rich countries' financial systems well into the 19th century.

fiscal surplus to accommodate. IMF financial programming with its twin fiscal and foreign deficits is based firmly on Stage I balance sheets.

Along with twin deficit hawks worldwide the Fund implicitly assumes that causality runs from the fiscal to foreign deficit. More recent global savings glut analysis for the US says it may run the other way as fiscal policy is adjusted to maintain an acceptable level of economic activity. In practice, these particular twins are not frequently observed in the data – foreign and private net borrowing flows are more likely to show correlation.

Secondly, Stage I accounts support the basic closed economy monetarist inflation model, set out by the Swedish economist Knut Wicksell in the late 19th century and propagandized worldwide by Milton Friedman and disciples as recently as the 1970s and 1980s. The question at hand is whether higher government borrowing will "spill over" into a worsening balance of payments or inflation. If the latter, then *P* is assumed to be set by the equation of exchange, $P = HV/X$.

Because liquidity in many economies now comprises a spectrum of financial assets and liabilities far wider than simple money, financial programming and monetarist inflation models are anachronistic. Inflation in Zimbabwe which took off in the mid-2000s can be interpreted along monetarist lines but Zimbabwe is (almost) at the end of the world.

In "Stage II," a domestic market in (at least short term) government debt has been created, typically by careful husbandry on the part of the central bank. The banking system and the public now have fairly substantial holdings of government bonds (B_B and B_p respectively). In outline form, Keynes in the 1930s thought in terms of

this sort of financial system, with the significant extension of having markets in corporate debt instruments as well.

Primary liquidity in Stage II is still money. Keynesian ideas about liquidity preference come into play, with the interest rate mediating portfolio choices between more liquid money and less liquid bonds (with government bonds being more liquid than corporates which are subject to interest rate spreads). As far as the private sector is concerned, the liquidity spectrum still spans a collection of assets, with specific holdings responding to returns and costs.

If a corporate bond market exists it can be of significant support to capital formation. But even without one, in financial Stage II governments can issue bonds to fund national development banks specialized in production-oriented loans. Such institutions have been very important in developing countries but played a significant 20th century role in advanced economies as well.

Finally, it is worth noting that although Keynes was certainly aware of possibilities for financial instability, they do not figure prominently in either the *Treatise on Money* or the *General Theory.*[5] One reason is that without the possibility of using liabilities as liquidity to acquire assets (allegedly) subject to capital gains, there is no room for financial excursions to take off as they have since before the linked Mississippi (in France) and South Sea (in England) bubbles almost 300 years ago. We now turn to more recent examples.

[5] Both volumes do provide analyses of the trade cycle involving shifts and/or non-linearities in liquidity preference. Minsky's financial cycle models rely on similar macro dynamics.

In "Stage III" foreign financial capital comes into play. The economy gets access to foreign loans (eL_P^* to the private sector and eL_G^* to the government, expressed in *domestic* prices). Many countries and regions have gone through such a transition – Austria and Germany around 1930 when bank deposits from foreigners were used to acquire domestic assets leading into the Credit-Anstalt crash, Western Europe when capital markets were liberalized in the 1970s, and emerging markets subsequently.

External *liabilities* now become a form of liquidity which can be used to acquire assets at home. Local actors may or may not be able to issue liabilities aboard denominated in domestic currency. If they cannot, the limitation is quaintly called "original sin" in the academic literature.[6] But stage III sinners are welcome to borrow in foreign currency terms.

The presence of foreign liabilities in portfolios immediately exposes their holders to exchange risk – the capital loss from devaluation or an increase in the exchange rate *e* cuts directly into net worth and jacks up the cost of debt service. The danger is especially grave for actors such as firms producing non-traded goods and possibly the government itself insofar as their main sources of income are set in local currency.

Money and credit expansion due to reserve increases from capital inflows has become a persistent problem in emerging markets, and was endemic in Western Europe around 1990.[7] If there is a market in domestic bonds, the central bank at least

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[6] What St. Augustine's views about the sinfulness of unbaptized babies have to do with international finance must remain obscure. In any case, a partial offset to the evil could take the form of debt issued in the local currency by transnational firms.

[7] If the exchange rate *e* is constant, foreign assets $e\Omega_R^* = P_V V_R + e(L^* - R^*)$ can only change gradually over time via a surplus or deficit on current account. Hence a jump in

has the option of sterilizing the reserve increases by selling part of its stock B_B in exchange for money in an open market operation (at the risk of driving up interest rates which may then bring in still more foreign capital!). But a long sequence of currency crises shows that such interventions may be of limited effectiveness at best.

Use of liabilities as a source of liquidity expands greatly in "Stage IV." A local market for equity issued by the private sector can provide the trampoline. In Table 1, the value of private sector shares outstanding is $P_V V$ with P_V as a price index and *V* a measure of outstanding volume.[8] In a wonderful 17th century Dutch word, a Stage IV economy can enter into *windhandel* or "wind trade" based on the use of liabilities (and derivatives built around them) as sources of liquidity.

In Table 1's financial sector, this possibility is (dimly) reflected by the offsetting asset and liability *S* (for "securities") entries. Individual financial actors such as broker-dealers, Fannie Mae (in the US at least), and hedge funds can borrow from one another but for their subsystem as a whole many of these transactions will be mutually offsetting.[9] If E_F is the subsystem's equity or financial capital (assumed to be held by the private sector as an asset) then by increasing *S* it can build up its asset/equity ratio or

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foreign lending L^* must be met by an equal increase in reserves R^* which can stimulate money and credit expansion through the usual channels.

[8] For the private non-financial sector, Table1 follows the accounting convention of the flow of funds by treating equity outstanding as a "liability" and allowing non-zero net worth. To illustrate a point made earlier, in flow of funds terms Google has highly negative net worth because its stock market valuation vastly exceeds its tangible capital and financial assets. On a balance sheet set up to follow accountants' conventions, Google like all other corporations would have zero net worth.

[9] In available US flows of funds data they do not offset completely – leveraged financial institutions typically have negative *net* positions in fed funds and security repurchase (repo) agreements. *Gross* repo asset and liability positions are not reported.

leverage $\lambda_F = (P_V V_F + S)/E_F$. The liabilities $L_F + S + eL_F^*$ underlying total assets $P_V V_F + S$ can support imposing structures of leverage and liquidity.

So long as P_V continues to rise, for example, then growing intra-financial sector claims make it possible to mobilize large sums of money to buy stock. Of course P_V can also fall, precipitating a collapse. “Appetite for risk” during a boom becomes “flight to quality” in a crash marked by “deleveraging” or a contraction of liquidity in the form of liabilities and a retreat to assets such as government bonds and (even) money.

The financial sector can also be dependent on the rest of the world. If local operators borrow heavily from abroad (eL_F^* in Table 1) and invest at home ample possibilities arise for currency and maturity misalignments in national balance sheets of the sort that led to the succession of emerging market financial crises in the 1990s.

“Stage V” finance puts even more emphasis on *S.* Gadgets from financial engineering ranging from borrowing on the margin on though asset securitization and collaterized debt or loan obligations (heavily relied upon in the US subprime mortgage bubble that imploded in 2007, as discussed below) make it possible to borrow large sums of money to increase claims on the non-financial sector.

How to evaluate collateral for loans raises problems. Imagine an extension of Table 1 in which a “Finance I” sector (very possibly a bank) makes two kinds of loans to the private sector. One sort goes to households for subprime mortgages and the other to highly rated firms. The loans are bundled into a “security” to be sold to “Finance II” which uses this new form of liquidity as pumped up by leverage to acquire equity, etc.

With derivatives upon the various securities thrown in, these balance sheets are a pale reflection of the situation on Wall Street in August 2007.

Aside from ample opportunities for fraud, one key point is that the housing collateral for the subprime loans was itself subject to capital gains and losses, and that the ability of the borrowers to be able to meet their payment obligations was open to question (without, needless to say, any prior provision being made on the part of the lenders for loan losses during a downswing). A simple example is presented below in which the asset price of (say) a house is linked directly to financial equity E_F. A capital gain on the primary asset leads directly to a jump in equity which stimulates balance sheet expansion. That leads in turn to upward pressure on asset prices and the temptation for financial actors to "push loans" onto the non-financial sector.

Secondly, complex securities were rarely marketed, and were given a hypothetical valuation based on mathematical models duly ratified by the ratings agencies. It was a wonderful source of liquidity for Finance II until the bottom fell out of the subprime market. Then a crisis hit, with deleveraging and shrinkage of liquidity from liability to asset form.

As illustrated below, such interactions can be traced in part using a data-based model. A major difficulty is that gross positions in securities such as *S* (security repurchase agreements or repos and reverse repos in the US) are not readily available. Nevertheless, simple illustrative simulations can be constructed using the flows of funds numbers that do exist.

The US Non-Financial Sector

Long-run aspects of such changes show up in the behavior of the US private non-financial sector over time. Figure 1 depicts the evolution of leverage ratios (total assets/net worth) for households and corporate non-farm non-financial business. The first point is that private leverage is rather low. Even after a run-up beginning in the late 1990s, the household ratio is less than 1.25. The business ratio peaked above two around 1990 and has since declined.[10]

Figure 1

In line with the financial transitions discussed above, leverage in the two series broadly trended upward over almost 60 years, with the business ratio dropping off toward the end of the period. Household leverage rose sharply with the property boom beginning in the late 1990s. However its overall range of variation is well below that of business.

Figure 2 shows ratios of assets and debt to net worth. Household owners' equity in real estate went through two fairly long cycles while debt went fairly steadily upward. Business also had two cycles but debt as a share of net worth fell back after the peak in share prices (debt/net worth was the leading variable in the first cycle and lagged in the second). The corporate sector retrenches after the peak of an equity boom.

Figure 2

[10] To repeat: in the flow of funds accounts household assets include holdings of business equity and mutual funds. On the other hand, equity is not counted as a liability in calculations of business net worth (it is a "memo item" instead).

Because net worth itself is a function of debt, it is cleaner to normalize debt and equity positions by the value of capital stock (the ratio of equity to capital is Tobin's *q*). Figure 3 shows the same Figure 2 cycles for business, with debt as the apparent leading variable in both. In Figure 4, household debt goes steadily upward relative to the value of real estate. Apart from its upswing peaking in the mid-1980s (see Figure 2), owners' equity share of their real estate goes down.

Figure 3

Figure 4

In summary, financial behavior in the major sectors of the real economy differs between non-financial business and households. Both show long-term trends toward higher leverage (tapering off for business late in the 20th century). Households have steadily run up debt, while business tends to reduce it after a stock market boom.

US Non-financial and Financial Sectors

Table 2, based on data from the Federal Reserve Flows of Funds accounts, provides another perspective on the US. It is organized around a real sector made up of households and private business and a leveraged financial sector which effectively consolidates the two such sectors of Table 1.[11] Then there is a "balancing" sector made up of state, local, and federal governments; non-leveraged finance (insurance companies, pension funds, mutual funds, etc.); the rest of the world; and discrepancies.

[11] The leveraged sector comprises commercial banking, savings institutions, credit unions, money market mutual funds, government-sponsored enterprises, and security brokers and dealers.

Liabilities exceed assets by around $3 trillion in the balancing sector, generating an overall inconsistency in the accounting of 1.8% of total assets (much of the discrepancy can be traced to US balances with the rest of the world).

Table 2

Several points are worth making. One is that the leveraged sector issues liabilities including money, shares in money market funds, and repos which are held by the real sector as sources of liquidity. As noted above, only *net* repo positions are reported in the Flows of Funds, totaling about $2.5 trillion as liabilities of the commercial banks and broker-dealers. Even so, the overall leverage ratio for the sector (with some crude approximations thrown in) works out to be 12.63.

Secondly, non-leveraged finance is important. Mutual funds and insurance and pension reserves make up a significant fraction of real sector (especially household) wealth. Equity is an important household asset and business liability (passed back to households via the mutual funds). Mortgages are big liabilities for both sectors on the real side.

Non-mortgage and miscellaneous credits comprise several items – consumer credit for households (2.55 trillion dollars), and miscellaneous assets (10.3) and liabilities (4.01) for nonfinancial business including foreign direct investment among other entries.

Commercial banks hold 3.16 trillion in non-mortgage loans and 3.63 in mortgages. It is very difficult to get a handle on leverage in the Fed accounts, but one estimate of commercial bank equity is 1.26, implying a leverage ratio of 8.83. Assets of the government-sponsored enterprises are 3.18, tied to mortgage and state and local

finance. Broker-dealers hold around $3 trillion in assets (roughly one-half miscellaneous) and have very high leverage even with their offsetting repo and reverse repo positions not included.

Following the work of Hyun Shin and colleagues (Adrian and Shin, 2007; Greenlaw, et.al., 2008), it makes sense to explore in a bit more detail the interactions of liquidity and leverage. Table 2 provides relevant background data.

Leverage and Liquidity

The key contemporary question is how capital gains (say on residential housing) may feed into jumps in leverage and the use of liabilities as liquidity. A higher asset price in the non-financial sector may stimulate increased demand for loans. Tangible assets of households (excluding consumer durables) in 2007 were around $22.5 trillion, a very large base for capital gains.

At the same time, if loans have been securitized into assets held by finance, then that sector's equity capital will also rise. For the reasons discussed below, a resulting desire to increase leverage could lead loan supply to go up. Will the desired loan supply increase exceed or fall short of higher demand? The answer could go either way, but in both cases the resulting asset price dynamics can pose substantial policy problems.

Table 3 presents a simple financial accounting matrix or FAM which can be used to set up an illustrative model. A "real" sector owns a tangible asset *K* with an asset price *P.* It also has deposits *H* with a "financial" sector. The real sector borrows *B* from finance so its net worth is E_R.

Table 3

Finance in turn splits its loans into two portions, keeping B_N on its balance sheet. The remainder B_M is passed over to a special purpose vehicle where it is transformed into a security with value *QM*. Its asset price is *Q.* The sector itself now has *QM* on its balance sheet, leading to equity E_F.

Now suppose that *P* jumps up, say because of increased real sector demand for tangible capital. As a consequence the real sector's tangible assets PK and equity E_R rise by an equal absolute amount. As a consequence, its leverage ratio

$$\lambda_R = \frac{PK+H}{E_R} = \frac{PK+H}{PK+H-B}$$

declines. Presumably the asset price *Q* will be driven up as well, with a similar impact on financial equity λ_F. How will the sectors adjust? A simple way to describe their portfolio adjustments is in terms of desired levels of leverage.

On the real side, demand for loans B^R and money holdings *H* are likely to increase as asset-holders cash in some portion of their capital gains. Shin and colleagues present evidence suggesting that after this realignment in the short run (comparing quarterly data on growth rates of total assets and leverage), real sector leverage will decline. Despite the upward trends in household and business leverage shown in Figure 1 there is little apparent cyclicality (except possibly for households beginning in the late 1990s!).

The story is different in finance where leverage tends to vary pro-cyclically. One rationale follows from strengthening balance sheets during an upswing. To maintain target levels of Value-at-Risk, banks and broker-dealers may be tempted to increase leverage. In a simple model, part of this adjustment will take the form of attempting to

supply more loans $B^F = QM + B_N$ to the real economy while at the same time accepting higher deposits *H.*

Behavioral responses in the two sectors can be described by several parameters. One set comprises α_R and α_F which describe desired changes in leverage. If in sector i $\alpha_i = 1$ it is assumed to borrow against the capital gain, acquire assets, and just restore its leverage to its original level. Presumably $\alpha_R < 1$ and $\alpha_F > 1$. Secondly, the elasticity β of the price *Q* of the securitized asset with respect to the underlying asset price *P* has to be taken into consideration. Finally, λ_F is likely to be an order of magnitude larger than λ_R.

Along with observed shares of assets and liabilities in balance sheets these parameters suffice to determine the slopes of loan demand and supply curves (details in the appendix). One possibility, illustrated in Figure 5, is that the elasticity of real sector loan demand B^R with respect to *P* will be less than the elasticity of financial sector supply B^F. The usual market response would be a decline in interest rates (broadly speaking) and an *increase* in the asset price in response to an excess supply of loans. Hence

$$\dot{P} = \frac{dP}{dt} = f(P)$$

and the function $f(P)$ has a positive first derivative. There is positive feedback of the asset price into its own growth – the classic driving force for a bubble.

Alternatively, Figure 6 shows a stable configuration of the curves, with the asset price increasing to a new equilibrium level in response to higher loan demand. Even so, if both curves are relatively steep the price change could be quite large – strong enough

to have significant effects (both upward and downward) on the level of economic activity.

Further Observations

Obviously a lot of work remains to be done here. There are a lot of outstanding issues which include:

It would be good to extend Table 2 (expanded to include households and business separately) to look at trends over time. If the data could be run back 50-60 quarters or so, econometrics could become interesting. The biggest stumbling block appears to be finding equity (or at least assets minus debt) levels for the private sector. The Flows of Funds are not easy to milk for such data, especially for broker-dealers and hedge funds. There is also the issue of trying to quantify gross repo and reverse repo positions for the broker-dealers and commercial banks.

With such a data base, one could think about a serious model instead of the back of the envelope stuff in the appendix here. Several issues would be explored. For example, did the system start behaving more like Figure 5 than Figure 6 with the housing boom on the one hand and the rise of more highly leveraged finance on the other? How did the stock market boom fit into the picture? Much more ambitious would be an attempt to put together a FAM/SAM financial/real model.

And of course historical analysis in much more detail and depth.

Appendix: Leverage/Liquidity Model Derivations

One can base a simple (though messy) model on Table 3 to examine how strongly real sector loan demand B^R and financial sector loan supply $B^F = B_N + QM$ respond to a change in the asset price *P.* The logic is that a higher *P* induces the real

sector to raise both its borrowing *B* and money holdings *H.* An induced increase in the securitized asset price *Q* makes the financial sector want to raise its leverage by lending more.

From Table 3, let total financial assets be $A_F = B_N + QM$. Financial sector leverage is $\lambda_F = A_F/E_F$. Also let ξ_F be the share of securitized loans in total assets, $\xi_F = QM/A_F$. With a "hat" over a variable denoting its log-differential (e.g. $\hat{Q} = dQ/Q$) then the increase in equity due to a jump in *Q* is

$$\hat{E}_F = \xi_F \lambda_F \hat{Q} \quad . \tag{1}$$

Financial firms can adjust leverage by changing their loan supply $B^F = A_F$. The shift in their total assets is

$$\hat{A}_F = \xi_F\left(\hat{Q} + \hat{M}\right) + (1 - \xi_F)\hat{B}_N$$

and the change in their leverage ratio when $\hat{Q} \neq 0$ is

$$\hat{\lambda}_F = \xi_F(1 - \lambda_F)\hat{Q} + \xi_F\hat{M} + (1 - \xi_F)\hat{B}_N \quad . \tag{2}$$

The sector's control variables are *M* and B_N. If they are not changed then from (2) leverage will decline sharply in response to a rise in *Q* because λ_F has a high initial value ($\lambda_F \gg 1$). Suppose that leveraged institutions seek to raise the volume of their loans according to the rule

$$\xi_F\hat{M} + (1 - \xi_F)\hat{B}_N = -\alpha_F\xi_F(1 - \lambda_F)\hat{Q} \tag{3}$$

with α_F as a convenient parameter.

The change in leverage becomes

$$\hat{\lambda}_F = \xi_F(\alpha_F - 1)(\lambda_F - 1)\hat{Q} \quad . \tag{4}$$

That is, financial sector leverage will go up when α_F is greater than one. Asset holdings rise more than in proportion to the direct reduction in leverage due to $\hat{Q} > 0$ in (2). Adding the term $\xi_F \hat{Q}$ to the right-hand side of (3) shows that the change in total assets is

$$\hat{A}_F = [\alpha_F(\lambda_F - 1) + 1]\hat{Q} \tag{5}$$

Assets of the real sector are $A_R = H + PK$. The leverage ratio is $\lambda_R = A_R/E_R$. If $\xi_R = PK/A_R$ then parallel to (1) we have

$$\hat{E}_R = \xi_R \lambda_R \hat{P} \quad . \tag{6}$$

The real sector has two control variables, *B* and *H*. Money demand growth comes into the sector's asset side as

$$\hat{A}_R = \xi_R \hat{P} + (1 - \xi_R)\hat{H}$$

so from (6) the log-change in the liquidity ratio is

$$\hat{\lambda}_R = \xi_R(1 - \lambda_R)\hat{P} + (1 - \xi_R)\hat{H} \quad . \tag{7}$$

Unless the real sector increases its money holdings (presumably by borrowing against its capital gain) its leverage will decline because $\lambda_R > 1$ when $B > 0$.

In analogy to (3) suppose that the sector sets its increased money demand according to the proportionality rule

$$(1 - \xi_R)\hat{H} = -\alpha_R \xi_R(1 - \lambda_R)\hat{P} \quad . \tag{8}$$

Substituting back into (7) gives

$$\hat{\lambda}_R = \xi_R(\alpha_R - 1)(\lambda_R - 1)\hat{P} \tag{9}$$

of the same general form as (4). If $\alpha_R < 1$ leverage still decreases when $\hat{P}$>0. In any case the change in leverage will not be large because ξ_R is a fraction and λ_R is not much greater than one.

To get to the change in loan demand, note that the sector's balance sheet can be expressed as $B = A_R - E_R = (\lambda_R - 1)E_R$. Differentiating this expression gives the log-change of loan demand as

$$\hat{B}^R = \alpha_R \lambda_R \xi_R \hat{P} \quad . \tag{10}$$

If β is the elasticity of *Q* with respect to *P,* then from (5) the change in financial sector loan supply is

$$\hat{B}^F = [\alpha_F (\lambda_F - 1) + 1]\beta \hat{P} \quad . \tag{11}$$

How do the magnitudes of the right-hand sides of (10) and (11) compare.

From Table 2, $\lambda_F = 12.63$. Real sector leverage is $\lambda_R = 1.85$. For residential capital alone, $\xi_R = \frac{22.48}{49.2} = 0.457$. With these numbers (10) can be written as

$$\hat{B}^R = 0.845\,\alpha_R \hat{P} \quad . \tag{12}$$

From (11), the log-differential of loan supply becomes

$$\hat{B}^F = (11.63\alpha_F + 1)\beta \hat{P} \quad . \tag{13}$$

Unless α_R substantially exceeds unity (so that the real sector strongly raises its leverage in response to a capital gain) the term multiplying $\hat{P}$ in (12) will be positive but not very large. Because α_F is likely be greater than one, only a very small value of the elasticity β will prevent the term multiplying $\hat{P}$ in (13) from exceeding its counterpart in

(12). Because of high leverage in the financial sector, the unstable price dynamics illustrated in Figure 5 could be a distinct possibility.

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Table 1: Illustrative Balance Sheets ("T-accounts")

Private Non-Financial		Banks		Finance	
$P_K K$	L_P	L	H	$P_V V_F$	L_F
H	eL_P^*	eR^*		S	S
B_P	$P_V V$	B_B			eL_F^*
E_P	Ω_P				E_F
Government		**Rest of World**			
Γ	B	eL^*	eR^*		
	eL_G^*	$P_V V_R$	$e\Omega_R^*$		

Wealth balance: $P_K K + \Gamma = \Omega_P + e\Omega_R^*$

Net foreign assets: $e\Omega_R^* = P_V V_R + e(L^* - R^*)$

Bank loan balance: $L_P + L_F - L = 0$

Government bond balance: $B_P + B_B - B = 0$

Foreign loan balance: $e(L_P^* + L_G^*) - eL^* = 0$

Equity balance: $P_V(V_F + V_R) - P_V V = 0$

Table 2: US Balance Sheets 2007 (trillions of dollars)

	Real sector		Leveraged Finance		Balancing sectors	
	Assets	Liab.	Assets	Liab.	Assets	Liab.
Tangible assets	49.2					
Money, repos, money funds	9.4		1.47	13.87	3.76	1.02
Non-mort. cred.& misc.	19.09	16.49	15.83	7.29	26.51	29.64
Mortgages	0.26	14.41	5.68		8.62	0.15
Mut. funds, ins. & pen. reserves	19.30				2.47	21.76
Equity	13.59	19.95		1.82	15.77	7.59
Totals	110.84	50.85	22.98	22.98	57.13	60.16

Net worth		59.99	
Leverage	1.85		12.63

Notes: Leveraged sector comprises commercial banking, savings institutions, credit unions, money market mutual funds, government-sponsored enterprises, and security brokers and dealers.

Balancing sectors are state, local, and federal governments; non-leveraged finance (insurance companies, pension funds, mutual funds, etc.); rest of the world; and discrepancies.

Table 3: Financial accounting matrix for the leverage/liquidity model

	Real Sector	Leveraged Finance	Special purpose vehicle	Totals
	PK			*PK*
	H	*-H*		0
	-B	B_N	B_M	0
		QM	*-QM*	0
	$-E_R$	$-E_F$		$-(E_R + E_F)$
Totals	0	0	0	

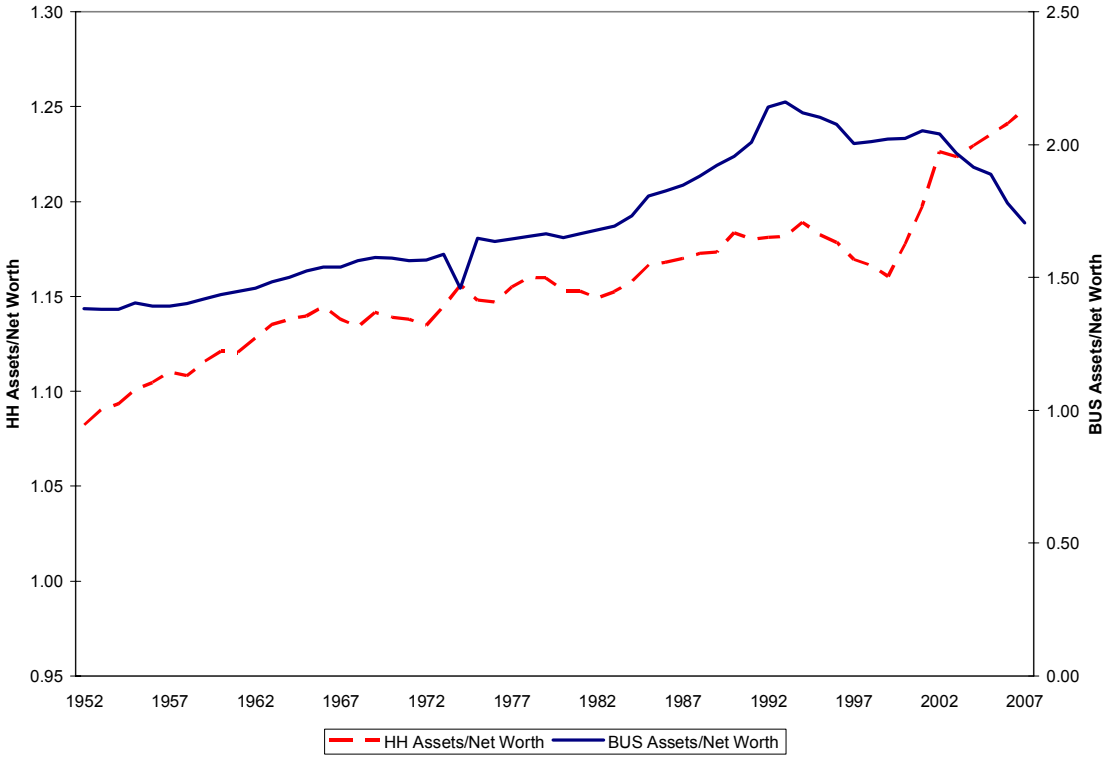
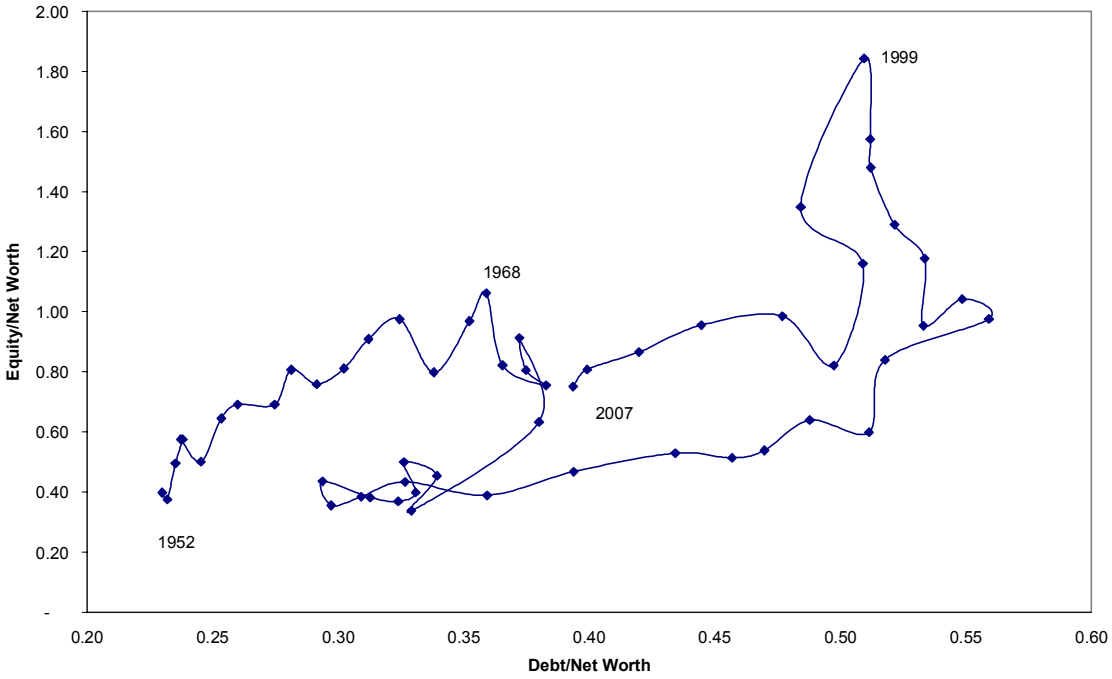


Figure 1: US household and business leverage ratios.

Business Sector's Debt-Equity Cycles: 1952-2007



Household Sector's Debt Equity Cycles: 1952-2007

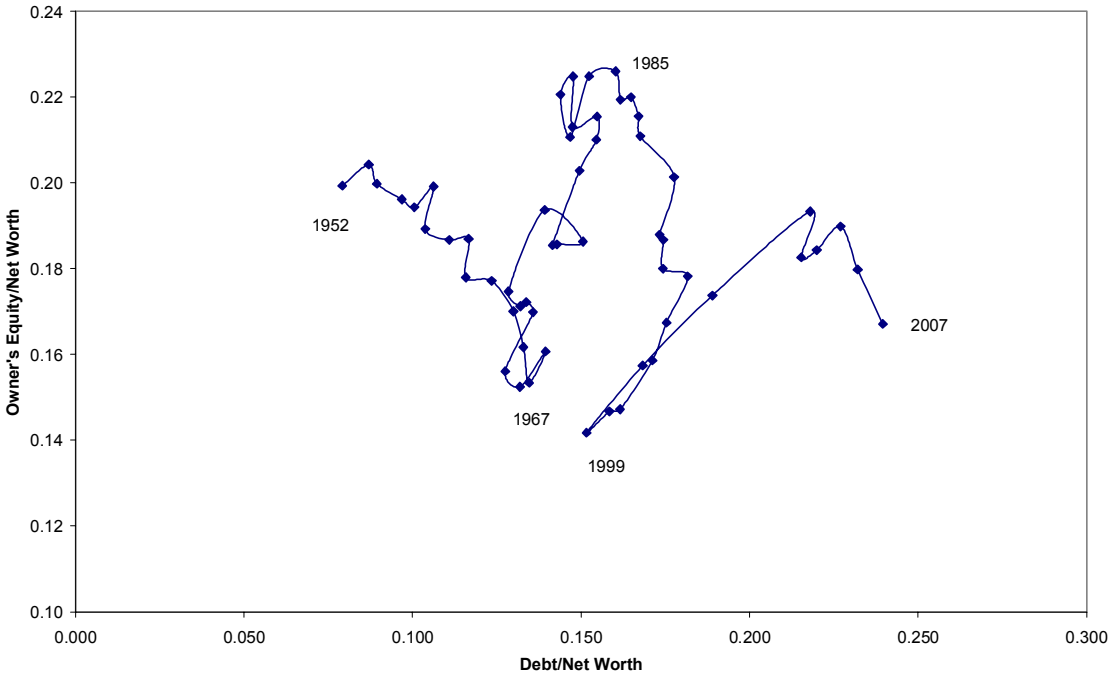


Figure 2: Ratios of equity and debt to net worth.

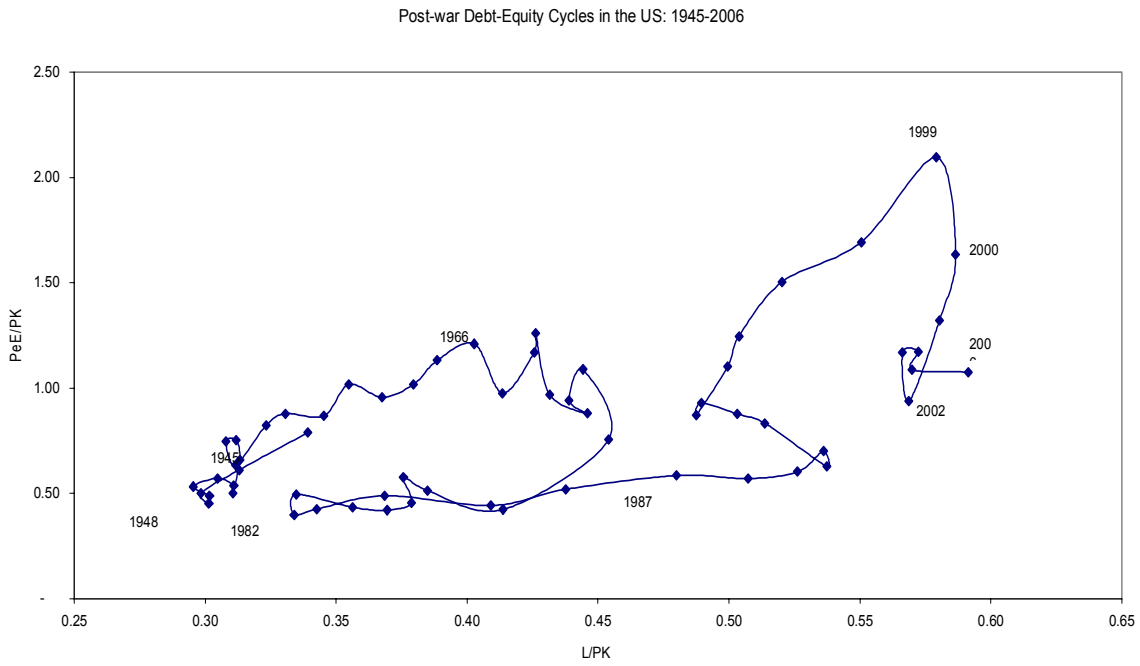


Figure 3: Cycles in business debt and value of equity normalized by the value of capital stock.

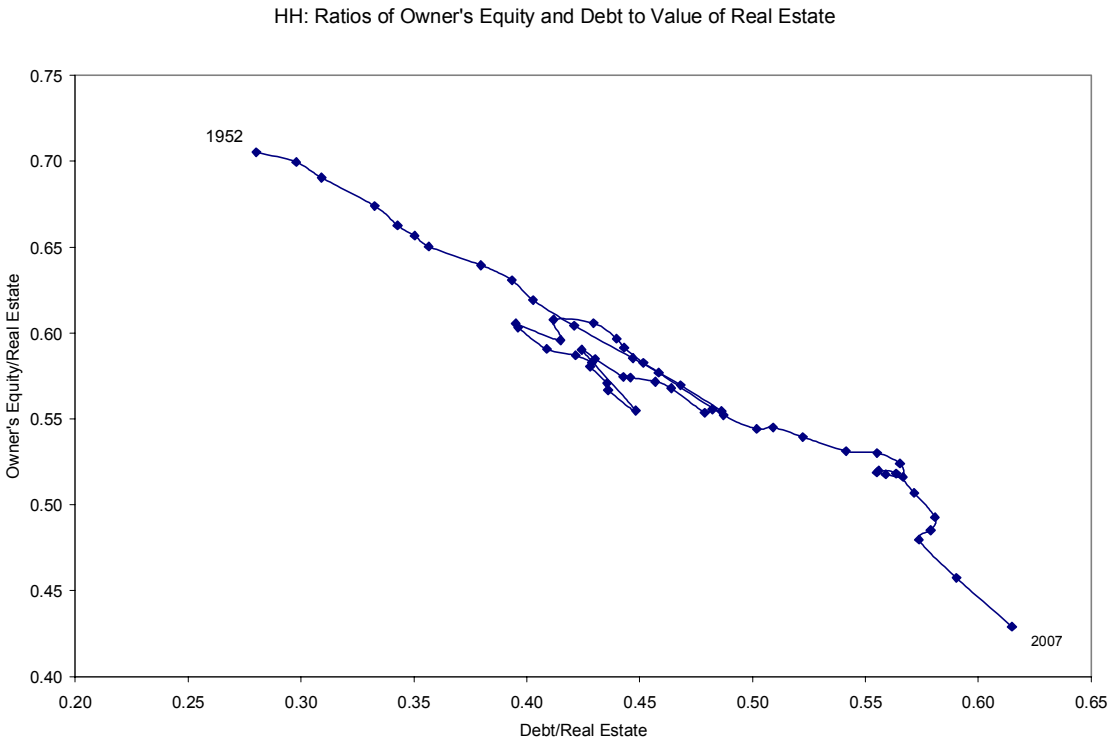


Figure 4: Household owners' equity and debt normalized by the value of real estate.

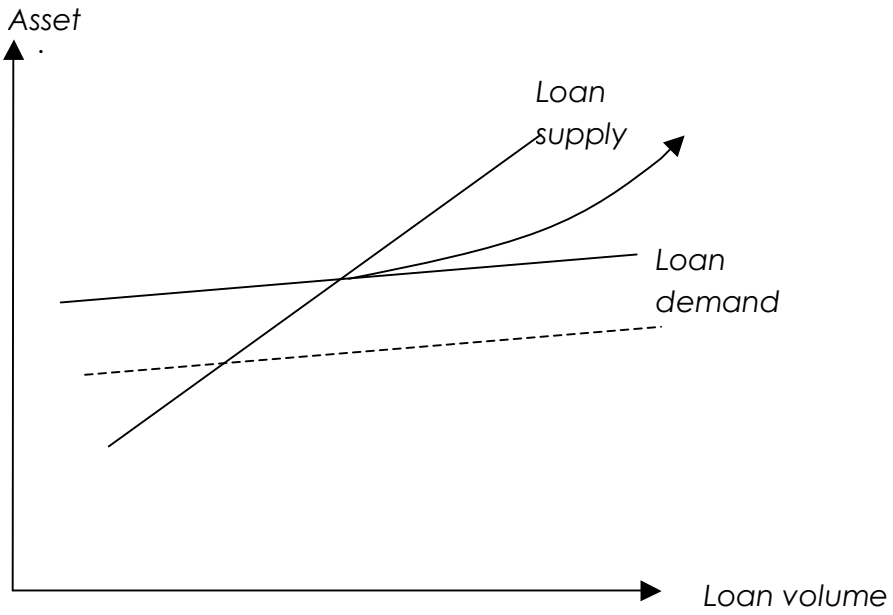


Figure 5: Unstable asset price dynamics in the leverage/liquidity model.

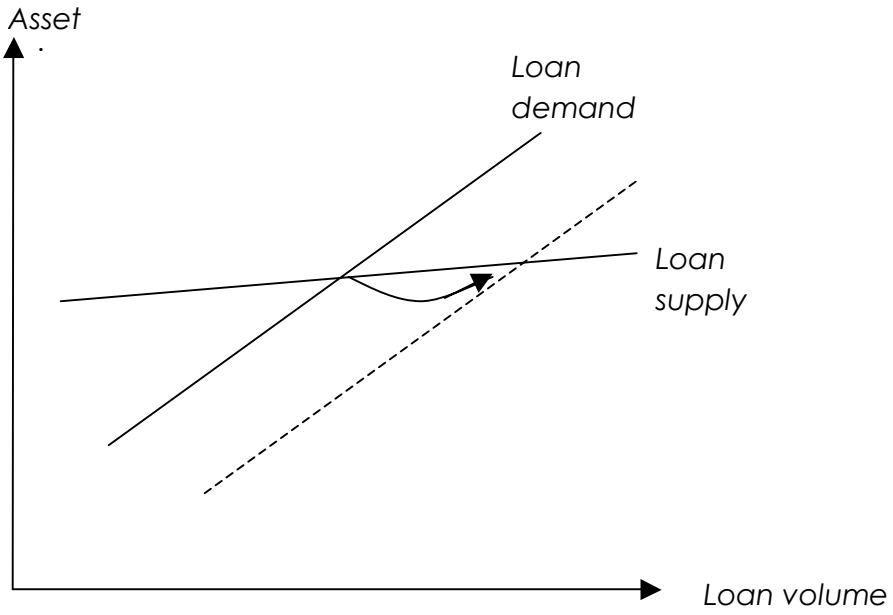


Figure 6: Stable asset price dynamics in the leverage/liquidity model.