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Working Paper No. 654

Measuring Macprudential Risk: Financial Fragility Indexes

by

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ABSTRACT

With the Great Recession and the regulatory reform that followed, the search for reliable means to capture systemic risk and to detect macrofinancial problems has become a central concern. In the United States, this concern has been institutionalized through the Financial Stability Oversight Council, which has been put in charge of detecting threats to the financial stability of the nation. Based on Hyman Minsky's financial instability hypothesis, the paper develops macroeconomic indexes for three major economic sectors. The index provides a means to detect the speed with which financial fragility accrues, and its duration; and serves as a complement to the microprudential policies of regulators and supervisors. The paper notably shows, notably, that periods of economic stability during which default rates are low, profitability is high, and net worth is accumulating are fertile grounds for the growth of financial fragility.

Keywords: Financial Fragility; Financial Regulation; Financial Crises; Macroprudential Risk; Debt-Deflation Process; Ponzi Finance

JEL Classifications: E32, G01, G18, G28, G38

INTRODUCTION

Over the past decade, economists have progressively recognized that macroprudential analysis is an important tool for financial regulation and supervision. Today, in the United States, the Financial Stability Oversight Council (FSOC) established by the Frank-Dodd Act is in charge of “identifying threats to the financial stability of the United States” and so needs to develop a comprehensive framework to understand and measure financial fragility. The paper contributes to the measurement of financial fragility by developing an index that captures the growth of financial fragility in macroeconomic sectors.

In order to do so, the paper uses the analytical framework of Hyman P. Minsky. Minsky argues that the degree of financial fragility of an economic unit can be conceptualized by defining three categories—hedge finance, speculative finance, and Ponzi finance. At the macroeconomic level, each category reflects the propensity of financial problems to generate a debt-deflation process, with Ponzi finance reflecting a high debt-deflation risk. Several authors have already used Minsky’s analysis to develop indicators of financial fragility, the current paper further contributes to the research by building an index that uses macroeconomic datasets that are widely available in the United States.

The paper shows that financial fragility was growing rapidly in the financial business sector and the household sector since 2003, whereas the growth of financial fragility was limited in the nonfinancial nonfarm corporate sector until late in 2006. The first part of the paper defines financial fragility and briefly reviews the work that has been done in the context of Minsky’s framework. The second part of the paper presents the methodology used to develop the index. The third part of the paper presents the index for the household sector, the nonfinancial nonfarm corporate sector, and the financial business sector. The final part concludes.

MEASURING FINANCIAL FRAGILITY: DEFINITION, PURPOSE, AND REVIEW

Defining Financial Fragility

In order to develop a financial fragility index, one must have a conceptual definition of what is being measured. There are macroeconomic and microeconomic aspects to financial fragility. At the microeconomic level, financial fragility broadly means that elements on the liability and/or

asset side of the balance sheet (on- and off-balance) are highly sensitive to changes in interest rate, income, amortization rate, and other elements that influence the liquidity and solvency of a balance sheet. In this case, not-unusual fluctuations in those variables create large financial difficulties. As shown below, the flip side of this high cash-flow sensitivity is a high expected reliance on refinancing sources (high refinancing risk) and/or asset liquidation at rising prices (high liquidity risk).

At the macroeconomic level, financial fragility can be broadly defined as the propensity of financial problems to generate financial instability. Financial instability is an economic state in which financial problems tend to affect employment and price stability. Ultimately, financial instability manifests itself in the form of a debt-deflation process; therefore, financial fragility can be defined as the propensity of financial problems to generate a debt-deflation process.

These broad microeconomic and macroeconomic definitions can be made more precise by taking the definition developed by Minsky. He noted that there are three different degrees of financial fragility when economic units are indebted: hedge finance, speculative finance, and Ponzi finance. Hedge finance means that an economic unit is expected to be able to pay its liability commitments with the net cash flow it generates from its routine economic operations (work for most individuals, going concern for companies). Thus, even though indebtedness may be high (even relative to income), an economy in which most economic units rely on hedge finance is not prone to debt-deflation processes, unless unusually large declines in routine cash inflows and/or unusually large increases in cash outflows occur. Even then, cash reserves and liquid assets are usually large enough to provide a buffer against unforeseen problems.

Speculative finance means that routine net cash flow sources and cash reserves are expected to be too low to pay the capital component of liabilities (principal servicing, margin calls, and others). As a consequence, an economic unit needs either to borrow funds or to sell some less-liquid assets to pay liability commitments. This state of financial fragility is especially common among economic units, like commercial banks, whose business model involves funding the ownership of long-term assets with short-term external sources of funds, and so requires constant access to refinancing sources to work properly.

Ponzi finance means that an economic unit is not expected to generate enough net cash flow from its routine economic operations (NCF_O), nor to have enough cash reserves to meet the

capital and income servicing due on outstanding financial contracts (CC). At time 0, it is expected that the following applies until a date n :

$$E_0(NCF_{0t}) < E_0(CC_t) \quad \forall t < n$$

Note that this implies that Ponzi finance involves what Minsky called (defensive) position-making operations, i.e., refinancing and asset liquidation. More precisely, Ponzi finance relies on an expected growth of refinancing loans (L_R), and/or an expected full liquidation of asset positions at a growing asset prices (P_A) in order to meet debt commitments on a given level of outstanding debt (L).

$$E(CF_{PM}) = \Delta L_R + \Delta P_A Q_A > 0 \text{ and } \Delta(E(CF_{PM})/L) > 0$$

At the microeconomic level, an economic unit that uses Ponzi finance to fund its asset positions is highly financially fragile. At the macroeconomic level, if a majority of economic units is involved in Ponzi finance the economic system is highly prone to debt-deflation because position-making risk (i.e., unavailable refinancing sources and decline in market liquidity) is high.

Purpose of Measuring Financial Fragility

The main purpose of measuring financial fragility is to provide financial regulators with a means to understand how the financial practices economic units use to acquire assets are changing and how they promote financial instability. This would allow regulators to intervene in a proactive fashion in order to stop dangerous funding practices.

The need for a conceptual framework and a measure of financial fragility has been illustrated very clearly during the housing boom. From at least 2004, most households and financial institutions were engaged in mortgages practices that involved negative amortization, expectations that refinancing at low interest rates would be available to service debts, underwriting based on rising home prices, and other practices that contributed to higher risk of financial instability, i.e., higher financial fragility. During the housing boom, all this, as well as fraud, was the common practice across the board in the mortgage industry (Tymoigne 2009b;

Wray 2009; Black 2009). While regulators did express concerns about those practices in the subprime sector, their capacity and willingness to intervene was limited by the conceptual framework that they had in mind, coupled with strong lobbying from the financial industry (Tymoigne 2011). In addition, they completely ignored the same dangerous practices that were going on in the prime mortgage sector. In the end, regulators convinced themselves that everything was fine because default rates recorded historical lows, homeownership was rising, bank profits were hitting record highs, and financial markets were assumed to be efficient. However, low default rates and high profits were only possible because of the loose underwriting standards in all segments of the mortgage industry—prime, alt-A, and subprime.

If regulators had a means to recognize changes in funding practices toward rising financial fragility, it would provide them with a signal that, maybe, low default rate and rising profitability are not necessary a sign of financial health/strength, and that some interventions may be needed to curtail financial practices that promote financial instability. This may involve intervening long before a recession is in sight and even if there is no bubble. All this is, of course, pretty typical of the way regulators intervene, but it is worth emphasizing a bit more because it is critical for effective regulation and supervision.

Firstly, the point of detecting financial fragility is not to detect financial crises or economic recessions but rather to intervene proactively to prevent the crisis from occurring, or at least limit their significance. There is a large body of literature that focuses on developing early warning systems for financial crises (Tymoigne 2010; Galati and Moessner 2010). Ultimately, the search for these systems has not proven terribly successful for at least two reasons. First, when an economy is financially fragile there are many different sources of risks that can be very complex and/or impossible to measure because of lack of data. More importantly, even usual fluctuations in income, asset prices, and other variables can lead to a crisis, and the triggering of a crisis can be based on unpredictable changes in the sentiments of economic agents. As Bell (2000) notes, most banking crises involve, at least in part, random triggers that are impossible to predict. Thus, rather than focusing on predicting the size or timing of financial crises (something probably impossible to do), a more productive analysis should focus on the growth of financial fragility during periods of economic stability. Second, significant economic and financial crises do not just happen; there is a long process during which the economic and financial system becomes more fragile. The point of detecting financial fragility is to provide a means to capture

the process of fragilization so regulators can intervene before problems accumulate to the point that a debt deflation becomes likely. More broadly, by measuring financial fragility, one puts position-making risk, and so risk of debt deflation, on the radar screen of regulators—something that they have had a tendency to ignore.

Secondly, the point of detecting financial fragility is not to detect asset-price bubbles. Indeed, the three degrees of financial fragility are defined independently of the accuracy of the asset pricing mechanism. As shown above, the cash-flow definition of Ponzi finance (income lower than debt service) has a corollary balance-sheet definition. This is enlightening when one wants to distinguish bubble and Ponzi finance because the latter does not require the existence of a bubble (i.e., that P_A be above its “fundamental” value, however defined); it just requires rising prices of collateral assets or other assets held by the entity involved in a Ponzi process. The latter condition is required for cheap refinancing to occur and/or to liquidate at a price that covers debt services. More broadly, for Ponzi finance to occur, net worth should be rising but that does not tell us anything about the existence of a bubble. This is, however, not a problem because this is not what financial fragility aims at detecting; the aim is to detect debt-deflation risks that result from the interaction between debt and asset value on the upside. Thus, an economy may be highly fragile even if there is no bubble, and a bubble may exist but financial fragility may be limited because of the limited recourse to external funding. In that case, a debt-deflation process is not possible given that debt is not involved, or is of limited size. An example of this would be the current housing bubble in China, which is mostly self-funded. A decline in home prices will have an impact on the economy but it will be limited, and the size of the decline itself may be limited given the limited need to liquidate housing to pay outstanding debts.

Brief Review of Past Work

A more substantial review of the measure of financial fragility and discussion of macroprudential risk is available elsewhere (Galati and Moessner 2010; Tymoigne 2010; Schroeder 2008, 2009). This section focuses briefly on the papers that have used Minsky’s theory to develop a measure of financial fragility. Several studies have been conducted in this framework of analysis and they can be separated in two categories. The most straightforward studies analyze the trend of several variables and check how they help to explain recessions. The second set of studies uses the hedge, speculative, and Ponzi categories and aims at detecting one or more of these categories.

In the first set of categories authors usually find that leverage increases and liquidity decreases during periods of expansion (Minsky 1977, 1984, 1986; Sinai 1976; Niggle 1989; Wolfson 1994; Grabel 2003; Estenson 1987). Leverage and liquidity are measured by looking at several balance sheet ratios, like debt-to-income ratio, proportion of short-term debts, debt-service-to-income ratio, the proportion of cash, and other liquid assets. By studying the Great Depression, Isenberg (1988, 1994) finds that, instead of being recorded at the aggregate level, the fragilization of the economy can be localized within the most dynamic part of the nonfinancial business sector. Minsky (1984) notes that the nonfinancial business sector may not be at the source of the fragility, but rather the household sector or the government sector may be the main contributor to the risk of a debt-deflation process.

The second group of authors has developed a more elaborated strategy that aims at detecting the different stages of financial fragility. Some of them develop methods to detect all three stages (Schroder 2009; Foley 2003). Other authors focus their attention on detecting a specific stage of fragility, like Ponzi finance (Seccarecia 1988), or an overall index of fragility that shows overall position-making risk (i.e., refinancing risk and liquidation risk) (De Paula and Alves 2000). This paper contributes to this second group of studies.

FINANCIAL FRAGILITY INDEX: CONSTRUCTION AND INTERPRETATION

Construction

In order to build the index, Ponzi finance is taken as a point of reference. Ponzi finance was defined above, and in much more detail elsewhere (Tymoigne 2009a, 2010). As shown above, the cash-flow definition implies a corollary balance-sheet definition of Ponzi finance. Whenever possible, the index tries to capture as many elements of these two facets of Ponzi finance as possible. One of the main goals, therefore, becomes to identify what type of variable would do that best.

Following Minsky's framework the goal is to build an index using macroeconomic variables that are related to the funding methods. Two major datasets are the Flow of Funds of the Federal Reserve Board and the National Income and Product Accounts (NIPA) of the Bureau of Economic Analysis, but there are additional datasets used. All data are available on a quarterly

basis and each of them is smoothed by calculating a four-quarter moving average. Once this is done, a quarterly annual growth rate is calculated on the basis of the moving average data.

Once the needed variables were found the next step was to assign a weight to each of them. Given that Ponzi finance is the point of reference, greater weight is given to variables that more directly reflect refinancing and liquidation pressures. Note that Minsky's framework gives us some clues about ordinal importance of different variables to measure fragility, but does not give any clue about their cardinal importance so some arbitrariness enters in the actual value given to the weights. As stated below, the trend of net worth or debt, while relevant, is not in itself a sign of problem and so is given a smaller weight. On the contrary, variable like debt-service ratio, refinancing volume, and proportion of liquid assets relative to debt are assigned a greater weight. At the same time, however, the importance given to those variables depends on how well the data reflect refinancing pressures and liquidation pressures. Thus, overall the weight given to a specific variable will vary in function of its importance relative to the definition of Ponzi finance and in relation to its reliability. This, of course, leaves some space for arbitrariness.¹

Before leaving this section a bit more needs to be said about the relevance of the trend of net worth (or the debt-to-asset ratio) and so the weight attributed to it in the index. Minsky noted: "With speculative finance, net worth and liquidity can increase even as debt is refinanced, whereas for a Ponzi unit net worth and liquidity necessarily decrease" (Minsky 1986: 340).

While ultimately Ponzi finance does lead to a decline in net worth, this decline in net worth will not be recorded in data until defensive position-making operations actually occur. Moreover, if assets are valued on a market basis, and if their prices grow fast enough to compensate for higher debt or lower liquid assets, the decline in net worth can be avoided (Minsky 1964: 213ff.). In that case, the solvency of economy units involved in a Ponzi process may depend highly on the continuation of rising asset prices, rather than on the capacity to generate an income from the ownership of the asset. Thus, Ponzi finance requires that net worth grow to be successful and to be perpetuated, especially if there is no expectation that income from the use of assets will ever cover debt commitments. Indeed, refinancing at low costs (in

¹ In order to check briefly the sensitivity of the index to changes in weights, the annex shows what the index would look like if all variables had the same weight. The main implications would be a higher growth rate of financial fragility on average with a similar pattern overall.

terms of interest rate but also in terms of downpayment) cannot occur if net worth goes down; and if net worth goes down liquidation of assets makes it difficult to cover outstanding debts.

Overall, net worth is of limited usefulness to detect financial fragility. Indeed, rising net worth is not necessarily a sign of financial health, and the inverse is true too—declining net worth is not necessarily a sign of financial problems. In fact, an economic unit involved in Ponzi finance is guaranteed to record very high short-term profits and so a very high increase in net worth for a short period. This is what was observed before the S&L crisis and the Great Recession (Black 2005; Tymoigne 2009a). In the latter case, the net worth of households and financial institutions grew very rapidly. However, the greater the use of Ponzi finance, the lower the quality of leverage, and so the greater the chance that, when refinancing channels close, a large decline in net worth will be recorded that may put an economic unit into insolvency. This state of insolvency, however, is not a signal of fragility but a consequence of fragility. In the end, to detect the use of Ponzi finance, *rising* net worth should be used as a criteria because rising net worth is what allows borrowing based on the expectation of the availability of refinancing sources and/or asset liquidation to meet debt services, at least until income from the holding of assets is expected to become high enough, if ever.

Interpretation

At the macroeconomic level, financial fragility will grow over time because of two effects: the compounding effect and the volume effect. Compounding effect refers to the length of time economic units have been involved in Ponzi finance. As the length of time increases, refinancing needs and liquidation needs grow because the size of interest payment due grows exponentially. The volume effect refers to the fact that as more people are involved in Ponzi finance, financial fragility grows given the time during which Ponzi finance was used. Therefore, the longer and more widely Ponzi finance is used, the more destructive the debt-deflation process will be if it occurs.

The goal of the index is to capture both effects by capturing changes in funding methods that promote financial instability. Thus, rather than measuring a state of financial fragility, it captures changes in the funding methods that economic units use to fund their activities. The bigger both effects are, the higher the growth of financial fragility.

Following Minsky's framework, during periods of economic stability, financial fragility grows and the closer we get to a crisis the more this growth accelerates as more people are involved in a Ponzi process and as the time of the Ponzi finance process increases. When a crisis occurs, the use of Ponzi finance stops, that is, the size of refinancing risk and liquidation risk stops growing and instead materializes itself in a debt-deflation process. The strength of this process depends on how long and how fast financial fragility grew. During a crisis, financial fragility will start to decline as economic units try to "simplify debts," as Minsky noted. However, the fact that financial fragility stops growing does not mean that financial fragility is low. Thus, the index gives us a clue of how strong the risk of debt-deflation is, given the length over which Ponzi finance was used and given the volume of Ponzi finance that occurred prior to a crisis.

Limits

There are conceptual and data limits to the index. In terms of data, the most obvious one is that the index is as reliable as the variables and weights used. As shown below, there are intrinsic limits to the data that have been chosen, which limits their capacity to detect refinancing and liquidation risks. The variables chosen are proxy macroeconomic variables that may overestimate or underestimate actual risks. As explained above, there is some arbitrariness involved in choosing the weights.

In terms of concept, one must remember that Ponzi finance is an expectation about the future. This is important because it does not mean that right now there is a need to refinance or liquidate in order to meet cash commitments. In addition, this state of expectation may never materialize if net cash flows from core operations turn out to be higher than expected, and/or interest rates turn out to be lower than expected, and/or borrowing for a longer maturity than expected is available. In fact, the frustration of expectations is part of the internal dynamics of the financial instability hypothesis. However, if the state does materialize itself and position-making operations are used, the index will capture them.

The fact that expectations are involved has two implications for empirical analysis. A first implication is that Ponzi financial practices will be going on in underwriting procedures before they are captured in actual data about refinancing operations, debt levels, and other variables (Kregel 1997; Suzuki 2005; Knutsen and Lie 2002). Thus, macroeconomic data will

tend to capture the development of Ponzi finance with a delay. In order to deal with this issue, it is therefore important to check how loan underwriting is done, i.e., traditional bank supervision is crucial. Indeed, at the level of each bank, one can understand the nature of the expectations behind the growth of debt and the nature of a Ponzi process, if existent (Tymoigne 2009a, 2011). Two central questions to ask at the microeconomic level are: “will debts be repaid?” (expected default rate and recovery rate) *and* “how will repayment of debts occur?” (sources of cash flows for repayment, and amount of defensive position-making operations needed). As Minsky (1975) noted decades ago, this second question is not asked by current banking supervisors, who mostly focus on detecting fraud and mismanagement.

THE FINANCIAL FRAGILITY INDEX

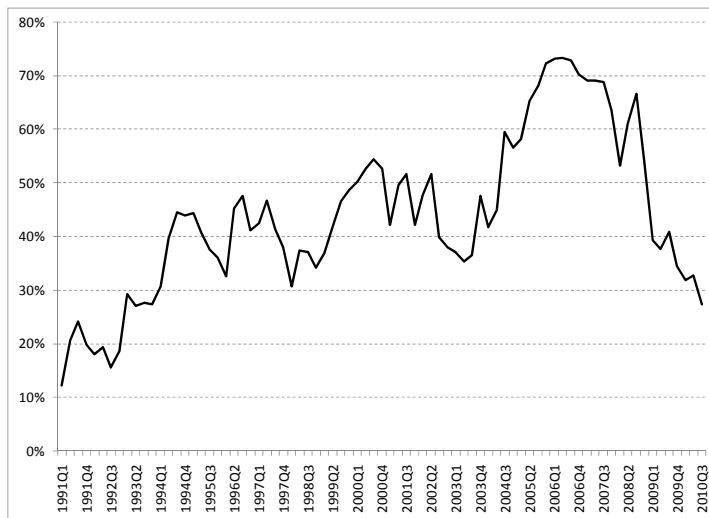
The financial fragility index was constructed for three sectors: household, nonfinancial nonfarm corporate, and financial business. While economic units within the household sector and within the non-financial sector are relatively homogenous in terms of their financial activities, the financial business sector contains financial companies with very diverse financial purposes and methods of operation. This paper will not go further into this point, but it is recognized that later work should clearly separate banking institutions from others. The point of this paper is to show that basic macroeconomic indexes can be developed for each broad sector.

Household Sector

Given the availability of data for the household sector, it was possible to create two indexes. A general index that checks households’ funding practices, and a house funding index that focuses on the financial practices underlying the acquisition of a house.

The overall index includes outstanding total liabilities (L), net worth (NW), debt-service ratio (DSR), monetary instruments relative to outstanding liabilities (MLR) (monetary instruments include dollar-denominated currency, demand and time deposits, and money-market mutual funds shares), proportion of cash-out refinancing mortgage loans in mortgage refinancing loans (COR), and proportion of revolving consumer debts (RCD). All data come from the Federal Reserve Board (Flow of Funds and other datasets) except the cash-out refinance data that comes from Federal Housing Finance Agency and is shown in figure 1.

Figure 1. Proportion Cash-Out Refinance among Refinance Mortgages



Source: FHFA (Loan purposes by quarter: <http://www.fhfa.gov/Default.aspx?Page=87>).

Each data is used to capture some aspects of financial fragility that can be classified into refinancing risk and liquidation risk. L and DSR measure the debt burden and so capture both risks. MLR is used to capture the liquidation risk, i.e., the risk that one needs to sell illiquid assets to meet debt payments. COR and RCD are used to capture refinancing risk.

In order to determine the weight put on each variable the point becomes to figure out which of those variables is able to more accurately measure refinancing risk and/or liquidation risk. As explained above, even though they are essential to financial fragility dynamics (e.g., growing net worth is necessary for Ponzi finance to grow), net worth and outstanding debt are not as good of an indicator of financial problems as the other variables so they are given a lower weight. DSR is the variable that more directly measures the debt burden and so it is given a higher weight. A higher weight is also given to MLR because it is able to more directly capture liquidation pressures. Finally, variables that measure refinancing risk are given a total weight of 30% that is equally split between COR and RCD. The weight put on those variables is not bigger because they are specific to some economic activities (housing and consumption) rather than general to the household sector. Thus, some households are not concerned with them because not all households have a mortgage. As shown below, when specific economic activities are analyzed more weight can be put on refinancing variables if reliable enough.

The index is calculated as followed:

$$I_H = 0.1D_L + 0.1D_{NW} + 0.25D_{DSR} + 0.25D_{MLR} + 0.15D_{COR} + 0.15D_{RCD}$$

With $I_H \in [0, 1]$ and D_X a dummy variable for variable X defined as followed for all variables except MLR:

$$D_X = \begin{cases} 1 & \text{if } g_{X_t} > g_{X_{t-1}} > 0 \\ 0.9 & \text{if } g_{X_t} > 0 \\ 0 & \text{if } g_{X_t} = 0 \\ -0.9 & \text{if } g_{X_t} < 0 \\ -1 & \text{if } g_{X_t} < g_{X_{t-1}} < 0 \end{cases}$$

For MLR we have:

$$D_{MLR} = \begin{cases} 1 & \text{if } g_{MLR_t} < g_{MLR_{t-1}} < 0 \\ 0.9 & \text{if } g_{MLR_t} < 0 \\ 0 & \text{if } g_{MLR_t} = 0 \\ -0.9 & \text{if } g_{MLR_t} > 0 \\ -1 & \text{if } g_{MLR_t} > g_{MLR_{t-1}} > 0 \end{cases}$$

In order to capture the intensity of the growth of financial fragility, some allowance is made to account for differences in growth rates, but most of the direction of the index is driven by the sign of the growth rate of each variable.

The home funding index follows the same logic but focuses exclusively on homeownership (a similar index could be built for consumption). It contains the following variables: home mortgage of households (L), home price index (P), proportion of cash-out refinance (COR), mortgage financial obligation ratio (MOR), and the ratio of monetary assets to mortgage debt (MMR). The index for household home funding is constructed as followed:

$$I_{HHF} = 0.1D_L + 0.1D_P + 0.2D_{COR} + 0.3D_{MOR} + 0.3D_{MMR}$$

With $I_{HHF} \in [0, 1]$. Dummy variables work exactly in the same way as presented above. More weight is put on MOR and MMR because they are the variables that reflect most directly debt burden and liquidation risk. COR is also given a high weight because it provides a proxy of mortgage refinancing risk. However, COR was not given as high of a weight as the previous variables because COR only reflects the proportion of cash-out refinance within refinancing loans rather than cash-out refinance among all mortgages. Similarly to the previous indicator, rising home prices and rising mortgage debts are not by themselves signs of growing fragility. Even though they are necessary for fragility to grow they are not intrinsically signs of refinancing risk or liquidation risk so they are given a lower weight. The index will be higher if all variables behave simultaneously in a specific fashion. A high growth of the debt-service ratio is not enough to have a high index value, but if simultaneously refinancing grows, home price rises and the liquidity ratio declines, then the index will be very high.

The two indexes are presented in figures 2 and 3. The availability of data limited the range from the first quarter of 1992 to the third quarter of 2010. If one studies the household funding index, the fragility of the household sector has grown quite rapidly over the past two decades. The second part of the 1990s recorded high growth of fragility due to a consumption boom based on credit that was encouraged by the stock market boom. Leveraged speculation in financial markets and house funding methods (as shown below) also have played a role toward the end of the 1990s. In the new millennium, the growth of financial fragility increased rapidly from 2002. Today financial fragility is declining as households pay off their debts and save. However, given that financial fragility grew rapidly for a long period of time, the level of financial fragility is high and the repayment of debts and rebuilding of savings have led to a massive decline in home prices.

The broad view of the cause of financial fragility in the household sector can be detailed a bit more by looking at the funding of home. As one can see from figure 3, the fragility of house funding has grown rapidly since the end of 1999. At that time, some FOMC members already started to be concerned:

There are people making real estate investments for residential and other purposes in the expectation that prices can only go up and go up at accelerating rates. Those expectations ultimately become destabilizing to the economic system.
(FOMC Transcripts 1999: 123)

Governor Gramlich had similar concerns at that time, especially in relation to subprime lending and predatory lending. The 2001 recession led to a short decline in the growth of fragility but it was back in full force from 2002 and at its maximum from 2003 until the end of 2006. Without the small recession, the housing boom would have probably started (and finished) much earlier.

Figure 2. Household Index

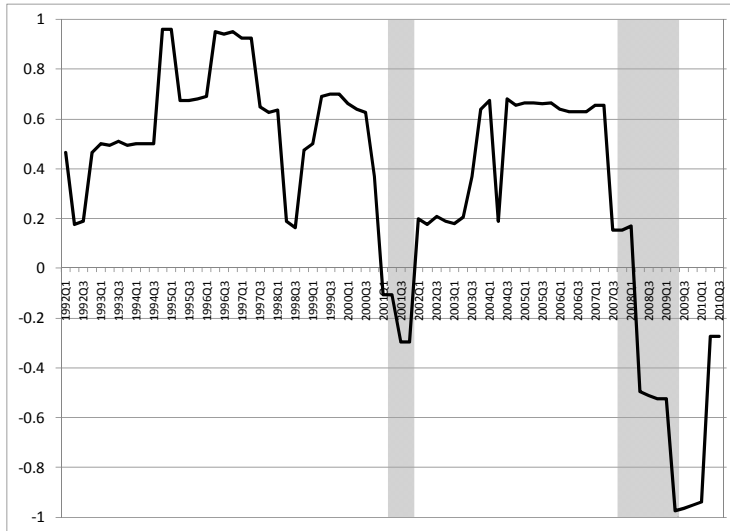
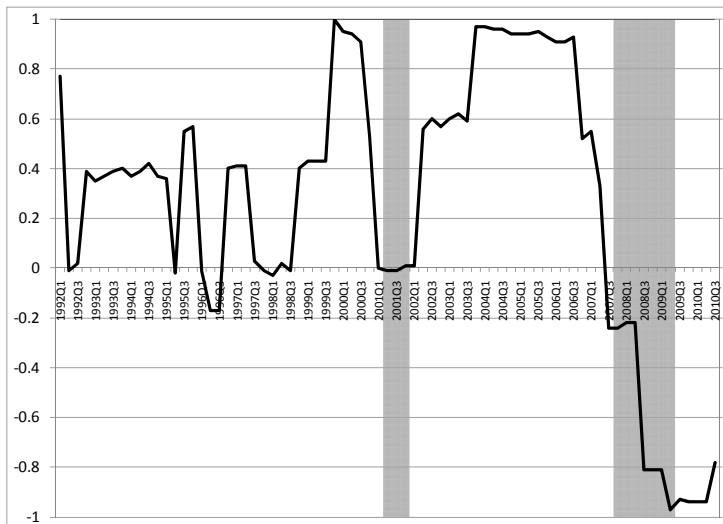


Figure 3. Home Funding Index



This brings us back to a point made earlier in the paper. One cannot judge the relevance of the index in relation to its capacity to predict economic recessions; that is not its purpose. Its purpose is a regulatory and supervisory tool in order to help to guide supervision; it has no fine-tuning purpose. More precisely, the home funding index is high before the 2001 crisis but probably is not directly a cause of the crisis given that fragility just started to accumulate. This, however, should not have prevented supervisors from investigating underwriting practices in a way explained elsewhere (Tymoigne 2011) because the practices that led to the current housing crisis emerged at least in 1999. The lengthy mortgage crisis, still occurring as the economic recession officially ended in the second quarter of 2009, is directly related to the home funding index, which was high for an extended period of time. This is where the index is useful; it detects the accumulation financial problems, even if the latter may not have an immediate negative economic consequences.

Financial Business Sector and Nonfinancial Nonfarm Corporation

Indexes can also be developed for the business sector but the data availability shrinks quite dramatically. Two core datasets are unavailable, the debt-service ratio and refinancing volume. The debt-service ratio is approximated by the interest-service ratio (ISR). The interest service ratio is equal to:

$$\text{ISR} = \text{Monetary interest paid} / \text{After-tax sources of income}$$

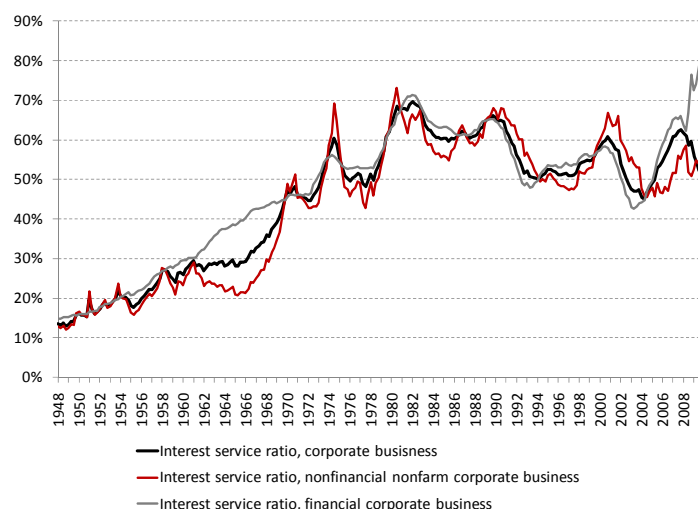
Sources of income are equal to net operating surplus plus income receipts on assets. Net operating surplus is a proxy of the net cash inflow that results from production. It is equal to monetary value of production (sales and changes in inventories) less charges induced by production (intermediate consumption, compensation of employees, taxes on production and imports less subsidies, and consumption of fixed capital), and inventory capital gains/losses are eliminated. It is a measure of the monetary return on assets used in production that excludes any capital gains or losses (Hodge and Corea 2009; Gutierrez et al. 2007; Evans et al. 2002).²

² Net operating surplus is not corporate profit. Interest payments are made out of net operating surplus, not corporate profit. Corporate profit is equal to sources of income less uses of income, or, alternatively, the sum of retained earnings, corporate income tax, and dividends distributed. More specifically the following holds in the NIPA tables for the business sector (corporate and noncorporate):

Ideally, all elements that do not generate a cash inflow or cash outflow should be excluded. For example, higher inventories are not a source of cash inflows and principal servicing generates cash outflows. In addition, following the Minskian framework, cash inflows and outflows should exclude any exceptional financial gains that are unrelated to routine business operations. If a business routinely makes money from the turnover of assets, this should be included in the sources of income (Minsky 1962, 1972). The data from NIPA does not allow us to do that and the Flow of Funds dataset does not provide cash flow data for the business sector. Figure 4 shows the interest-service ratio for the corporate business sector.

Even though there is an aggregate value for income receipts on assets, the latter is not disaggregated by industry. The only disaggregated component is interest received, which is available on an annual basis. The fact that interest received is the only component available is not too limiting because it represents over 80% of income receipts on assets. The bigger challenge is that the data is only available annually. To deal with this problem, quarterly data were created through extrapolation and by using moving averages.

Figure 4. Interest Service Ratio, Corporate Sector



Source: BEA (NIPA, tables 1.14, 7.11)

Sources of income = uses of income + corporate profit

This can be broken into:

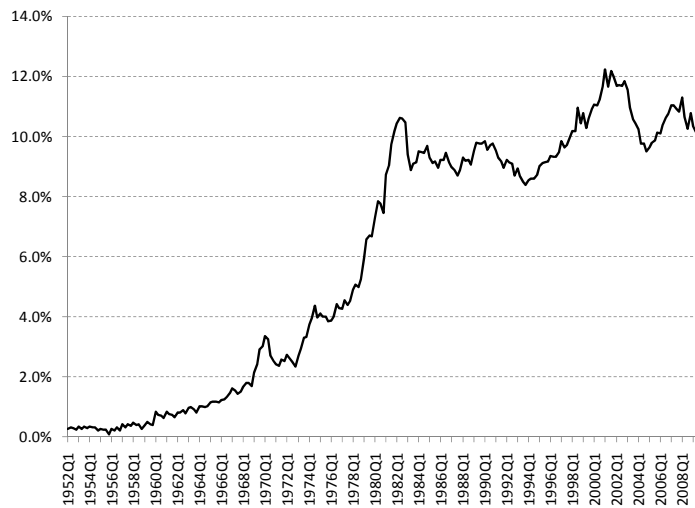
Net operating surplus + asset income receipts = asset income payments + net business transfer payments + proprietor's income + rent + corporate income taxes + dividends paid + retained earnings.

From that one can derive corporate net operating surplus (NIPA 1.14, Hodge and Corea 2009):

Corporate net operating surplus = corporate profit with IVA and CCadj + net interest receipts + net business transfer payments.

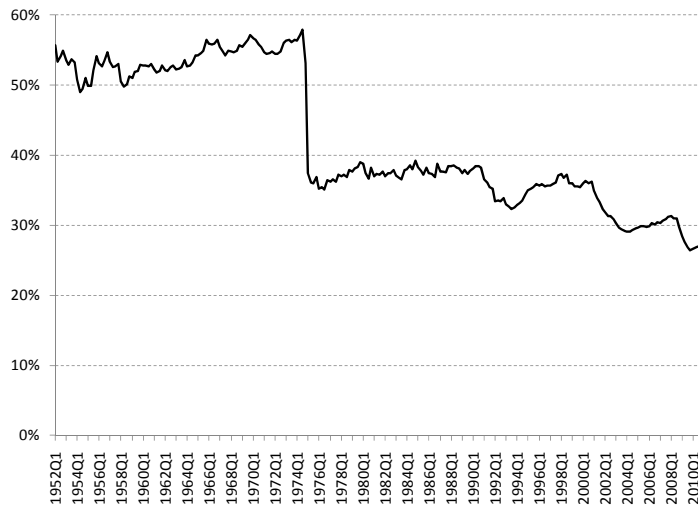
One of the main drawbacks of the ISR is that it excludes principal servicing. This is an important component because principal servicing may capture in part refinancing pressures. Indeed, the shorter the maturity of outstanding debt, the bigger principal service given outstanding debts, and so the higher the pressure may be to rollover debt. In order to account for refinancing pressures in some ways, the proportion of short-term debts relative to total debts is used. The amount of short-term debt is provided for the nonfinancial nonfarm corporate sector but not for the financial business sector; for the latter the short-term debts are approximated by the sum of money-market mutual fund liabilities, federal funds and security repurchase agreements, and open-market paper outstanding. Monetary authorities' liabilities were removed from the liabilities of the financial business sector. Figures 5 and 6 provide the proportion of short-term debts for each sector.

Figure 5. Proportion of Short-Term Debt, Financial Business



Source: Federal Reserve Board

Figure 6. Proportion of Short-Term Debts, Nonfinancial Nonfarm Corporate Business



Source: Federal Reserve Board

Note: There is a big drop in the proportion around 1973. This is due to a large increase in the amount of miscellaneous liabilities due to a change in the computation of Flow of Funds data.

Aside of refinancing needs and debt-service ratio, the other variables used are very similar to the household sector and the index works in a similar fashion. For both business sectors, the index is constructed in the following way:

$$I = 0.125D_L + 0.125D_{NW} + 0.3D_{ISR} + 0.3D_{MLR} + 0.15D_{ST}$$

The weights are assigned in a similar fashion as for households. However, one may note that a greater weight is given to liabilities and net worth and less weight is given to the proportion of short-term debts because the latter is not necessarily a good proxy for refinancing needs. Figures 7 and 8 show the index of financial fragility for each sector. Given the data availability, the indexes could be computed from the first quarter of 1954 to the fourth quarter of 2009.

The most striking aspect of these two indexes is that the financial sector is much more prone to financial fragility than the nonfinancial sector, which is something that the Minskian framework predicts. If one focuses on what happened in the last two decades, the growth of fragility in the nonfinancial sector was high especially at the end of the 1990s and the end of 1980s. For the financial sector, the fragility has been very high at the end of the 1980s, most of the second half of the 1990s, and from 2004 until 2007. The tranquil post-World War II period

until the late 1960s was also characterized by a rapid growth of the fragility in the financial industry as banks leveraged on the massive amount of liquidity they had accumulated by the end of the war (Minsky 1983).

Figure 7. Index of Financial Fragility, Nonfinancial Nonfarm Corporate Business

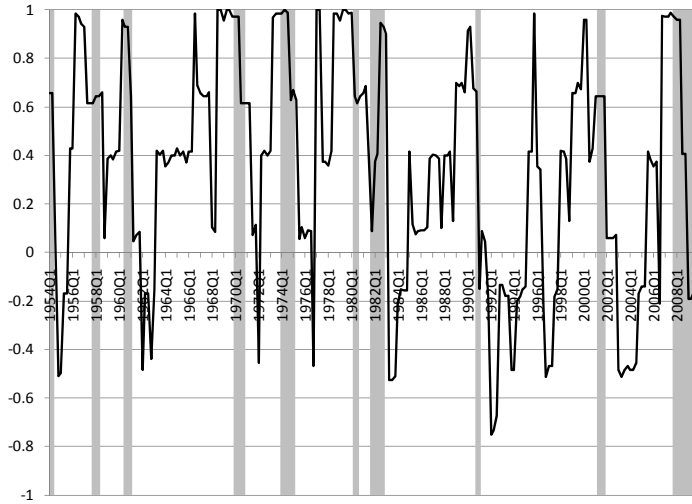
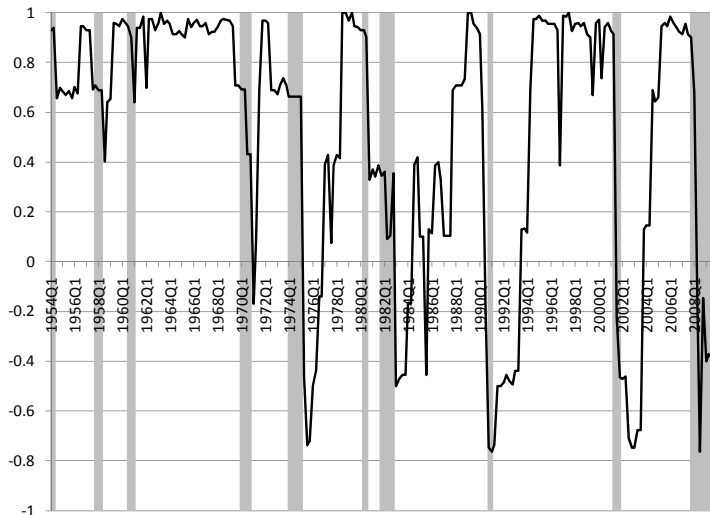


Figure 8. Index of Financial Fragility, Financial Business



With the collapse of Lehman Brothers at the end of 2008, the financial system recorded massive instability. This instability is the direct result of a long period of rapidly growing financial fragility from 2004 to 2007. This illustrates well that this index provides a signal to financial regulators that troubles may be growing when everything looks fine when judged with

traditional supervisory and economic indicators (low default rate, low risk premium, high profitability, etc.). Today the fragility of financial businesses is declining as businesses are closing down, leverage declines, and restructuration occurs.

CONCLUSION

The paper constructs an index of financial fragility based on Minsky's framework of analysis by using existing macroeconomic data. This index is constructed for different sectors of the economy to allow regulators and supervisors to get a better view of where risks of financial instability may develop. The index provides some clues about how the financial practices used to fund asset acquisition change overtime. This helps regulators and supervisors to get an idea of the financial sustainability, or lack thereof, over a period of economic growth.

The financial fragility index provides regulators with a means to detect financial fragility independently of the merit of an economic activity, of the profitability of business, of the default rate on loans, of the welfare created or destroyed by an economic activity, of the existence of a bubble or not, of the existence of fraud or not, of the expectation of an economic recession or not, or of the views of the future of economic units. More precisely, the index focuses solely on an analysis of how economic units actually fund their economic activity to determine if their economic activity is viable. The relevance of such an index for regulatory and supervisory purpose has been demonstrated one more time with the Great Recession. The new regulatory framework created the FSOC, which is in charge of dealing with systemic risk. The index could be an element among others, including financial market signals, to help regulators make decisions regarding which economic activity to monitor more closely. For example, it is clear from the index that the growth of homeownership in the past decade was not sustainable because its funding was unsustainable. Financial supervisors and regulators should have intervened much earlier even though default rates on mortgages were very low, wealth was rising, and banks were highly profitable. For the moment, they do not have the means to detect aggregate financial fragility and so do not have the means to intervene, or at least to include this information in their decision-making process.

The logic behind the index is based on the Minsky's view that the fragility of an economic unit can be defined according to three states of financial position—hedge, speculative,

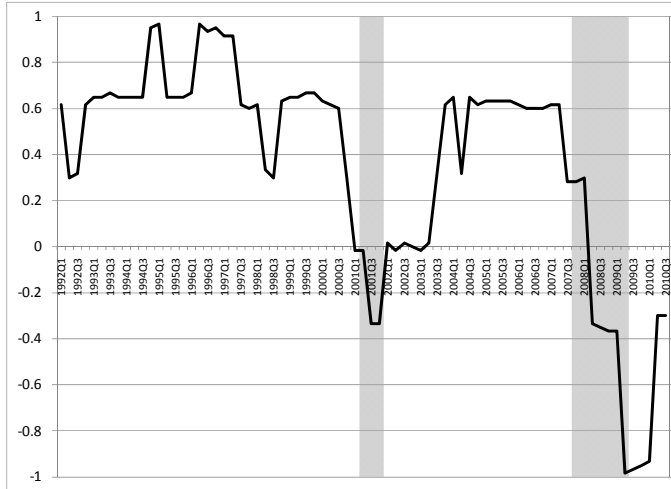
and Ponzi—and the Ponzi finance position is taken as a point of reference to construct the index. The index is also based on a theoretical framework that rejects the idea that financial markets are efficient and instead states that periods of economic stability are a fertile ground for the growth of financial instability. More precisely, periods during which wealth accumulates and people benefit from prosperity end up being the times when financial fragility grows. If macroprudential risk grows during these economic times, supervisory efforts should be increased even if no recession or financial crises is in sight according to traditional indicators of financial soundness (default rate, profitability, among others).

One implication for the construction of the index is that financial market data (CDS spread, risk premium, credit ratings, among others) may not provide a reliable means to capture the risk of financial instability long before it occurs. Financial market participants are interested mostly in short-term gains, tend to ignore important information that hurts profitability, and rely on social conventions to make decisions. In addition, market participants usually see lower default rate and rising profitability as positive signs independently of means through which those results were achieved. All this tends to make financial markets and financial market participants unwilling to deal with and/or unaware of accumulating financial difficulty until well past the time when problems can be resolved smoothly. As a consequence, financial market data tend to signal problems only right before they occur or at the time they occur.

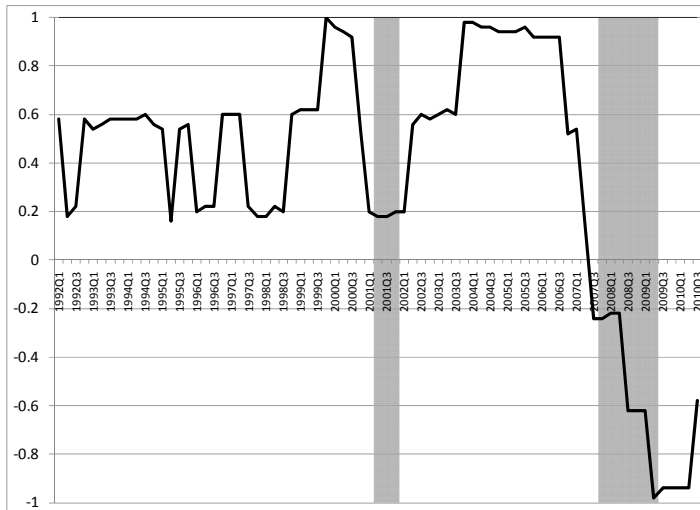
Another implication of this index is that it sets a very specific research agenda. The amount of data available about sources of refinancing needs, debt-service ratio, cash inflow sources, and cash outflow sources is currently extremely limited. Some research efforts should be oriented toward improving our understanding of the funding practices of economic units.

APPENDIX: INDEXES WITH EQUAL WEIGHT FOR ALL VARIABLES

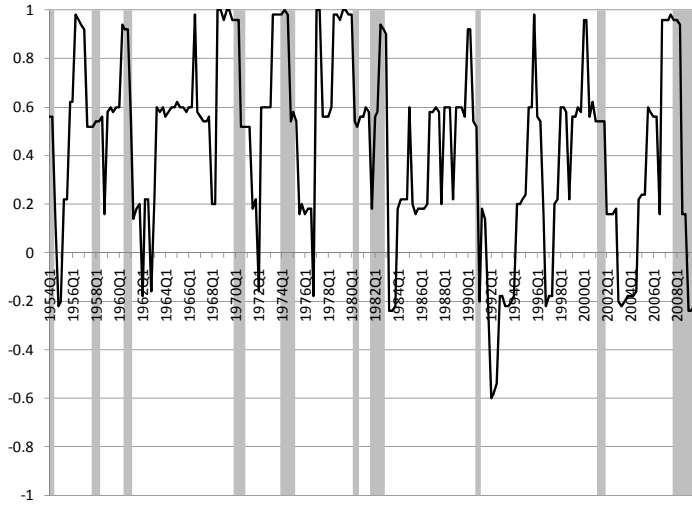
Appendix Figure 1. Household Financial Fragility Index



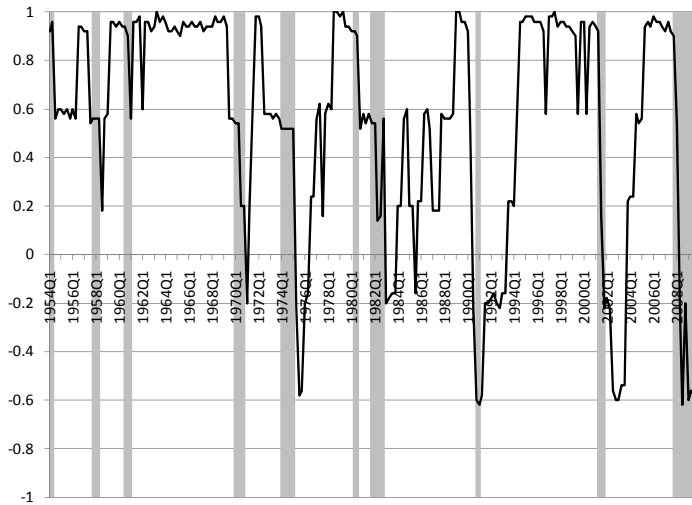
Appendix Figure 2. Household Home Funding Fragility Index



Appendix Figure 3. Corporate Nonfinancial Business Financial Fragility Index



Appendix Figure 4. Financial Sector Financial Fragility Index



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