Financial Intermediation in the National Accounts:
Asset Valuation, Bubbles, and Tobin's *q*

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"One reason why the financial system spun out of control before 2007 was that few non-financiers had any idea how finance worked; 21st century banking had become so complex and opaque, that there was little external oversight, and thus little common sense – and endless opportunity for arbitrage. The bitter irony of the current reform process is that these flaws are reappearing, in a new guise; instead of a world marred by the "CDO cubed", there is now "complexity cubed": complex financial products are colliding with complex reform processes run by leaders with complex (or unstated) reform goals." Gillian Tett (2011)

I. Introduction

The collapse of the housing-price bubble starting in mid 2006 has had far reaching consequences. This collapse led to a crisis in the sub-prime mortgage market, a relative small part of the overall debt market, by this crisis soon propagated to the financial markets as a whole. The terms "systemic risk" and "counterparty risk" became a prominent part of the vocabulary in the financial sector, as a crisis of confidence developed that ultimately brought down some of the most prestigious financial houses in the sector. Credit flows dried up, and the crisis propagated from "Wall Street" to "Main Street." The overall bill paid by households, the ultimate owner of most financial claims, was enormous: from the fourth quarter of 2007 to the first quarter of 2009, household net worth fell from $64 trillion to $48 trillion. Over the same period, eight million jobs were lost and the unemployment rate rose from 4.8 to 8.2 percent.

Overall net worth has just about recovered to its pre-crisis as of this writing, but U.S. unemployment is stubbornly high percent and the labor force participation rate is near its low levels of the 1980s. The size of these numbers invites the question: why wasn't the

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approaching crisis more apparent in the formal macroeconomic models and data that inform economic policy? This is a complex issue, involving the types and frequency of the data collected (or not collected), and the way they are organized and interpreted. We focus in this paper on one aspect of the problem: the conceptual foundations of accounting practice that describe the relation between the financial and non-financial sectors of the economy. We examine an alternative treatment of financial intermediation in the Knight's circular accounting framework of stocks and flows. Looking at the financial from this perspective helps explain why a problem in a relative small sector of the economy (in the accounting sense) could propagate so widely and rapidly in the rest of the economy.

The alternative treatment is discussed in the sections below, which are organized around the following points. First, conventional accounting practice treats the financial sector as but one on many industries that draw on scarce resources and deliver goods and services. This view of the sector is not wrong, but neither is it very informative about the linkages among producers and consumers. Nor does it highlight the crucial role played by financial intermediation. The financial sector is more than a producer of goods and services; it enables production and consumption by "lubricating the wheels of commerce." This is an overhead function that links saving to investment, manages risk, and coordinates the flow of payments, but it is not a direct production activity on a par with auto and steel production. It is precisely this enabling (or disabling) function that allowed the crisis to spread so rapidly and extensively, and that the conventional accounting framework should be modified in order to make the intermediation process more explicit.

Our second point is that the channels of financial intermediation are complex and non-transparent. In a static system with perfect information, agents are assumed to see through the

complexity and arbitrage away any differences in valuation. In this case, Tobin's marginal *q* should equal one, and the efficient market hypothesis would interpret much, if not all, the large drop in household net worth as a corresponding drop in the value of the underlying income-generating assets. This view minimizes the importance of the complexity, opaqueness, and frictions of the intermediation process. An alternative view emphasizes the lack of transparency and rigidities, and the associated systemic and counter-party risk. In this view, which is the one taken in this paper, a shock to the economy may lead to a divergence between the value of the productive (income generating) capital stock and the wealth as perceived by the owners of the claims on the income. In other words, Tobin's marginal *q* need not equal one in the case.

A final goal of this paper is to estimate leverage (as an indicator of illiquidity) and Tobin's *average q* for sectors and aggregates the U.S. economy using data from the Integrated Macroeconomic Accounts and Flow of Funds Accounts, as modified to fit the circular-flow view of the economy.

II. Accounting for Capital and Wealth

National income and growth accounting would be a relatively simple exercise if there were no capital to worry about. In this case, output would be comprised only of consumption goods and these goods would be produced by labor input alone. If all the output of consumption goods and labor inputs flowed through product and factor markets, the main job of income accounting would be to record the current flows. The aggregate expenditure for consumption would equal aggregate labor income.

The economic world becomes considerably more complicated when capital, in any of its various manifestations, is introduced. Indeed, Hicks (1981) observed that "the measurement of capital is one of the nastiest jobs that economists have set to statisticians." One form of capital is

implicit even in a simple all-consumption framework. Some workers may want to shift current consumption to later years, while others may want (or need) to consume more in the current year by borrowing against future consumption. If they can be brought together, the former may loan their current saving to the latter in the form of a consumption loan to be repaid in later years out of the future consumption of the borrowers. The loan of current consumption goods creates an asset (wealth) to the saver/lender and negative net worth (liability) to the dissaver/borrower.

The problem gets messier when capital goods are introduced. In this situation, some of the current capacity used to produce consumption goods is diverted to the production of capital goods. This investment provides an alternative way that current consumption can be shifted to future years, since, while the capital itself cannot be consumed directly, it can be employed in production to produce the desired future consumption. This reveals a key feature of a capital: it is both a current output of the economic system, as investment, and a future input as part of the accumulated stock of past investments.

Another key feature of capital is that it is both a productive asset and a source of wealth. Where the capital stock is the net accumulation of past investments, wealth is the net accumulation of past saving (which is to say, past forgone consumption). As productive capital, its value reflects a balance between the discounted present net value of the output it produces over its useful life and the cost of acquiring the unit. From the standpoint of wealth, the value of the accumulated wealth is a balance between consumption and the discounted present value of the future consumption made possible by the return to wealth. The acquisition cost reflects the opportunity cost in terms of consumption forgone.

When the capital stock is owned directly by the person whose own savings enables the acquisition of the capital, the distinction between the value of capital and wealth is somewhat

artificial. Direct and complete ownership means that the return to the stock of capital is equally the return to wealth, and saving equals investment directly and capital stock equals wealth. However, owner-utilization tends to obscure the fact that the decision to invest is separate and apart from the decision to save. The investment decision is based on the productivity of capital in production while the saving decision is based upon the shift in consumption from one time period to another.

The arrangement in which the capital is wholly owned by a sole user was more common in the past and vestiges linger in current economic structures (owner-occupied housing without mortgages). However, the decoupling of individual investments from individual savings was one of the most important innovations that enabled the evolution of modern economic organization. Decoupling was made possible by the rise of financial intermediaries that, in effect, connected the supply of saving indirectly to the demand for investment. Financial intermediaries aggregated the savings of individual investors and transferred them through a variety of financial instruments to entrepreneurs and businesses who then used the funds to acquire the capital necessary for their operations. Investment was no longer limited to the opportunities available to individual savers, leading to a reallocation that greatly increased the efficiency of investment and the return to savers.

This is where the measurement of capital really turns “nasty”. With financial intermediation, the link between saving and investment runs through a chain of financial instruments that channel to return to investment back to the owners of the claims against the stock, the owners of the wealth. The households hold claims against the productive stock in the form of instruments like stocks or bonds that channel the income from the productive stock directly to the wealth holder. If the financial instruments connecting the sectors consisted

exclusively of basic stocks and bonds issued by businesses and sold directly to the wealth holders, the degree of complexity would be limited. However, financial intermediaries have developed a variety of instruments that package and securitize the debt and equity issued by businesses for passage on to other financial intermediaries or to the ultimate wealth holder. These include more or less straightforward instruments like mutual funds, annuities, exchange-traded funds, and less straightforward to derivatives, structured investment vehicles, and private equity arrangements. The degree of complexity of these instruments has grown greatly in recent years with the result that the link between the source of capital income in the business sector and its destination in the household sector has become ever more indirect and opaque.

It is this complexity and situation that many observers blame for part of the financial crisis. As the degree of complexity increased so did the degree indirection and therefore the more steps in the valuation of assets and liabilities. The proliferation of new derivative instruments meant that the claims against a given income-generating asset became ever more tenuously linked to that asset. The mortgage market at the center of the financial crisis is an important case in point. Individual mortgages, which were often held by the originating banks, were increasingly pooled to form mortgage-backed securities, as the market evolved, which were then pooled again and repackaged into tranches of collateralized debt obligations (CDO). The link back to the individual mortgages became progressively more tenuous, to the point that it became hard to value the complex derivatives or even proven hard to establish the legal ownership of some properties in foreclosure proceedings. High degrees of leverage (with short-term borrowing) and use of credit default swaps (CDS) further complicated the valuation problem.

The growing lack of transparency and interconnectedness of the instrument led to increased counterparty systemic risk, and meant that a crisis that originated in the subprime mortgage market was transmitted across the financial sector. As the spread, confidence in the value of many of the assets involved plummeted, creating a solvency issue as assets were marked to market value. The mark-to-market valuation threatened the solvency of a number of financial institutions and led to the collapse of many. When financial markets have a hard to valuing the underlying worth of a class of asset, the job of the statistician is very nasty indeed.

III. Modeling Financial Intermediation in a General Equilibrium Framework

A. The Circular Flow Model

The conventional representation of economic flows in the economy as a whole is Knight's circular flow model of an economy (CFM).[1] This organization of economic activity is a conceptual foundation on which general equilibrium theory is erected. The CFM distinguishes two essential economic functions: consumption and production. Consumption takes place in the household sector, and, in a closed economy, they are the recipients of the flow of goods and services; they are also the source of the labor and capital used in the production sector. Production takes place in the business sector, which is divided into industries that deliver intermediate goods to each other, and final demand outside the sector. This sector uses labor and capital provided by the household sector.

A simplified version of the CFM is shown in Figure 1. Resources flow into the factor markets from household sector, where they are priced, and sent on to producers. There, the

[1] As noted by Hulten (2006), Patinkin (1973) traces the circular flow model, in its modern form, to the work of Frank Knight in the 1920s and 1930s, although earlier incomplete forms of the model can be found.

resources are transformed into outputs via each industry's production function. The output are priced in the product markets and sent on to consumers, whose demand is determined by their utility function and incomes, which reflect their utility-maximizing supply decisions. The flow outputs though product markets creates a dollar value that is in principle equal to Gross Domestic Product, and the value of the flow of inputs through factor markets equals Gross Domestic Income. These flows are linked via the standard national income accounting identity, where output is the value of deliveries to final demand and income is split between labor and capital. The counter-clockwise flows shown in Figure 1 are denominated in current prices. The clockwise flows refer to the quantity flows of inputs and outputs between consumers and producers.

The CFM is helpful in laying out the logical structure of the economy and tracking the sources and uses of resources. It covers, in principle, all sources and uses but, in practice, measured GDP records (with some exceptions) only goods and services that flow through markets. The use of market transactions provides a more-or-less objective, and largely available, metric with which to value the flows, but it is subject to the practical drawback that the market economy is only a fraction of total economic activity. Household production is omitted, and problems also arise from the omission of own-account intangible capital in the business sector.[2]

At a conceptual level, issues arise in the treatment of the government and owner-occupied housing sectors. The treatment of owner-occupied housing illustrates the difference between the national structural accounting approach of the U.N. System of National Accounts and the functional approach of the CFM. From the structural standpoint of the CFM, the production of

[2] According to Landefeld and McCulla (2000), the non-market production of consumption goods by household amounted to 24 percent of measured GDP in 1946. More recent estimates of the value of investments in human capital alone are 23 percent of GDP in 2005 (Christian 2010). Estimates by Corrado. Hulten and Sichel (2005, 2009) suggest that the omission of own-account intangible investment may understates understate GDP by as much as 14 percent (though this will change in the U.S. with the capitalization of R&D expenditures in 2013).

owner-occupied housing services is conceptually no different from the production of rental housing services. Both are located on the producer side of Figure 1, and if the owners of housing asset chooses to rent to themselves, there is no substantive economic different from the market rental option. A rent is paid to the landlord, who distributes the payment (less expenses and any interest payments) to the owners of the equity in the assets.[3]

B. Financial Intermediation in the Circular Flow Model

In the SNA and conventional CFM, finance is treated as just another industry, drawing from the pool of available resources to produce a flow of deliveries to final demand and deliveries to intermediate demand in other industries. This accounting convention is by no means wrong -- its does keep track of the uses of resources -- but neither does it illuminate one of the most important functions of financial intermediation, the connection of saving and investment.

The expanded circular flow model of Figure 2 is designed to make this connection explicit. A balance sheet is attached to each of the sectors in the diagram (the two circular areas adjacent to each box). The balance sheet associated with the production sector contains the net stock of productive capital in the sector as an asset, and debt and residual equity on the liability side. While businesses are treated as the legal owner of these assets, the household sector is the owner of the claims against the income generated by those assets. These claims form the basis for the net worth of the household sector, shown on the balance sheet at the right-hand side of

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[3] Similar remarks apply to the public sector. The government is a producer of services and can be located on the left-hand side of Figure 1, along with other productive entities that draw on a common pool labor and capital. The fact that government distributes much of it product outside market channels does not change the basic nature of these flows. Problems do arise from the collective nature of much of the consumption and from the collective nature of the "ownership" of public capital. Should these assets be treated as being held in common by the household sector, with the government a separate consumer within the household sector with its own utility function?

Figure 2. The two balance sheets are connected by the flow of saving and investment. Household saving is channeled into financial instruments which are then held in the household balance sheets as increments to wealth, and the proceeds are channeled the business sector in order to finance the purchase of investment goods.[4] The new capital goods are added to the existing stock, less reductions in the stock due to wear, tear, and obsolescence. In the process, the deferred consumption of household is matched by the shift in the current production of consumption good to the production of capital goods that enable additional consumption in the future.

The flow of capital income moves in the opposite direction from saving and investment in Figure 2. The income from the productive stock flows from its origin in the business sector (mostly) through financial intermediaries to households, along the pathways determined by the ownership structure of assets and liabilities. It provides the basis for the income accruing to the instruments held by households (the dividends, capital gains, interest, rents, and other payments associated with the various types of instrument). The channels may be more or less direct, depending on the degree of complexity of the ownership linkages.[5]

This general picture can be made more explicit with the use of some standard accounting equations and theory. The stock of productive capital at any point in time is the sum of current and past investment goods, weighted by the productive efficiency of those investments:

[4] In practice, large companies can fund part of their investment program via retained earnings and the depreciation reserve. In the framework of Figure 2, retained earnings are treated as an increment to the firm's capital assets that result in an increase in the value of household equity claims. More will be said about this below, in the discussion of revaluation.

[5] There are, of course, many closely held firms, including family held firms that control a lot of assets. According to the BEA/Federal Reserve's Integrated Macroeconomic Accounts, the noncorporate business holds about 40 percent of the value of total nonfinancial business nonfinancial productive assets, and against this, about 65 percent is direct owner equity (2001 to 2007). Thus, the equity income generated by about one-fourth of the stock of nonfinancial business productive assets in the United States is not intermediated but rather flows directly to owner-operators (and then back to financial business, to the extent assets are debt financed). Ninety percent of noncorporate income-generating assets are real estate assets, about two-thirds of which is residential housing.

$$(1) \qquad K_t = I_{t-0} + (1-\delta)I_{t-1} + \ldots + (1-\delta)^s I_{t-s} + \ldots = I_{t-0} + (1-\delta)K_{t-1}$$

The productive efficiency is assumed, here, to decline at a constant (geometric) rate δ, though a more general form can be adopted.[6] The term $(1-\delta)^s I_{t-s}$ is therefore the amount of investment put in place s years previously, measured in units of productive efficiency. The stock K_t is thus the total amount of effective capital *denominated in units of new capital*, that is, the equivalent amount of new capital needed to replace the capacity of the actual stock with its various layers of vintage capital.

The value associated with purchasing a unit of new capital is the discounted present value of the expected stream of future income, adjusted for depreciation. In standard neoclassical investment theory, the gross annual return to the capital good is the value of its marginal product (*VMPK*). The price an investor is willing to pay for the good, in this model, is the discounted present value of the *VMPK*s adjusted for depreciation. With a discount rate r_t the equilibrium price $P^I_{t,s}$ for an asset of age *s* is:

$$(2) \qquad P^I_{t,s} = \sum_{\tau=0}^{\infty} \frac{(1-\delta)^{s+\tau} E(P^K_{t,s+\tau})}{(1+r)^{\tau+1}} \quad .$$

This formulation assumes that the present value on the right-hand side is fully arbitraged against the cost of acquiring the capital good. In many accounting applications, this formulation assumes perfect foresight on the part of the investor.

The term $E(P^K_{t,s})$ is the expected annual Jorgensonian user cost of capital (or implicit per period rent). Under profit maximization, the user cost is equal to *VMPK*, connecting the return to capital in the business sector to the flow of capital income. Following Jorgenson (1963),

[6] A survey of the literature on capital measurement and depreciation is available in Hulten (1990).

equation (2) can be used to derive an explicit form for the user cost in terms of its logical components: the opportunity cost of capital r_t, expected holding gains (or revaluation) π_t, which is equal to expected asset price change $dE(P^I_{t+1}) / P^I_t$, and depreciation δ:

$$P^K_{t,0} = (r_t - \pi_t + \delta)P^I_{t,0} \tag{3}$$

(we abstract, here, from within-year timing issues). $P^K_{t,0}$ is a cost to the user but at the same time, a return to the owner whose components are part of the capital income flows in Figure 2.

The total value of the capital stock at any point in time is the value of the individual vintage components, each valued at the corresponding vintage asset price:

$$P^I_{t,0}I_{t-0} + P^I_{t,1}I_{t-1} + \ldots + P^I_{t,s}I_{t-s} + \ldots = P^I_{t,0}K_t \tag{4}$$ [7]

The right-hand side of this equation, $P^I_{t,0}K_t$, is the *replacement value* of the entire stock, that is, the cost of purchasing a quantity new assets (at the new asset price, $P^I_{t,0}$) equivalent to the productive capacity embodied in the surviving investment vintages. The left-hand side of this equation is the value of those vintages measured at the shadow price of each vintage, $P^I_{t,s}$, which equals the remaining discounted present value. When there are active markets for vintage capital assets, the right-hand side of (4) is the "spot" resale value of the firm's capital stock when broken into individual components. The two sides are equal in a fully-arbitraged equilibrium, but necessarily so during periods of market disequilibrium.

The total value of the firm is the value of all its assets, plus any rents. For simplicity of exposition, we assume only one productive asset and zero rents, but allow for a financial asset,

[7] This equality reflects the fact that, under the geometric form of depreciation, the price of older (used) capital shrinks at the rate δ, so that $P^I_{t,s} = (1-\delta)^s P^I_{t,0}$.

F_t^B (where the superscript denotes financial assets owned by the business sector). One implication of equation (2) is that the value of older vintages of capital declines with age, so total value depends of the age structure of the stock. Another implication is that revaluation $dE(P_{t+1}^I)/P_t^I$ will also affect the stock's value of over time.

The total gross income generated by the capital stock in any year is the sum of the income from each of the individual vintages. This is equal to *VMPK* for the total stock:

$$P_{t,0}^K I_{t-0} + P_{t,1}^K I_{t-1} + \ldots + P_{t,s}^K I_{t-s} + \ldots = P_{t,0}^K K_t \ . \tag{5}$$

This is the gross capital income originating in the production sector of the circular flow model. It is the source of the income transferred to the household sector as part of Gross Domestic Income. In view of (3), gross capital income from the production of output is the sum of the opportunity cost of capital less holding gains, plus depreciation: $P_{t,0}^K K_t = (r_t - \pi_t) P_{t,0}^I K_t + \delta P_{t,0}^I K_t$. The total return to holding a unit of K_t is equal to the *VMPK* on the left-hand side net of depreciation plus any holding gain of the asset, i.e., $r_t = VMPK_t - \delta + \pi_t = \rho_t + \pi_t$. The return to a firm's financial assets F_t^B plus the return to the productive assets equals the total return generated by the operation of the firm.

C. Household Saving and Wealth with Financial Intermediation

The asset value of the firm as a business, V_t , is the value of its productive capital $P_{t,0}^I K_t$ and its financial assets F_t^B that appear on the left-hand side of the firm's balance sheet. The firm's liabilities, in our simple model debt D_t^B plus net worth NW_t^B, appear on the other side of the "T" account. Thus,

(6) $$V_t = P^I_{t,0} K_t + F^B_t = D^B_t + NW^B_t \quad .$$

The items on the liability side of the business balance sheet are assets of households, which hold the legal claims to the income from these assets, $\rho_t P^I_t K_t$, in the form of financial instruments, equities E_t and debt D_t, or other instruments of direct ownership that establish legal control over assets and the income they generate and responsibility for the associated liabilities (for simplicity of exposition, we ignore the latter as a separate equity category). In our simplified model, the holders of the value of the equity have a residual claim to the net worth of businesses NW^B_t and are the holders of the debt D^B_t.

The households' claims on business net worth come in the form of equity certificates E_t that are valued at a price P^E_t per unit (this is a market-determined value when such markets exist and a shadow price when they do not).

(7) $$P^E_t = \sum_{\tau=0}^{\infty} \frac{E(Div^K_{t+\tau})}{(1+r)^{\tau+1}} \quad .$$

The value of total household equity claims in any point in time is thus $P^E_t E_t$.

The value of debt is more complicated because it is typically issued in different vintages, each with its own price (a situation similar to the vintages of productive capital in equation (5)). Borrowers (firms in this case) typically carry debt at par value on their books, whereas value of the debt to the (household) lenders depends on market price at each point in time P^D_t. In a model with perfection information, this is not a problem and the aggregate value of the debt instruments carried on the household balance sheet is thus D^B_t (with imperfect information, the "market-to-

market" disconnect discussed below can arise). The net household balance (with just one type of debt, issued by business) is thus

$$P_t^E E_t + P_t^D D_t = W_t \tag{8}$$

where W_t is household net worth, and intra-household lending netted out.

Ignoring sector distinctions and financial assets held by business (or treating them as just another form of K), the net capital income originating arising in the business sector is transferred to households via interest, dividends, capital gains, or additions to equity. Thus,

$$\rho_t P_t^I K_t = \sum_n i_{t,n}^D P_t^D D_{t,n} + i_t^E P_t^E E_t \tag{9}$$

where

i_n^D = interest rate paid on loan/debt security type *n*;
$P^D D_n$ = net value of liability in loan/debt security type *n*;
i^E = return on equity (ROE);
$P^E E$ = value of equity.

The return to financial instruments held by households is derived from the return to the underlying income-generating assets K_t. This is true even when the intermediation process has multiple stages. Each stage involves a transaction in which an intermediate instrument is transferred from seller to buyer, and therefore valuation equations like (2) and (7) at each stage. For example, a pension plan may hold the assets of different managed funds, which may themselves hold the pooled assets of other funds, as well as options and other derivatives. The financial instruments held by households are the last stage in the chain, whatever its length and complexity, but the connection between saving to investment still occurs.

A great deal of simplification is achieved under the conditions of the Modigliani-Miller Theorem, which states that the value of the firm (6) and the income generated by its operation (in

(7)) are independent of the debt-equity ratio. By implication, net worth is independent of the degree of leverage. In the M&M world, the complexity of the financial instruments generated in the financial intermediation process hardly matters since all are, in principle, equivalent to the all equity case. However, there is little opportunity for assets bubbles to form and burst, as they have done twice in the last decade and a half in the U.S. Nor is there much scope for one of the main contributors to the second bubble, excess leverage funded by a mismatch in the debt maturities on the asset a liabilities sides of the balance sheet. For this reason, we now turn to the question of how to account for periods of financial market disequilibrium while retaining the essential structure of the accounting models.

IV. Disequilibrium Effects in the Circular Flow Model.

An accounting system based on the assumption of perfect foresight would not seem to be the ideal system for handling assets bubbles. Investment decisions may embody all the available information, available *ex ante*, and arbitrage may bring valuation equations like (2) and (7) into equilibrium, leading to *ex post* revaluations. However, the arbitrage processes may not function smoothly or rapidly in complex financial systems with limited information about the short-run value of financial instruments, or about the reliability of the counterparties involved in certain transactions. In such cases, valuations base on equations like (2) and (7) may diverge, even though they are based on the same income generating asset. The mark-to-market versus hold-to-maturity divergence that occurred during the financial crisis is an example of this disconnect, as are the liquidity problems faced by some lenders who engaged short maturity borrowing to fund longer maturity investments.

Tobin's average *q* is a useful statistic for examining disequilibrium in the accounting model set out in the preceding section. Tobin's average *q* is defined in the CFM context as the ratio of the value of consumer wealth to the value of the income-generating capital held by businesses, or in the notation of the preceding section:

$$q = \frac{P_t^E E_t + P_t^D D_t}{P_{t,0}^I K_t + F_t^B} = \frac{W_t}{V_t} \quad . \tag{10}$$

In the "perfect" M&M world, arbitrage drives the value of *q* to an equilibrium value of one.[8] Neither the degree of leverage or complexity and indirectness matters in equilibrium.

Periods of disequilibrium in the financial markets are another matter. Estimates of Tobin's average *q* from the Flow of Funds accounts show a great deal of volatility over the business cycle, and during the period of the technology bubble of the late 1990s. Thus, the hypothesis that *q* is always at its theoretical value (one, when all assets and liabilities are accurately measured) is empirically untenable, and it is therefore reasonable to ask where in equation (10) the disequilibrium occurs. A look back at the preceding equations reveals that there are three good candidates: the real asset pricing equation (2), the financial asset pricing equation (7), and the Modigliani-Miller balance equation (8).

The asset pricing equation (2) assumes complete arbitrage purchase price of an asset, $P^I_{t,s}$, and the discounted present value of the income expected over its remaining life. The latter is a forecast that can turn out to be wrong, and the value of an asset of vintage *s*, $P^I_{t,s}$, changes with the shift in expectations. Recall, however, that the arbitrage also implies a relation between the vintage asset price and the price of new assets, $P^I_{t,s} = (1-\delta)^s P^I_{t,0}$. The new asset price varies only a little over the business cycle and for this equality to hold, most of the required adjustment

[8] The study by Hayashi (1982) derives a set of conditions under which the marginal and average *q*'s are equal.

must come from the quantity of capital (e.g., less capital means a higher marginal product and thus higher shadow prices, $P^I_{t,s}$). A problem arises because capital stocks are hard to adjust rapidly during periods of economic volatility, and this rigidity is reflected in equation (4) by a potential disconnect between the replacement-cost value of capital on the right-hand side and the implied market-to-market value of the other side. The result of this disconnect is that there are two possible values of average *q*, with the replacement cost variant typically exhibiting less volatility that the mark-to-market version.[9]

A disconnect can also occur in the numerator of the ratio (10), which is based on the financial asset pricing equation (7). Here, too, a period of cyclical economic volatility can led to a disequilibrium between mark-to-market valuation and hold-to-maturity value. The case of financial instruments differs from the problem of real asset valuation because the former tend to be traded in active secondary markets and are often held for relatively short periods of time. Arbitrage in these markets can thus be expected to operate more rapidly, but the experience of the tech and housing bubbles, and the financial crisis, suggest that market imperfections can persist. One source of these imperfections is the complexity of financial instruments and a lack of transparency about risk, combined with the principle-agent problem, which can lead to periods of exuberance or panic during which the willingness to pay for an instrument is driven by factors other than intrinsic value. The cyclical volatility of the price-earnings ratio of equities bears witness to the swings.

Increased complexity and nontransparency may also lead to a significant disconnect between the numerator and denominator of the *q*-ratio, and this potential is increased by the

[9] Replacement-cost accounting is used in the construction of the *q*-ratio out of data necessity, though owner-occupied housing is an exception because of the rich data on sales of existing homes. The replacement-cost problem is exacerbated by the use of an exogenous time-invariant estimate of the depreciation rate δ (again, out of necessity), and the stock K_t,, computed suing equation (1), does not exhibit a great deal of cyclical volatility. The main volatility comes from the price component of $P^I_{t,0}K_t$ and the most recent investment vintages K_t.

growth in the degree of financial intermediation. As the number of financial instruments separating the productive asset in (7) and the final instrument held by the household grows, so do the number of market transactions for the intermediate instruments. A separate q_i ratio exists (in principle) for each stage in the intermediation process, defined as the ratio of the value perceived by the owner of the asset and the value as perceived by the receiver of the asset. The stages are not independent, in the sense that the separate q_i ratios refer back to the value of the same income-generating asset. For illustration, the case in which the quantities of K_t and E_t are normalized to one, and bid and ask values are the same,

$$P^E = (q_N \times q_{N-1} \times \ \ldots \ \times q_1)P^I = qP^I \ . \tag{11}$$

Under perfect conditions, each of the sub q's may equal one. However, the longer the chain of intermediation, the larger the N, the more likely is it that last sub q's in the chain will depart from a value of one.

How is this disequilibrium treated in the conventional accounting framework? The change in the q-ratio involves accounting revaluation is both the numerator and denominator: thus

$$\begin{aligned} \Delta q_t &= \Delta W_t - \Delta V_t \\ &= P_t^E \Delta E_t + \Delta P_t^E E_t + P_t^D \Delta D_t + \Delta P_t^D D_t - P_t^I \Delta K_t + \Delta P_t^I K_t \quad . \end{aligned} \tag{12}$$

When q is equal to one, the revaluation of wealth is associated with a revaluation of capital. A drop in the value of equity reflects some change in the value of owning the underlying capital (conversely, an increase in the value of capital through retained earnings will increase the value of equity). When q is not equal to one, Δq_t becomes part of the revaluation account.

V. Empirics and Disequilibrium Effects

Just how large is this disequilibrium implied by a non-unitary value of q? We have calculated the ratio for the years from 1960 to 2012, for the consolidated total private sector, i.e., it includes assets held by households and nonprofit institutions as well as business. Our estimates are based on data from Flow of Funds and Integrated Macro Accounts, transformed to reflect the two-sector framework of the CFM and the q equation (10). These transformations are somewhat involved, given the five-sector organization of the data, and the equilibrium-orientation of each of these sectoral accounts. Our estimates exclude the government and foreign sectors, but an adjustment is made for intangible capital. The intangible capital (e.g., R&D) created on own-account within firms is not recognized as an asset by financial accounting practice or, until recently, in national income and wealth accounting practice. Without a correction for this, part of the denominator of the q ratio is effectively ignored. Research over the last decade has shown that this omission is quite large. Corrado and Hulten (2010) show that investment in broad-based measure of intangible capital in the U.S. nonfarm business sector (one that included far than just formal R&D) grew steadily over the period 1977-2010, starting from around 8 percent and reached nearly 14 percent by the end of the period (with an acceleration starting with the ICT investment boom of the 1990s).[10]

The resulting q ratio is shown in Figure 3. It is essentially the value of household net worth (the sector's direct holdings of nonfinancial assets plus its net financial holdings) and the

[10] In a study of the price-to-book ratio (a form of the q ratio) of more than 600 U.S. firms in the Compustat data base that reported performing R&D, Hulten and Hao (2008) found that the conventional equity reported on the financial statements accounted for only 42 percent of the ratio, suggesting that the measured q-gap is quite large. However, when own-account intangible assets were added to the balance sheet, the combined value accounted for 86 percent of the gap.

denominator is the value of all private nonfinancial assets at replacement cost. Debt holdings are now almost completed consolidated in the numerator of this *q*-ratio, although the numerator is a bit more complicated because it still includes foreign financial claims against U.S. nonfinancial assets. The *q* ratio shows a steady rise starting in the late 1980s and an acceleration in the mid-1990s, leading to a peak in 2000 some 20 percent about the baseline value of one. This was followed by a sharp decline associated with the "tech wreck", with *q* falling back to the latter. This pattern is mainly due to the stock market value in the numerator of the *q* ratio, since the value of the capital (the stock times its replacement cost) changed more slowly and smoothly.

The value of *q* then began to rise again, retracing its 20 percent rise to its peak in 2007, followed again by a crash as the housing bubble burst and the financial crisis took hold. It has risen from its trough of around 0.90 to its 2012 value of around 1.10. The volatile pattern of the *q* ratio over these 20 years tracks fairly closely the volatility of the assets markets over the same period.

A persistent problem in valuing the stock of capital used in the denominator of the average *q*-ratio is that very little data are available on the price of vintage assets on which to base revaluations, or on the amount of capital in each vintage that survives. A perpetual inventory method like that in equation (1) is typically used to circumvent this, but the weights assigned to each vintage are constant parameters that do not vary when economic conditions change. One consequence is that the *q*-ratio may be biased over the business cycle. The dashed line in Figure 3 attempts to correct for this bias in the one class of business capital for which an adjustment can be made, business real estate. The difference between the modified *q*-ratio of the dashed line and the conventional solid line arises from a "marked to market" adjustment in the denominator of the ratio. The increase in the modified *q*-ratio in the period preceding the financial crisis

(2003 to 2007) now appears muted, rising to a value less than 1.10 before falling to the trough value of around 0.9. However, while the adjusted *q* estimate implies a muted volatility over the 2004-2008 period, it also implies increased volatility in the period that followed, with a value of *q* moving back toward 1.20. This pattern is consistent with the rise in the stock market over this period of time, pushing up the denominator while the slow recovery in real estate prices held back the growth in the denominator.

D. Debt and Leverage

The Modigliani-Miller Theorem implies that leverage is not a determinant of asset valuation and should not affect the equilibrium value of *q*. However, many observers have pointed to a high degree of leverage in many of systemically important financial institutions as a factor that greatly deepened the financial crisis. Curiously, the balance sheet data that are available from Integrated Macroeconomic Accounts did not reveal the risks that were building on financial business balance sheets during the period leading up to the financial crisis (Palumbo and Parker (2010)). Part of the difficulty owes to the aggregate nature of instruments in these accounts; another lies in their lack of information on the market values of debt. Although not all assets of financial businesses that were held in the form of debt securities were illiquid, the much discussed maturity mismatch and build-up of short-term debt at systemically important institutions is not very evident in these data.

The upper panel of Figure 4 depicts simple leverage ratios based on the balance sheet information for the three major business sectors in the IMAs. For each major sector total assets/liabilities as a multiple of the value of equity is shown, i.e., the following ratio is calculated:

(13) $$LVr = (\sum_n P^D D_n + P^E E) / P^E E \ .$$

The value of LVr for financial intermediaries as a whole (financial business) is shown on the right scale, and exhibits no evidence of over-leverage, consistent with Palumbo/Parker. It should be noted that leverage ratios for individual banks calculated using total assets as a multiple of tangible common equity are one of the most basic measures of capital adequacy used in the regulatory analysis of banks and is similar to the ratio we calculate.

The bottom panel shows ratios for households as homeowners (household "business") and for the household and nonprofit institutions sector as a whole. As may be seen the former ratio (plotted on the right scale) spiked beginning in 2006, and both show a building of leverage beginning in the late 1990s. This finding also consistent with Palumbo/Parker, who concluded that households' rising levels of leverage were very evident in these data. Also seen in Figure 4 is a large spike in the ratio for noncorporate business. Note, however that this spike did not occur until 2008, after the onset of the crisis and two years after the jump in homeowner leverage.

V. Conclusion

The basic assumption that underpins our analysis is that the current financial crisis is essentially a disequilibrium phenomenon precipitated by the inflation and subsequent bursting of the housing price bubble, and magnified by the growing complexity and lack of transparency of financial sector activities. While there are those who do not share this assumption, it is backed by a significant amount of evidence. If correct, it has some implications for national income accounting, asset valuation, and productivity measurement.

First, the centrality of financial intermediation for the functioning the economy needs to be recognized more clearly in accounting practice. We have addressed this problem by placing the financial intermediation process at the center of a modified Knightian circular flow model (our Figure 2). In this modified framework, nonfinancial businesses and households are linked by financial intermediaries, rather than treating these intermediaries as just another resource-using industry. Recognition of this link helps explain how shocks that affect even small parts of the economy can propagate rapidly and widely.

We argued that technical change in the form of new products and processes has greatly affected the financial intermediation linkages, increasing the complexity and decreasing the transparency of the intermediation process. This, in turn, increased the likelihood that a shock to the economy that can cause a disconnect between the valuation of capital by businesses and associated wealth of households. This disconnect is formalized by Tobin's average *q* model, which we link to the increased degree of complexity of the intermediation process and to the mark-to-market problem of the financial crisis. We then estimated the degree of disequilibrium by measuring the *q* ratio using leverage and found that it did indeed increase during the years before the financial crisis. However, we also found that when both the numerator and denominator of the *q* ratio are adjusted to a mark-to-market basis, the increase in the ratio is attenuated for the pre-crisis years, but is enhanced during the years thereafter. We also found that the degree of leverage, often implicated as a major cause of the financial crisis, was mainly a problem in the household and non-corporate business sectors.

What are the implications for national income accounting? If one objective is to spot, or at least, track, emerging asset bubble, the assumption of asset market equilibrium is unhelpful. Tobin's average *q* is not equal to one during periods of financial market disequilibrium, and

imposing the assumption *a priori* assumes away much of the problem even as it lurks in the data. During periods of disequilibrium, *q* becomes an important variable in the revaluation account of the national accounting structure. There also needs to be a clearer functional division of economic actively into consumption (household) and production (business) components, and a parallel distinction between wealth and capital stock. The functional arrangement of economic activity, as in the CFM, permits the more plausible treatment of owner-occupied housing (also of other owner-utilized capital), in which the housing ownership function is located in the production sector and the consumption of services of from the same asset is located in the household sector.

Whether or not this functional disequilibrium framework would have been able to spot the approach of the financial crisis is another matter. National accounting data are highly aggregated and comingle many factors and trends. They are not inherently good diagnostic instruments for spotting emerging problems and, moreover, are no better than the analysis that they inform. That said, diagrams such as Figure 3, with its unconventional adjustments, might have supplied analysts with some useful clues.

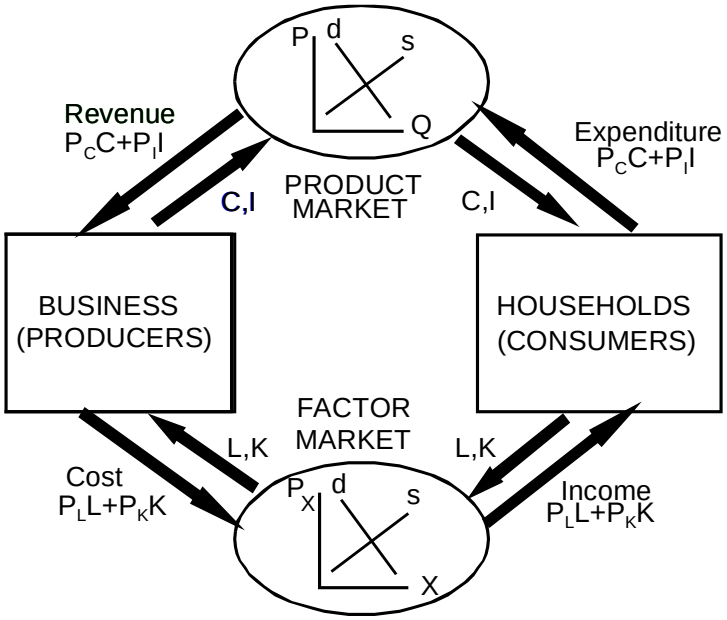


FIGURE 1

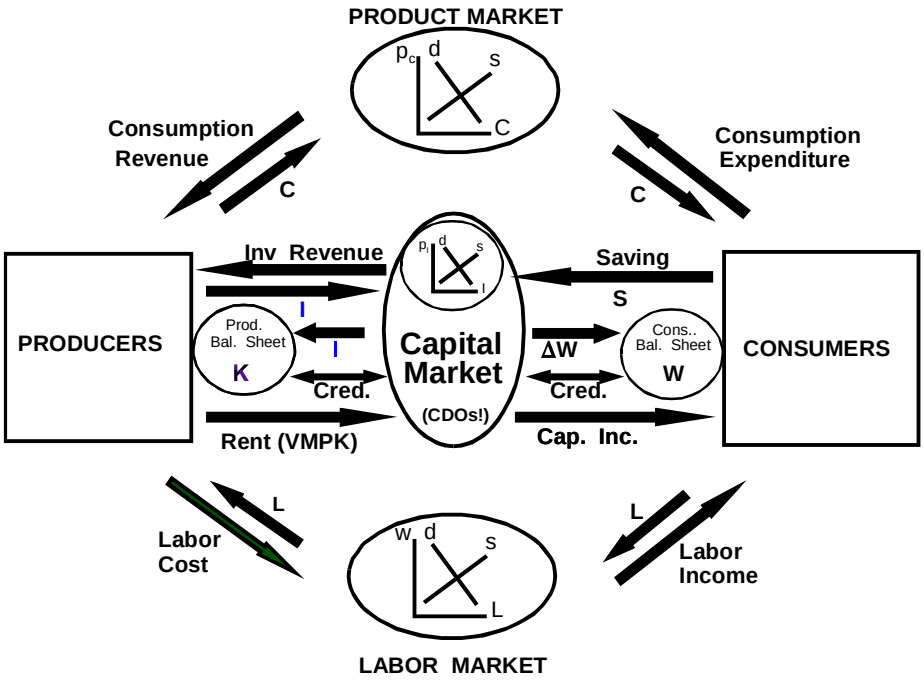
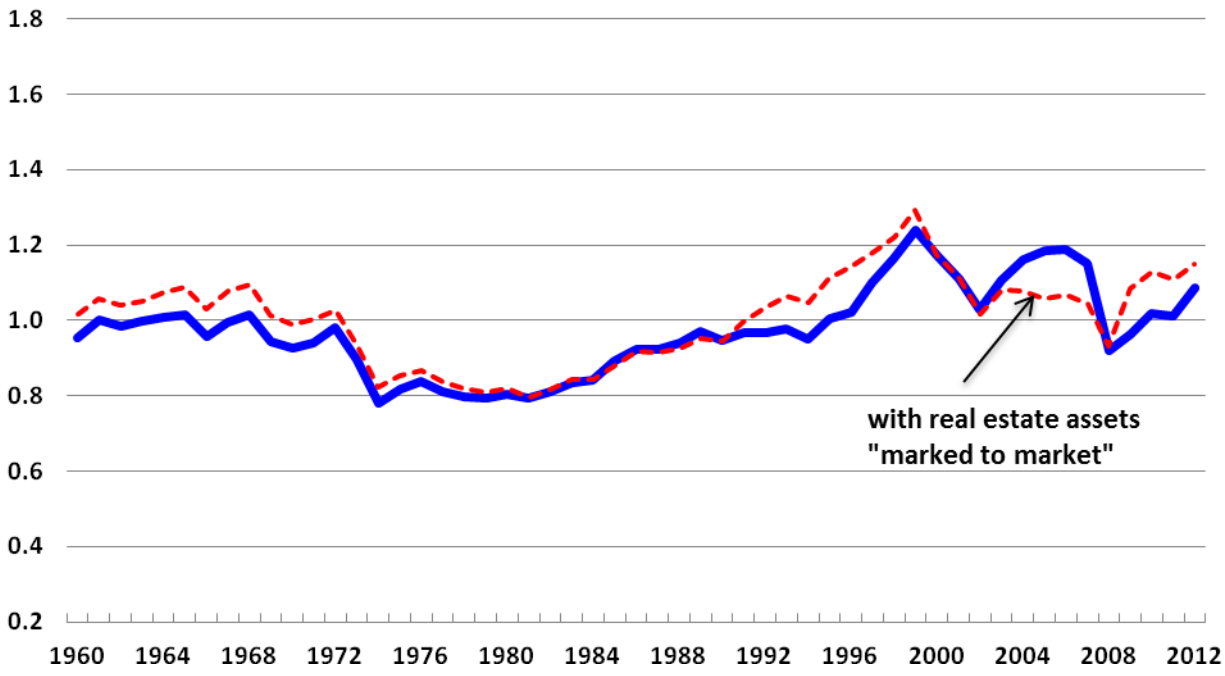


FIGURE 2

Figure 3

Private sector Q:
Value of aggregate financial claims relative to replacement cost of all privately held assets, 1960 to 2012

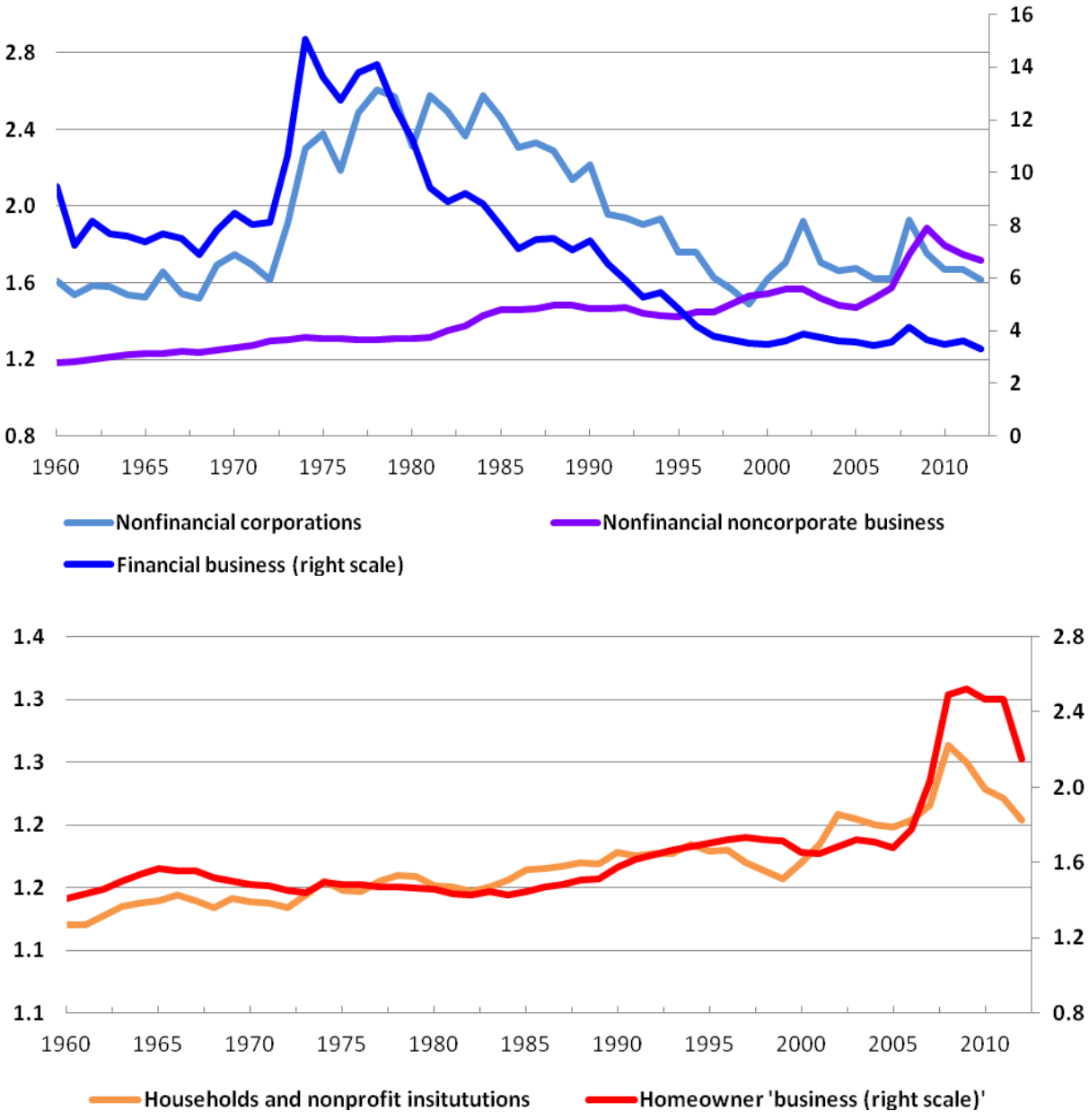


NOTES—The value land is not included in replacement cost measures. To account for this on the level of the Q ratio, the ratio in 1987 is indexed to a ratio calculated using real estate assets at market value in that year. The actual series for ratio using real estate assets at market value is plotted as the red dashed line.

SOURCES—Author calculations using data on the replacement cost of productive assets in the Flow of Funds and Integrated Macro Accounts (as of 3/9/12 on the Federal Reserve website) and the value of financial claims developed from the same data. The replacement cost of productive assets includes an estimate of the value of intangible assets not included in these data. The intangible asset estimate is an unpublished update to Corrado and Hulten (2010) and Corrado, Hulten, and Sichel (2009). The value of financial claims is calculated by consolidating debt across the three business sectors (nonfinancial corporations, nonfinancial noncorporate and financial business) and thus only reflects holdings of corporate bonds and agency- and GSE-backed securities by households, governments, and rest of world. Equity equals the market value of domestic corporations plus net equity in mutual funds and money market funds plus noncorporate equity plus foreign direct investment in the United States less U.S. direct investment abroad by domestic corporations. Debt estimates are at market value based on information from S&P for corporate bonds and from Bosworth (this volume, table 1) for ABS issues.

Figure 4

Financial Claims against U.S. Sector Assets:
Value of sector equity plus debt relative to value of equity,
1960 to 2012



NOTE—Homeowner 'business' refers to owner-occupied housing, and its numerator and denominator are included in the ratio for the overall household and nonprofits sector.
SOURCE—Author calculations using Flow of Funds (table B100) and Integrated Macroeconomic Accounts sector balance sheet data reported on the Federal Reserve website (as of 3/9/2013).

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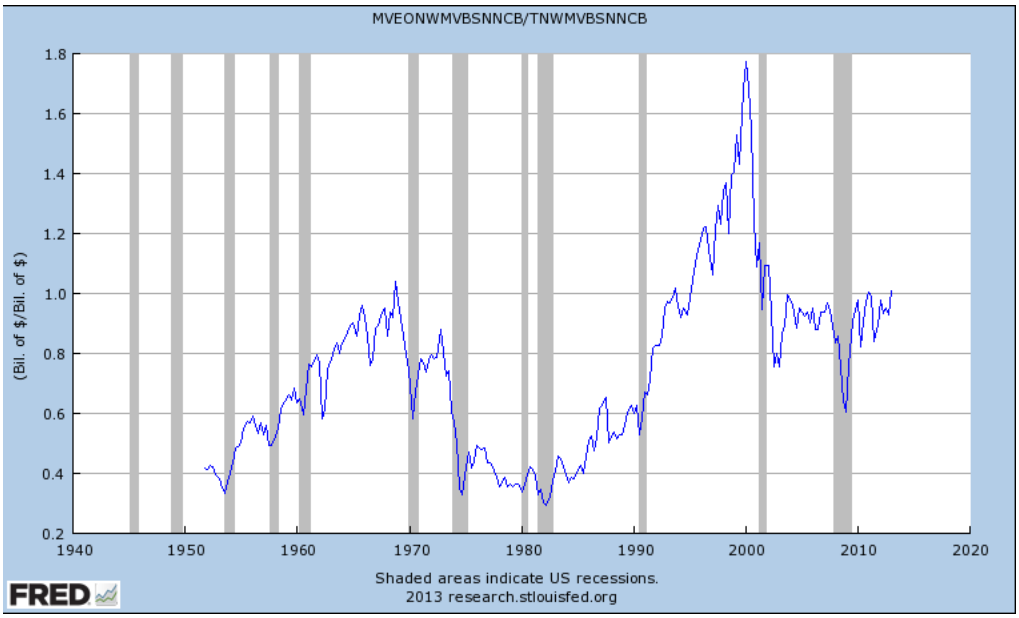
MVEONWMVBSNNCB/TNWMVBSNNCB
(Bil. of $/Bil. of $)
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1940
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Shaded areas indicate US recessions.
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